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UNITED STATES DISTRICT COURT

NORTHERN DISTRICT OF CALIFORNIA

SAN FRANCISCO DIVISION

CAPELLA PHOTONICS, INC., Plaintiff, v. CISCO SYSTEMS, INC., Defendant.	No. 3:14-CV-03348-EMC **JOINT CLAIM CONSTRUCTION AND PREHEARING STATEMENT [PATENT L.R. 4-3]**
CAPELLA PHOTONICS, INC., Plaintiff, v. FUJITSU NETWORK COMMUNICATIONS, INC., Defendant.	No. 3:14-CV-03349-EMC
CAPELLA PHOTONICS, INC., Plaintiff, v. TELLABS OPERATIONS, INC. AND CORIANT (USA) INC., Defendant.	No. 3:14-CV-03350-EMC
CAPELLA PHOTONICS, INC., Plaintiff, v. CIENA CORPORATION, Defendant.	No. 3:14-CV-03351-EMC

FNC 1012

Pursuant to Patent Local Rule 4-3 the Court's Order (DE 122), Plaintiff Capella Photonics, Inc. ("Capella" or "Plaintiff"), and Defendants Ciena Corporation ("Ciena"), Cisco Systems, Inc. ("Cisco"), Fujitsu Network Communications, Inc. ("FNC"), Tellabs Operations, Inc. ("Tellabs Ops"), and Coriant (USA) Inc. ("Coriant") (collectively "Defendants") (together with Plaintiff, "the parties") hereby submit this Joint Claim Construction and Prehearing Statement concerning U.S. Patent Nos. RE42,678 (the "'678 patent") and RE42,368 (the "'368 patent").

I. PATENT L.R. 4-3(a): AGREED CONSTRUCTIONS

Pursuant to Patent Local Rule 4-3(a), the claim terms on which the parties have reached an agreed-upon construction are provided in Appendix A. The parties further agree that when such terms appear more than once in the asserted claims of the patents-in-suit, these agreed-upon constructions should be applied consistently in patents-in-suit.

II. PATENT L.R. 4-3(b): PROPOSED CONSTRUCTIONS OF DISPUTED TERMS

Each party's proposed construction of each disputed claim term, phrase, or clause, along with an identification of all references from the specification or prosecution history that support that construction, and identification of any extrinsic evidence known to the party on which it intends to rely either to support its proposed construction of the claim or to oppose any party's proposed construction of the claim, including, but not limited to, as permitted by law, dictionary definitions, citations to learned treatises and prior art, and testimony of percipient and expert witnesses is provided in Appendix B.

Defendants' statement: Defendants ask that the Plaintiff's evidence and proposed constructions be struck in their entirety, based on Plaintiff's willful violation of the local rules. Defendants provide the background for this request as follows.

In its Rule 4-2 statement, Plaintiff proposed only plain and ordinary meaning for the claim terms other than "channel micromirror." Plaintiff also provided in its statement no specific identification of any intrinsic or extrinsic evidence that it intended to rely upon, nor identified any witnesses that it planned to call. The Plaintiff said only that "[t]he supporting evidence for each construction is the patents in suit and their file histories." Plaintiff then provided a draft statement proposing plain and ordinary meaning for all terms and confirmed that they were not planning on proposing any constructions during the parties' meet and confer on January 7.

After identifying no specific evidence or witnesses, and confirming that Plaintiff would construe no claims, Plaintiff changed course just hours before this Joint Statement was due. Less than four hours before midnight on January 12, Plaintiff revealed for the first time its proposed constructions for every term that Defendants had identified in their L.R. 4-2 statement. Plaintiff also provided for the first time alleged supporting evidence for their new constructions that spanned over 100 pages. The Plaintiff also identified several potential witnesses for claim construction for the first time.

In light of the Plaintiff's willful violation of the local rules (including at least Patent L.R. 4-2) and the severe prejudice to the Defendants, Defendants request that either (i) Plaintiff's proposed constructions (other than the construction of "channel micromirror") and all evidence be stricken from the joint statement, and that Plaintiffs be limited to arguing only for plain and ordinary meaning; or (ii) that Plaintiffs are sanctioned in whatever other way the Court finds appropriate.[1]

Plaintiff's statement: In its L.R. 4-2 statement, Plaintiff identified the asserted patents and their file histories as providing evidentiary support for its proposed constructions. Defendants attempt to rely on statements from Plaintiff's counsel as intrinsic evidence to support their proposed definitions. Such statements do not constitute intrinsic evidence and should be struck.

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[1] The Plaintiff's sandbagging in this statement is not the first instance of the Plaintiff's inappropriate behavior. Earlier, while the Defendants timely provided their initial Patent L.R. 4-2 statement at a time agreed upon by the parties for a simultaneous exchange, Plaintiff failed to provide their statement until an hour later, citing email problems. Plaintiff also appears to have purposely delayed its disclosure of the content of this pleading. Specifically, Defendants provided Plaintiff with a draft of this pleading (which included Defendants' proposed constructions and supporting evidence first provided on December 22) at about 12:00pm PT on January 8, 2015. Despite repeated—and unanswered—requests throughout the day on January 12, 2015 for Plaintiff's comments, Plaintiff waited until after 8:00 pm PT to provide Defendants with its inserts, which added nearly 100 pages to the length of this pleading and exhibits and included new proposed constructions of numerous terms that have never before been disclosed to Defendants.

III. PATENT L.R. 4-3(c): TEN MOST SIGNIFICANT DISPUTED CLAIM TERMS FOR CONSTRUCTION

The parties jointly identify the following claim terms as most significant to resolution of the case (terms are not presented in the following list in order of importance):

A. Jointly Identified Term:

1. Channel micromirror

B. Capella's Terms:

Plaintiff Capella maintains that no term other than "channel micromirror" requires construction and that all other terms should be awarded their plain and ordinary meaning.

C. Defendants' Terms:

1. Continuously
2. Controllable in two dimensions/Controlling . . . in two dimensions
3. Corresponding
4. Beam-deflecting element(s)
5. Elements being individually… controllable
6. Maintaining a predetermined coupling
7. Servo-control assembly

IV. PATENT L.R. 4-3(d): ANTICIPATED LENGTH OF CLAIM CONSTRUCTION HEARING

The Court has scheduled a Claim Construction Tutorial for March 16, 2015 at 2:30 p.m. and a Claim Construction Hearing for March 30, 2015 at 2:30 p.m. The parties estimate that the length of the Claim Construction Hearing will be approximately 4 hours. The parties estimate that the length of the Tutorial will be approximately 2 hours; the parties estimate having equal time for presentation.

V. PATENT L.R. 4-3(e): WHETHER ANY PARTY PROPOSES TO CALL ONE OR MORE WITNESSES AT THE CLAIM CONSTRUCTION HEARING, AND SUMMARIES OF TESTIMONY

The parties do not currently anticipate presenting live testimony.

Defendants' statement: In compliance with Patent L.R. 4-2(b), Defendants identified a witness and the expected substance of that witness's testimony on which Defendants may rely in connection with claim construction. The Plaintiff identified no such witness or testimony in its L.R. 4-2 statement. Accordingly, Plaintiffs have waived any right to rely upon percipient or expert witnesses in connection with claim construction. The Defendants reserve their right to present live expert testimony should the Court request it, but do not otherwise expect to provide such testimony.

Plaintiff's statement: Plaintiff may call inventor Joe Davis to provide live testimony should the Court permit it. Mr. Davis will testify about the plain and ordinary meaning of the claim terms and how a person of ordinary skill in the art would have understood or viewed the disputed terms, phrases, or clauses at the time of invention, including the plain meaning of terms, phrases, or clauses as understood by one of ordinary skill in the art within the context of the claim wording, the teachings of the specification, and the prosecution history, and an explanation of the meaning of those terms in the context of the subject matter of the patents-in-suit, an explanation of any representations in the prosecution histories of the patents-in-suit, a description of the state of the technology relating to the subject matter of the patents-in-suit including any cited prior art in the prosecution histories of the patents-in-suit, a description of the state of the technology relating to the claimed inventions at the time the applications for those patents were filed, a description of the qualifications of a person of ordinary skill in the art at the time the applications for those patents were filed, and how a person of ordinary skill in the art would interpret the identified claim term or phrase at the time the applications for the patents were filed. Mr. Davis may also provide rebuttal testimony to any claim construction that Defendants offer and support through expert and/or percipient witness testimony. Plaintiff further may rely on the testimony of the inventors Jeffrey Wilde and/or Tai Chen to support its claim construction arguments or to rebut Defendants' claim construction arguments.

VI. ADDITIONAL ISSUES

The parties do not believe there are any other issues that must be addressed prior to the Claim Construction Hearing.

Dated: January 12, 2015

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APPENDIX A

Claim Term	**Agreed-Upon Construction**
dynamically […controlling] [controlling] dynamically	Plain and ordinary meaning
focusing said spectral channels into corresponding spectral spots	Plain and ordinary meaning
maintains said power levels at a predetermined value maintaining power levels of said spectral channels directed into said output ports at a predetermining value	Plain and ordinary meaning
maintains said power levels at predetermined values	Plain and ordinary meaning
spectral monitor	Plain and ordinary meaning
to control the power of the spectral channel reflected to said selected port to control the power of said received spectral channels coupled into said output ports	Plain and ordinary meaning
spatial array	Plain and ordinary meaning
wavelength-selective device wavelength separator	Plain and ordinary meaning

APPENDIX B

Claim Term	Plaintiff's Proposed Construction and Evidence	Defendants' Proposed Construction and Evidence
continuously [controllable] continuously [controlling] continuously [pivotable] [controlling …] continuously	Plain and ordinary meaning *or if there is disagreement* actively Intrinsic Evidence "The channel micromirrors are individually controllable and movable, e.g., continuously pivotable (or rotatable), so as to reflect the spectral channels into selected ones of the output ports. As such, each channel micromirror is assigned to a specific spectral channel, hence the name "channel micromirror". And each output port may receive any number of the reflected spectral channels. A distinct feature of the channel micromirrors in the present invention, in contrast to those used in the prior art, is that the motion, e.g., pivoting (or rotation), of each channel micromirror is under analog control such that its pivoting angle can be continuously adjusted. This enables each channel micromirror to scan its corresponding spectral channel across all possible output ports and thereby direct the spectral channel to any desired output port." 3:66-4:15 "All in all, the OADMs of the present invention provide many advantages over the prior art devices,	by analog and not step-wise control Intrinsic Evidence "[a] distinct feature of the channel micromirrors in the present invention, in contrast to those used in the prior art, is that the motion…of each channel micromirror is under analog control such that its pivoting angle can be continuously adjusted" 4:7-11 "[w]hat is important is that the pivoting (or rotational) motion of each channel micromirror be individually controllable in an analog manner, whereby the pivoting angle can be continuously adjusted so as to enable the channel micromirror to scan a spectral channel across all possible output ports." 9:9-14 "channel micromirrors 103 are individually controllable and movable, e.g., pivotable (or rotatable) under analog (or continuous) control." '368 Patent at 7:6-8. More importantly, however, the Smith patent does not disclose mirrors that can be rotated in "analog fashion," or "continuous" control of its MEMS mirrors. In fact, neither the word "analog" nor "continuous" is used anywhere in the Smith patent specification to describe how the rotation of the MEMS mirrors is controlled. On the contrary, the Smith patent discloses step-wise control, specifically noting that its mirrors are tilted at both large and small angles: "Tilting about the major axis can be performed both at the large angles

Claim Term	Plaintiff's Proposed Construction and Evidence	Defendants' Proposed Construction and Evidence
	notably: 1) By advantageously employing an array of channel micromirrors that are individually and continuously controllable, an OADM of the present invention is capable of routing the spectral channels on a channel-by-channel basis and directing any spectral channel into any one of the output ports. As such, its underlying operation is dynamically reconfigurable, and its underlying architecture is intrinsically scalable to a large number of channel counts." 5:49-58 "The channel micromirrors 103 are individually controllable and movable, e.g., pivotable (or rotatable) under analog (or continuous) control, such that, upon reflection, the spectral channels are directed into selected ones of the output ports 110-2 through 110-N by way of the focusing lens 102 and the diffraction grating 101. As such, each channel micro mirror is assigned to a specific spectral channel, hence the name "channel micromirror"." 7:6-14 "As described above, a unique feature of the present invention is that the motion of each channel micromirror is individually and continuously controllable, such that its position, e.g., pivoting angle, can be continuously adjusted. This enables each channel micromirror to scan its corresponding spectral channel across all possible output ports and thereby direct the spectral channel to	corresponding to the positionsof the mirrors and at finer angular resolution within the large angles." IPR2014-01166, Capella Prelim. Response, Paper 7 at 44-45; IPR2014-01276, capela Prelim. Response , Paper 7, at 47-48. Regardless, the '683 provisional discloses nothing more than "using a mirror array with elements that can be rotated in an analog fashion." ('683 provisional, p. 6.) Nowhere does the '683 provisional mention the word "continuous" or what it means with regard to "analog." IPR2014-01166, Capella prelim. response, Paper 7 at 45; IPR2014-01276, Paper 7 at 48. In fact, neither the word "analog" nor "continuous" is used anywhere in the Smith patent specification to describe how the rotation of the MEMS mirrors is controlled. On the contrary, the Smith patent discloses step-wise control, specifically noting that its mirrors are tilted at both large and small angles: "Tilting about the major axis can be performed both at the large angles corresponding to the positions of the mirrors and at finer angular resolution within the large angles." (Smith patent, 18:12-14.) IPR2014-01166, Capella 368 prelim. response at 47. "[e]ach micromirror is configured to operate between two discrete states, such that it either retroreflects its corresponding spectral channel back into the input port as a pass-through channel." '368 Patent at 2:25-28 "Moreover, Aksyuk does not disclose an array of micromirrors that are continuously controllable. Rather,

Claim Term	Plaintiff's Proposed Construction and Evidence	Defendants' Proposed Construction and Evidence
	any desired output port. To illustrate this capability, FIG. lC shows a plot of coupling efficiency as a function of a channel micromirror's pivoting angle 8, provided by a ray-tracing model of a WSR apparatus in the embodiment of FIG. lA. As used herein, the coupling efficiency for a spectral channel is defined as the ratio of the amount of optical power coupled into the fiber core in an output port to the total amount of optical power incident upon the entrance surface of the fiber (associated with the fiber collimator serving as the output port). In the ray-tracing model, the input optical signal is incident upon a diffraction grating with 700 lines per millimeter at a grazing angle of 85 degrees, where the grating is blazed to optimize the diffraction efficiency for the "-1" order. The focusing lens has a focal length of 100 mm. Each output port is provided by a quarter-pitch GRIN lens (2 mm in diameter) coupled to an optical fiber (see FIG. lD). As displayed in FIG. lC, the coupling efficiency varies with the pivoting angle 8, and it requires about a 0.2-degree change in 8 for the coupling efficiency to become practically negligible in this exemplary case. As such, each spectral channel may practically acquire any coupling efficiency value by way of controlling the pivoting angle of its corresponding channel micromirror. This is also to say that variable optical attenuation at the granularity of a single wavelength can be obtained in a WSR apparatus of the present invention. FIG. lD provides ray-tracing illustrations of two extreme points on the coupling	the micromirrors of Aksyuk operate in a "binary" or discrete manner. That is each micromirror is configured to be positionable between two discrete states, such that it either retroreflects its corresponding wavelength back into the input port as a passthrough channel, or directs its wavelength to a single output port as a drop channel. (Aksyuk at column 3, lines 30- 40)." 6,625,346 File History at 98 (.pdf pagination). See also '368 Patent at 3:27-31. <u>Extrinsic Evidence</u> Webster's New World College Dictionary, Third Edition (1997) – continuous, at Cappella_Defs_EE0000000003. The American Heritage Dictionary, Third Edition (1994) – continuous, , at Cappella_Defs_EE0000000006. Newton's Telecom (1999): "Continuously Variable", at Cappella_Defs_EE0000000009-10. Newton's Telecom (2001): "Continuously Variable", at Cappella_Defs_EE0000000013

Claim Term	Plaintiff's Proposed Construction and Evidence	Defendants' Proposed Construction and Evidence
	efficiency vs. 8 curve of FIG. lC: on-axis coupling corresponding to 8=0, where the coupling efficiency is maximum; and off-axis coupling corresponding to 8=0.2 degrees, where the representative collimated beam (representing an exemplary spectral channel) undergoes a significant translational walk-off and renders the coupling efficiency practically negligible. All in all, the exemplary modeling results thus described demonstrate the unique capabilities of the WSR apparatus of the present invention." 8:21-63 "What is important is that the pivoting (or rotational) motion of each channel micromirror be individually controllable in an analog manner, whereby the pivoting angle can be continuously adjusted so as to enable the channel micromirror to scan a spectral channel across all possible output ports. The underlying fabrication techniques for micromachined mirrors and associated actuation mechanisms are well documented in the art, see U.S. Pat. No. 5,629,790 for example." 9:9-17. FIGs 1A, 1B, 1C, 1D. The Abstract. Claim 1, 15-17, 20 of the '368 patent. Claims 1, 9, 27, 31, 34, 37, 41, 44, 57, 61 of the '678	

Claim Term	Plaintiff's Proposed Construction and Evidence	Defendants' Proposed Construction and Evidence
	patent. '368 Reissue Prosecution, Claims, Amendments, Applicant Comments and Notice of Allowance '678 Reissue Prosecution, Claims, Amendments, Applicant Comments and Notice of Allowance Extrinsic Evidence US Patent Application No. 13/532,735 (the '735 application), filed Jun. 25, 2012, titled Optical Wavelength Selective Switch Calibration System, assigned to Finisar Corporation, which refers to PCT Application Publication WO 02/075410, which is assigned to Capella and claims priority to, inter alia, US Patent Nos. 6,625,346 and 6,687,431, in the background of the invention section and describes WO 02/075410 as disclosing "MEMS based WSS devices" that include "a 2-dimensional array of individually tiltable mirrors. Each mirror operates on the local optical wavefront to selectively steer and manipulate optical signals incident thereon." Plaintiff reserves the right to comment on and to rebut any and all extrinsic evidence used by Defendants to support their proposed construction.	

Claim Term	Plaintiff's Proposed Construction and Evidence	Defendants' Proposed Construction and Evidence
controllable in two dimensions controlling . . . in two dimensions	Plain and ordinary meaning *or if there is disagreement* controllable in two dimensions (e.g., x and y dimensions) Intrinsic Evidence "The fiber collimators serving as the input and output ports may be arranged in a one-dimensional or two-dimensional array. In the latter case, the channel micromirrors must be pivotable biaxially." 4:25-30, 37-39 "In the embodiment of FIG. 1A, it is preferable that the diffraction grating 101 and the channel micromirrors 103 are placed respectively at the first and second (i.e., the front and back) focal points (on the opposing sides) of the focusing lens 102. Such a telecentric arrangement allows the chief rays of the focused beams to be parallel to each other and generally parallel to the optical axis. In this application, the telecentric configuration further allows the reflected spectral channels to be efficiently coupled into the respective output ports, thereby 40 minimizing various translational walk-off effects that may otherwise arise. Moreover, the input multi-wavelength optical signal is preferably collimated and circular in cross-section. The corresponding spectral	movable in two axes Intrinsic Evidence The channel micromirrors are individually controllable and movable, e.g., continuously pivotable (or rotatable), so as to reflect the spectral channels into selected ones of the output ports. '368 Patent at 3:66-4:2. "[a] distinct feature of the channel micromirrors in the present invention, in contrast to those used in the prior art, is that the motion…of each channel micromirror is under analog control such that its pivoting angle can be continuously adjusted" '368 Patent at 4:7-11. "each channel micromirror may be pivotable about one or two axes. The fiber collimators serving as the input and output ports may be arranged in a one-dimensional or two-dimensional array. In the latter case, the channel micromirrors must be pivotable biaxially". '368 Patent at 4:25-29; Abstract. "Let the reflective surface of each channel micromirror lie in the x-y plane as defined in the figure and be movable, e.g., pivotable (or deflectable) about the x-axis in an analog (or continuous) manner." '368 Patent at 8:14-18.

Claim Term	Plaintiff's Proposed Construction and Evidence	Defendants' Proposed Construction and Evidence
	channels diffracted from the diffraction grating 101 are generally elliptical in cross-section; they may be of the same size as the input beam in one dimension and elongated in the other dimension." 7:30-48 "Depicted in FIG. lB is a close-up view of the channel micromirrors 103 shown in the embodiment of FIG. lA. By way of example, the channel micromirrors 103 are arranged in a one-dimensional array along the x-axis (i.e., the horizontal direction in the figure), so as to receive the focused spots of the spatially separated spectral channels in a one-to-one correspondence. (As in the case of FIG. lA, only three spectral channels are illustrated, each represented by a converging beam.) Let the reflective surface of each channel micromirror lie in the x-y plane as defined in the figure and be movable, e.g., pivotable (or deflectable) about the x-axis in an analog (or continuous) manner. Each spectral channel, upon reflection, is deflected in they-direction (e.g., downward) relative to its incident direction, so to be directed into one of the output ports 110-2 through 110-N shown in FIG. lA." 8:5-20 "Moreover, a fiber collimator is typically in the form of a collimating lens (such as a GRIN lens) and a ferrule-mounted fiber packaged together in a mechanically rigid stainless steel (or glass) tube. The fiber collimators serving as the input and output ports may be arranged in a one-dimensional array, a two-dimensional array, or	

Claim Term	Plaintiff's Proposed Construction and Evidence	Defendants' Proposed Construction and Evidence
	other desired spatial pattern. For instance, they may be conveniently mounted in a linear array along a V-groove fabricated on a substrate made of silicon, plastic, or ceramic, as commonly practiced in the art. It should be noted, however, that the input port and the output ports need not necessarily be in close spatial proximity with each other, such as in an array configuration (although a close packing would reduce the rotational range required for each channel micromirror). Those skilled in the art will know how to design a WSR apparatus according to the present invention, to best suit a given application." 9:20-35 "Depicted in FIG. 2A is a second embodiment of a WSR apparatus according to the present invention. By way of example, WSR apparatus 200 is built upon and hence shares a number of the elements used in the embodiment ofFIG. 1A, as identified by those labeled with identical numerals. Moreover, a one-dimensional array 220 of collimator-alignment mirrors 220-1 through 220-N is optically interposed between the diffraction grating 101 and the fiber collimator array 110. The collimator-alignment mirror 220-1 is designated to correspond with the input port 110-1, for adjusting the alignment of the input multi-wavelength optical signal and therefore ensuring that the spectral channels impinge onto the corresponding channel micromirrors. The collimator-alignment mirrors 220-2 through 220-N are designated to the output ports 110-2	

Claim Term	Plaintiff's Proposed Construction and Evidence	Defendants' Proposed Construction and Evidence
	through 110-N in a one-to-one correspondence, serving to provide angular control of the collimated beams of the reflected spectral channels and thereby facilitating the coupling of the spectral channels into the respective output ports according to desired coupling efficiencies. Each collimator- alignment mirror may be rotatable about one axis, or two axes." 9:40-60 "FIG. 3 shows a fourth embodiment of a WSR apparatus according to the present invention. By way of example, WSR apparatus 300 is built upon and hence shares a number of the elements used in the embodiment ofFIG. 2B, as identified by those labeled with identical numerals. In this case, the one dimensional fiber collimator array 110 of FIG. 2B is replaced by a two-dimensional array 350 of fiber collimators, providing for an input-port and a plurality of output ports. Accordingly, the one-dimensional collimator-alignment mirror array 220 of FIG. 2B is replaced by a two-dimensional array 320 of collimator-alignment mirrors, and first and second one-dimensional arrays 260,270 of imaging lenses of FIG. 2B are likewise replaced by first and second two-dimensional arrays 360, 370 of imagining lenses respectively. As in the case of the embodiment of FIG. 2B, the first and second two-dimen-sional arrays 360, 370 of imaging lenses are placed in a 4-f telecentric arrangement with respect to the two-dimensional collimator-alignment mirror array 320 and the two-dimensional fiber	

Claim Term	Plaintiff's Proposed Construction and Evidence	Defendants' Proposed Construction and Evidence
	collimator array 350. The channel micromirrors 103 must be pivotable biaxially in this case (in order to direct its corresponding spectral channel to any one of the output ports). As such, the WSR apparatus 300 is equipped to support a greater number of the output ports." 10:25-50 FIGs 1A, 1B, 1C, 1D, 2A, 2B, 3. The Abstract. Claim 1, 15-17 of the '368 patent. Claims 11, 13, 31, 37, 42, 61, of the '678 patent. Statements from the Examiner in the prosecution histories of the asserted patents, including: "Bouevitch (USPN 6,498,872) teaches (Figs.1-12) an optical device which is used in conjunction with configurable optical add/drop multiplexers (COADM) which includes optical fiber input/output ports 80a,80b,99a,99b which sends wavelength of light which are collimated through lens 90 to spherical reflector 10 which is incident of diffraction grating 20 to MEMS reflector(s) 51 ,52, which are movable in either the horizontal or vertical directions to return specific wavelengths lambda 1, lambda2 to the output ports 3. Bouevitch does not teach or suggest using channel micromirrors which are both individually and continuously controllable to reflect	

Claim Term	Plaintiff's Proposed Construction and Evidence	Defendants' Proposed Construction and Evidence
	received spectral channels to anyone of the output ports and to control the power of the received spectral channels coupled to the output ports. Wagener (USPN 6,631,222) (Figs.1-4), Jin (USPN 6,256,430) (Figs.1-7) and Ma (USPN 6,567,574) (Figs.1-12) all teach that at the time the invention was made it was known that pivotable micromirrors orvMEMS can be used with wavelengthvmultiplexers to switch or selectvwavelengths between input and outputvports. [But these four references taken together do not teach amended claim 1.]" *See* Notice of Allowance in the reissue prosecution histories of the asserted patents (emphasizing specific points of novelty, including "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said ports and to control the power of the spectral channel reflected to said selected port.") Statements from the Examiner in the prosecution history of USPN 6,879,750 (which includes the prosecution history of USPN 6,687,431), including that the new claims in the '750 patent are fully supported by the specification and are broader than those previously presented (*e.g.*, in the '431 patent). '368 Reissue Prosecution, Claims, Amendments,	

Claim Term	**Plaintiff's Proposed Construction and Evidence**	**Defendants' Proposed Construction and Evidence**
	Applicant Comments and Notice of Allowance '678 Reissue Prosecution, Claims, Amendments, Applicant Comments and Notice of Allowance Extrinsic Evidence US Patent Application No. 13/532,735 (the '735 application), filed Jun. 25, 2012, titled Optical Wavelength Selective Switch Calibration System, assigned to Finisar Corporation, which refers to PCT Application Publication WO 02/075410, which is assigned to Capella and claims priority to, inter alia, US Patent Nos. 6,625,346 and 6,687,431, in the background of the invention section and describes WO 02/075410 as disclosing "MEMS based WSS devices" that include "a 2-dimensional array of individually tiltable mirrors. Each mirror operates on the local optical wavefront to selectively steer and manipulate optical signals incident thereon." Plaintiff reserves the right to comment on and to rebut any and all extrinsic evidence used by Defendants to support their proposed construction.	
corresponding	Plain and ordinary meaning *or if there is disagreement*	in one-to-one correspondence Intrinsic Evidence

Claim Term	**Plaintiff's Proposed Construction and Evidence**	**Defendants' Proposed Construction and Evidence**
	assigned Intrinsic Evidence "U.S. Pat. No. 6,204,946 to Askyuk et al. discloses an OADM that makes use of free-space optics in a parallel construction In this case, a multi-wavelength optical signal emerging from an input port is incident onto a ruled diffraction grating. The constituent spectral channels thus separated are then focused by a focusing lens onto a linear array of binary micromachined mirrors. Each micromirror is configured to operate between two discrete states, such that it either retrofits its corresponding spectral channel back into the input port as a pass-through channel, or directs its spectral channel to an output port as a drop channel. As such, the pass-through signal (i.e., the combined pass-through channels) shares the same input port as the input signal. An optical circulator is therefore coupled to the input port, to provide necessary routing of these two signals. Likewise, the drop channels share the output port with the add channels. An additional optical circulator is thereby coupled to the output port, from which the drop channels exit and the add channels are introduced into the output ports. The add channels are subsequently combined with the pass-through signal by way of the diffraction grating and the binary micromirrors. Although the aforementioned OADM disclosed by Askyuk et al. has the advantage of performing	"As such, each channel micromirror is assigned to a specific spectral channel, hence the name "channel micromirror." '368 Patent at 4:2-4. '368 Patent, Fig. 1B (with one beam per mirror). "This enables each channel micromirror to scan its corresponding spectral channel across all possible output ports and thereby direct the spectral channel to any desired output port." '368 Patent at 8:24-27. "The diffraction grating 101 angularly separates the multi-wavelength optical signal into multiple spectral channels, which are in turn focused by the focusing lens 102 into a spatial array of distinct spectral spots (not shown in FIG. 1A) in a one-to-one correspondence." '368 Patent at 6:65-7:2. "The channel micromirrors 103 must be pivotable biaxially in this case (in order to direct 45 its corresponding spectral channel to any one of the output ports). As such, the WSR apparatus 300 is equipped to support a greater number of the output ports" '368 Patent at 10:43-47. "processing unit 470 uses the power measurements from the spectral monitor 460 to provide feedback control of the channel micromirrors 430 on an individual basis, so as to maintain a desired coupling efficiency for each spectral channel into a selected output port." '368 Patent at 11:5-36. "This enables each channel micromirror to scan its

Claim Term	Plaintiff's Proposed Construction and Evidence	Defendants' Proposed Construction and Evidence
	wavelength separating and routing in free space and thereby incurring less optical loss, it suffers a number of limitations. First, it requires that the pass-through signal share the same port/fiber as the input signal. An optical circulator therefore has to be implemented, to provide necessary routing of these two signals. Likewise, all the add and drop channels enter and leave the OADM through the same output port, hence the need for another optical circulator. Moreover, additional means must be provided to multiplex the add channels before entering the system and to demultiplex the drop channels after exiting the system. This additional multiplexing/demultiplexing requirement adds more cost and complexity that can restrict the versatility of the OADM thus-constructed. Second, the optical circulators implemented in this OADM for various routing purposes introduce additional optical losses, which can accumulate to a substantial amount. Third, the constituent optical components must be in a precise alignment, in order for the system to achieve its intended purpose. There are, however, no provisions provided for maintaining the requisite alignment; and no mechanisms implemented for overcoming degradation in the alignment owing to environmental effects such as thermal and mechanical disturbances over the course of operation. U.S. Pat. No. 5,906,133 to Tomlinson discloses an OADM that makes use of a design similar to that of Aksyuk et al. There are input, output, drop and add ports implemented in this case. By positioning the	corresponding spectral channel across all possible output ports and thereby direct the spectral channel to any desired output port." '368 Patent at 4:12-15. Depicted in FIG. 1B is a close-up view of the channel micromirrors 103 shown in the embodiment of FIG. 1A. By way of example, the channel micromirrors 103 are arranged in a one-dimensional array along the x-axis (i.e., the horizontal direction in the figure), so as to receive the focused spots of the spatially separated spectral channels in a one-to-one correspondence. '368 Patent at 8:6-12. The lens has the property that it brings the different wavelength channels to focus at separate spatial locations such that each channel is associated with a unique focused spot. Each wavelength channel is associated with a single mirror in the micromirror array. U.S. Pat. App. No. 60/277,217 Provisional, p. 4.

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	four ports in a specific arrangement, each micromirror, notwithstanding switchable between two discrete positions, either reflects its corresponding channel (coming from the input port) to the output port, or concomitantly reflects its channel to the drop port and an incident add channel to the output port. As such, this OADM is able to perform both the add and drop functions without involving additional optical components (such as optical circulators used in the system of Aksyuk et al.). However, because a single drop port is designated for all the drop channels and a single add port is designated for all the add channels, the add channels would have to be multiplexed before entering the add port and the drop channels likewise need to be demutiplexed upon exiting from the drop port. Moreover, as in the case of Askyuk et al., there are no provisions provided for maintaining requisite optical alignment in the system, and no mechanisms implemented for combating degradation in the alignment due to environmental effects over the course of operation. As such, the prevailing drawbacks suffered by the OADMs currently in the art are summarized as follows: 1) The wavelength routing is intrinsically static, rendering it difficult to dynamically reconfigure these OADMs. 2) Add and/or drop channels often need to be multiplexed and/or demultiplexed, thereby imposing additional complexity and cost. 3) Stringent fabrication tolerance and painstaking optical alignment are required. Moreover, the optical alignment is not	

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	actively maintained, rendering it susceptible to environmental effects such as thermal and mechanical disturbances over the course of operation. 4) In an optical communication network, OADMs are typically in a ring or cascaded configuration. In order to mitigate the interference amongst OADMs, which often adversely affects the overall performance of the network, it is essential that the power levels of spectral channels entering and exiting each OADM be managed in a systematic way, for instance, by introducing power (or gain) equalization at each stage. Such a power equalization capability is also needed for compensating for non-uniform gain caused by optical amplifiers (e.g., erbium doped fiber amplifiers) in the network. There lacks, however, a systematic and dynamic management of the power levels of various spectral channels in these OADMs 5) The inherent high cost and heavy optical loss further impede the wide application of these OADMs. In view of the foregoing, there is an urgent need in the art for optical add-drop multiplexers that overcome the aforementioned shortcomings in a simple, effective, and economical construction." 2:19-3:50 "In operation, a multi-wavelength optical signal emerges from the input port. The wavelength-separator separates the multi-wavelength optical signal into multiple spectral channels,each characterized by a distinct center wavelength and associated bandwidth. The beam-focuser focuses the spectral channels into	

Claim Term	Plaintiff's Proposed Construction and Evidence	Defendants' Proposed Construction and Evidence
	corresponding spectral spots. The channel micromirrors are positioned such that each channel micromirror receives one of the spectral channels. The channel micromirrors are individually controllable and movable, e.g., continuously pivotable (or rotatable), so as to reflect the spectral channels into selected ones of the output ports. As such, each channel micromirror is assigned to a specific spectral channel, hence the name "channel micromirror". And each output port may receive any number of the reflected spectral channels." 3:58-4:6 "A distinct feature of the channel micromirrors in the present invention, in contrast to those used in the prior art, is that the motion, e.g., pivoting (or rotation), of each channel micromirror is under analog control such that its pivoting angle can be continuously adjusted. This enables each channel micromirror to scan its corresponding spectral channel across all possible output ports and thereby direct the spectral channel to any desired output port." 4:7-15 "Each collimator-alignment mirror may be rotatable about one or two axes. The collimator-alignment mirrors may be arranged in a one-dimensional or two-dimensional array. First and second arrays of imaging lenses may additionally be optically interposed between the collimator alignment mirrors and the fiber collimators in a telecentric arrangement, thereby	

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	"imaging" the collimator-alignment mirrors onto the corresponding fiber collimators to ensure an optimal alignment." 4:35-45 "FIG. 1A depicts a first embodiment of a wavelength-separating- routing (WSR) apparatus according to the present invention. By way of example to illustrate the general principles and the topological structure of a wavelength-separating- routing (WSR) apparatus of the present invention, the WSR apparatus 100 comprises multiple input/output ports which may be in the form of an array of fiber collimators 110, providing an input port 110-1 and a plurality of output ports 110-2 through 110-N (N~3); a wavelength-separator whichin form may be a diffraction grating 101; a beam-focuser in the form of a focusing lens 102; and an array of channel micromirrors 103. In operation, a multi-wavelength optical signal emerges from the input port 110-1. The diffraction grating 101 angularly separates the multi-wavelength optical signal into multiple spectral channels, which are in turn focused by the focusing lens 102 into a spatial array of distinct spectral spots (not shown in FIG. 1A) in a one-to-one correspondence. The channel micromirrors 103 are positioned in accordance with the spatial array formed by the spectral spots, such that each channel micromirror receives one of the spectral channels. The channel micromirrors 103 are individually controllable and movable, e.g., pivotable (or rotatable) under analog (or continuous) control, such	

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	that, upon reflection, the spectral channels are directed into selected ones of the output ports 110-2 through 110-N by way of the focusing lens 102 and the 10 diffraction grating 101. As such, each channel micro mirror is assigned to a specific spectral channel, hence the name "channel micromirror". Each output port may receive any number of the reflected spectral channels. For purposes of illustration and clarity, only a selective few (e.g., three) of the spectral channels, along with the input multi-wavelength optical signal, are graphically illustrated in FIG. 1A and the following figures. It should be noted, however, that there can be any number of the spectral channels in 20 a WSR apparatus of the present invention (so long as the number of spectral channels does not exceed the number of channel mirrors employed in the system). It should also be noted that the optical beams representing the spectral channels shown in FIG. 1A and the following figures are provided 25 for illustrative purpose only. That is, their sizes and shapes may not be drawn according to scale. For instance, the input beam and the corresponding diffracted beams generally have different cross-sectional shapes, so long as the angle of incidence upon the diffraction grating is not equal to the angle of 30 diffraction, as is known to those skilled in the art. In the embodiment of FIG. 1A, it is preferable that the diffraction grating 101 and the channel micromirrors 103 are placed respectively at the first and second (i.e., the front and back) focal points (on the opposing sides) of the focusing lens 35 102.	

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	Such a telecentric arrangement allows the chief rays of the focused beams to be parallel to each other and generally parallel to the optical axis. In this application, the telecentric configuration further allows the reflected spectral channels to be efficiently coupled into the respective output ports, thereby 40 minimizing various translational walk-off effects that may otherwise arise. Moreover, the input multi-wavelength optical signal is preferably collimated and circular in cross-section. The corresponding spectral channels diffracted from the diffraction grating 101 are generally elliptical in cross-section; they may be of the same size as the input beam in one dimension and elongated in the other dimension." 6:50-7:48 "Depicted in FIG. lB is a close-up view of the channel micromirrors 103 shown in the embodiment of FIG. lA. By way of example, the channel micromirrors 103 are arranged in a one-dimensional array along the x-axis (i.e., the horizontal direction in the figure), so as to receive the focused spots of the spatially separated spectral channels in a one-to-one correspondence. (As in the case of FIG. lA, only three spectral channels are illustrated, each represented by a converging beam.) Let the reflective surface of each channel micromirror lie in the x-y plane as defined in the figure and be movable, e.g., pivotable (or deflectable) about the x-axis in an analog (or continuous) manner. Each spectral channel, upon reflection, is deflected in they-direction (e.g.,	

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	downward) relative to its incident direction, so to be directed into one of the output ports 110-2 through 110-N shown in FIG. 1A. As described above, a unique feature of the present invention is that the motion of each channel micromirror is individually and continuously controllable, such that its position, e.g., pivoting angle, can be continuously adjusted. This enables each channel micromirror to scan its corresponding spectral channel across all possible output ports and thereby direct the spectral channel to any desired output port. To illustrate this capability, FIG. 1C shows a plot of coupling efficiency as a function of a channel micromirror's pivoting angle 8, provided by a ray-tracing model of a WSR apparatus in the embodiment of FIG. 1A. As used herein, the coupling efficiency for a spectral channel is defined as the ratio of the amount of optical power coupled into the fiber core in an output port to the total amount of optical power incident upon the entrance surface of the fiber (associated with the fiber collimator serving as the output port). In the ray-tracing model, the input optical signal is incident upon a diffraction grating with 700 lines per millimeter at a grazing angle of 85 degrees, where the grating is blazed to optimize the diffraction efficiency for the "-1" order. The focusing lens has a focal length of 100 mm. Each output port is provided by a quarter-pitch GRIN lens (2 mm in diameter) coupled to an optical fiber (see FIG. 1D). As displayed in FIG. 1C, the coupling efficiency varies with the pivoting	

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	angle 8, and it requires about a 0.2-degree change in 8 for the coupling efficiency to become practically negligible in this exemplary case. As such, each spectral channel may practically acquire any coupling efficiency value by way of controlling the pivoting angle of its corresponding channel micromirror. This is also to say that variable optical attenuation at the granularity of a single wavelength can be obtained in a WSR apparatus of the present invention. FIG. lD provides ray-tracing illustrations of two extreme points on the coupling efficiency vs. 8curve of FIG. lC: on-axis coupling corresponding to 8=0, where the coupling efficiency is maximum; and off-axis coupling corresponding to 8=0.2 degrees, where the representative collimated beam (representing an exemplary spectral channel) undergoes a significant translational walk-off and renders the coupling efficiency practically negligible. All in all, the exemplary modeling results thus described demonstrate the unique capabilities of the WSR apparatus of the present invention." 8:5-63 "Depicted in FIG. 2A is a second embodiment of a WSR apparatus according to the present invention. By way of example, WSR apparatus 200 is built upon and hence shares a number of the elements used in the embodiment ofFIG. 1A, as identified by those labeled with identical numerals. Moreover, a one-dimensional array 220 of collimator-alignment mirrors 220-1 through 220-N is optically interposed between the	

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	diffraction grating 101 and the fiber collimator array 110. The collimator-alignment mirror 220-1 is designated to correspond with the input port 110-1, for adjusting the alignment of the input multi-wavelength optical signal and therefore ensuring that the spectral channels impinge onto the corresponding channel micromirrors. The collimator-alignment mirrors 220-2 through 220-N are designated to the output ports 110-2 through 110-N in a one-to-one correspondence, serving to provide angular control of the collimated beams of the reflected spectral channels and thereby facilitating the coupling of the spectral channels into the respective output ports according to desired coupling efficiencies. Each collimator- alignment mirror may be rotatable about one axis, or two axes. The embodiment of FIG. 2A is attractive in applications where the fiber collimators (serving as the input and output ports) are desired to be placed in close proximity to the collimator-alignment mirror array 220. To best facilitate the coupling of the spectral channels into the output ports, arrays of imaging lenses may be implemented between the collimator- alignment mirror array 220 and the fiber collimator array 110, as depicted in FIG. 2B. By way of example, WSR apparatus 250 of FIG. 2B is built upon and hence shares many of the elements used in the embodiment of FIG. 2A, as identified by those labeled with identical numerals. Additionally, first and second arrays 260, 270 of imaging lenses are placed in a 4-f telecentric arrangement with respect to the	

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	collimator alignment mirror array 220 and the fiber collimator array 110. The dashed box 280 shown in FIG. 2C provides a top view of such a telecentric arrangement. In this case, the imaging lenses in the first and second arrays 260,270 all have the same focal length f. The collimator-alignment mirrors 220-1 through 220-N are placed at the respective first (or front) focal points of the imaging lenses in the first array 260. Likewise, the fiber collimators 110-1 through 110-N are placed at the respective second (or back) focal points of the imaging lenses in the second array 270. And the separation between the first and second arrays 260, 270 of imaging lenses is 2f. In this way, the collimator-alignment mirrors 220-1 through 220-N are effectively imaged onto the respective entrance surfaces (i.e., the front focal planes) of the GRIN lenses in the corresponding fiber collimators 110-1 through 11 0-N. Such a telecentric imaging system substantially eliminates translational walk-off of the collimated beams at the output ports that may otherwise occur as the mirror angles change. FIG. 3 shows a fourth embodiment of a WSR apparatus according to the present invention. By way of example, WSR apparatus 300 is built upon and hence shares a number of the elements used in the embodiment ofFIG. 2B, as identified by those labeled with identical numerals. In this case, the one dimensional fiber collimator array 110 of FIG. 2B is replaced by a two-dimensional array 350 of fiber collimators, providing for an input-port and a	

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	plurality of output ports. Accordingly, the one-dimensional collimator-alignment mirror array 220 of FIG. 2B is replaced by a two-dimensional array 320 of collimator-alignment mirrors, and first and second one-dimensional arrays 260,270 of imaging lenses of FIG. 2B are likewise replaced by first and second two-dimensional arrays 360, 370 of imagining lenses respectively. As in the case of the embodiment of FIG. 2B, the first and second two-dimen-sional arrays 360, 370 of imaging lenses are placed in a 4-f telecentric arrangement with respect to the two-dimensional collimator-alignment mirror array 320 and the two-dimensional fiber collimator array 350. The channel micromirrors 103 must be pivotable biaxially in this case (in order to direct its corresponding spectral channel to any one of the output ports). As such, the WSR apparatus 300 is equipped to support a greater number of the output ports." 9:40-10:50 "FIG. 4A depicts a schematic illustration of a first embodiment of a WSR-S apparatus according to the present invention. The WSR-S apparatus 400 comprises a WSR apparatus 410 and a servo-control assembly 440. The WSR 410 may be in the embodiment of FIG. 1A, or any other embodiment in accordance with the present invention. The servo-control assembly 440 includes a spectral monitor 460, for monitoring the power levels of the spectral channels coupled into the output ports 420-1 through 420-N of the WSR apparatus 410. By way of	

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	example, the spectral monitor 460 is coupled to the output ports 420-1 through 420-N by way of fiber-optic couplers 420-1-C through 420-N-C, wherein each fiber-optic coupler serves to tap off a predetermined fraction of the optical signal in the corresponding output port. The servocontrol assembly 440 further includes a processing unit 470, in communication with the spectral monitor 460 and the channel micromirrors 430 of the WSR apparatus 410. The processing unit 470 uses the power measurements from the spectral monitor 460 to provide feedback control of the channel micromirrors 430 on an individual basis, so as to maintain a desired coupling efficiency for each spectral channel into a selected output port. As such, the servo-control assembly 440 provides dynamic control of the coupling of the spectral channels into the respective output ports on a channel-bychannel basis and thereby manages the power levels of the spectral channels coupled into the output ports. The power levels of the spectral channels in the output ports may be dynamically managed according to demand, or maintained at desired values (e.g., equalized at a predetermined value) in the present invention. Such a spectral power-management capability is essential in WDM optical networking applications, as discussed above." 11:5-35 "FIG. 5 depicts an exemplary embodiment of an optical add-drop multiplexer (OADM) according to the present invention. By way of example, OADM 500	

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	comprises a WSR-S (or WSR) apparatus 510 and an optical combiner 550. An input port 520 of the WSR-S apparatus 510 transmits a multi-wavelength optical signal. The constituent spectral channels are subsequently separated and routed into a plurality of output ports, including a pass-through port 530 and one or more drop ports 540-1 through 540-N (N~l). The pass-through port 530 may receive any number of the spectral channels (i.e., the pass-through spectral channels). Each drop port may also receive any number of the spectral channels (i.e., the drop spectral channels). The pass-through port 530 is optically coupled to the optical combiner 550, which serves to combine the pass-through spectral channels with one or more add spectral channels provided by one or more add ports 560-1 through 560-M (M~ 1). The combined optical signal is then routed into an existing port 570, providing an output multi-wavelength optical signal. In the above embodiment, the optical combiner 550 may be a Kxl (K~2) broadband fiber-optic coupler, wherein there are K input-ends and one output-end. The pass-through spectral channels and the add spectral channels are fed into the K input-ends (e.g., in a one-to-one correspondence) and the combined optical signal exits from the output-end of the Kxl fiber-optic coupler as the output multi-wavelength optical signal of the system. Such a multiple-input coupler also serves the purpose of multiplexing a multiplicity of add spec tral channels to be coupled into the OADM 500. If the power levels of	

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	the spectral channels in the output multi-wavelength optical signal are desired to be actively managed, such as being equalized at a predetermined value, two spectral monitors may be utilized. As a way of example, the first spectral 5 monitor may receive optical signals tapped off from the passthrough port 530 and the drop ports 540-1 through 540-N (e.g., by way of fiber-optic couplers as depicted in FIG. 4A or 4B). The second spectral monitor receives optical signals tapped off from the exiting port 570. A servo-control system may be constructed accordingly for monitoring and controlling the pass-through, drop and add spectral channels. As such, the embodiment of FIG. 5 provides a versatile optical add-drop multiplexer in a simple and low-cost assembly, while providing multiple physically separate drop/add ports in a dynamically reconfigurable fashion." 12:40-13:18 FIGs 1A, 1B, 1C, 1D, 2A, 2B, 3, 4A, 4B, 5. The Abstract. Claim 1, 15-17, 20, 22 of the '368 patent. Claims 1, 9, 21, 30, 31, 37, 44, 57, 61 of the '678 patent. '368 Reissue Prosecution, Claims, Amendments,	

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	Applicant Comments and Notice of Allowance '678 Reissue Prosecution, Claims, Amendments, Applicant Comments and Notice of Allowance Extrinsic Evidence US Patent Application No. 13/532,735 (the '735 application), filed Jun. 25, 2012, titled Optical Wavelength Selective Switch Calibration System, assigned to Finisar Corporation, which refers to PCT Application Publication WO 02/075410, which is assigned to Capella and claims priority to, inter alia, US Patent Nos. 6,625,346 and 6,687,431, in the background of the invention section and describes WO 02/075410 as disclosing "MEMS based WSS devices" that include "a 2-dimensional array of individually tiltable mirrors. Each mirror operates on the local optical wavefront to selectively steer and manipulate optical signals incident thereon." Plaintiff reserves the right to comment on and to rebut any and all extrinsic evidence used by Defendants to support their proposed construction.	
beam-deflecting elements beam-deflecting	Plain and ordinary meaning *or if there is disagreement*	Indefinite for functional claiming. To the extent the court disagrees, 35 U.S.C. § 112(6) applies as follows:

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element	components of a switching array that can be controlled to cause a change in the path of a light beam Intrinsic Evidence "The present invention provides a wavelength-separating routing (WSR) apparatus and method which employ an array of fiber collimators serving as an input port and a plurality of output ports; a wavelength-separator; a beam-focuser; and an array of channel micromirrors. In operation, a multi-wavelength optical signal emerges from the input port. The wavelength-separator separates the multi-wavelength optical signal into multiple spectral channels, each characterized by a distinct center wavelength and associated bandwidth. The beam-focuser focuses the spectral channels into corresponding spectral spots. The channel micromirrors are positioned such that each channel micromirror receives one of the spectral channels. The channel micromirrors are individually controllable and movable, e.g., continuously pivotable (or rotatable), so as to reflect the spectral channels into selected ones of the output ports. As such, each channel micromirror is assigned to a specific spectral channel, hence the name "channel micromirror". And each output port may receive any number of the reflected spectral channels. A distinct feature of the channel micromirrors in the present invention, in contrast to those used in the prior art, is that the motion, e.g., pivoting (or rotation), of	Function: each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said ports and each of said elements being individually and continuously controllable in two dimensions to control the power of the spectral channel reflected to said selected port. Structure: The channel micromirrors may be provided by silicon micromachined mirrors, reflective ribbons (or membranes), or other types of beam-deflecting means known in the art. '368 Patent, 4:22-25. The channel micromirrors may be provided by silicon micromachined mirrors, reflective ribbons (or membranes), or other types of beam-deflecting elements known in the art. And each micromirror may be pivoted about one or two axes. What is important is that the pivoting (or rotational) motion of each channel micromirror be individually controllable in an analog manner, whereby the pivoting angle can be continuously adjusted so as to enable the channel micromirror to scan a spectral channel across all possible output ports. The underlying fabrication techniques for micromachined mirrors and associated actuation mechanisms are well documented in the art, see U.S. Pat. No. 5,629,790 for example. '368 Patent, 9:5-16. To the extent the court disagrees that the term is indefinite or that 35 U.S.C. § 112(6) applies: moveable mirrors

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	each channel micromirror is under analog control such that its pivoting angle can be continuously adjusted. This enables each channel micromirror to scan its corresponding spectral channel across all possible output ports and thereby direct the spectral channel to any desired output port. In the WSR apparatus of the present invention, the wavelength- separator may be provided by a ruled diffraction grating, a holographic diffraction grating, an echelle grating, a curved diffraction grating, a dispersing prism, or other wavelength- separating means known in the art. The beam-focuser may be a single lens, an assembly of lenses, or other beamfocusing means known in the art. The channel micromirrors may be provided by silicon micromachined mirrors, reflective rib bans (or membranes), or other types of beam –deflecting means known in the art. And each channel micromirror may be pivotable about one or two axes. The fiber collimators serving as the input and output ports may be arranged in a one-dimensional or two-dimensional array. In the latter case, the channel micromirrors must be pivotable biaxially. The WSR apparatus of the present invention may further comprise an array of collimator-alignment mirrors, in optical communication with the wavelength-separator and the fiber collimators, for adjusting the alignment of the input multiwavelength signal and directing the spectral channels into the selected output ports by way of angular control of the collimated beams. Each collimator-alignment mirror may be rotatable	Intrinsic Evidence "A distinct feature of the channel micromirrors in the present invention, in contrast to those used in the prior art, is that the motion, e.g., pivoting (or rotation), of each channel micromirror is under analog control such that its pivoting angle can be continuously adjusted." ('368 Patent at 4:7) "As described above, a unique feature of the present invention is that the motion of each channel micromirror is individually and continuously controllable, such that its position, e.g., pivoting angle, can be continuously adjusted." ('368 Patent at 8:21) "1) By advantageously employing an array of channel micromirrors that are individually and continuously controllable, an OADM of the present invention is capable of routing the spectral channels on a channel-by-channel basis and directing any spectral channel into any one of the output ports." ('368 Patent at 5:51) "In the WSR apparatus of the present invention, the wavelength-separator may be provided by a ruled diffraction grating, a holographic diffraction grating, an echelle grating, a curved diffraction grating, a dispersing prism, or other wavelength-separating means known in the art. The beam-focuser may be a single lens, an assembly of lenses, or other beam-focusing means known in the art. The channel micromirrors may be provided by silicon micromachined mirrors, reflective ribbons (or membranes), or other types of beam-deflecting means known in the art. And each channel

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	about one or two axes. The collimator-alignment mirrors may be arranged in a one-dimensional or two-dimensional array. First and second arrays of imaging lenses may 40 additionally be optically interposed between the collimatoralignment mirrors and the fiber collimators in a telecentric arrangement, thereby "imaging" the collimator-alignment mirrors onto the corresponding fiber collimators to ensure an optimal alignment." 3:58-4:45 "FIG. 1A depicts a first embodiment of a wavelength-separating- routing (WSR) apparatus according to the present invention. By way of example to illustrate the general principles and the topological structure of a wavelength-separating- routing (WSR) apparatus of the present invention, the WSR apparatus 100 comprises multiple input/output ports which may be in the form of an array of fiber collimators 110, providing an input port 110-1 and a plurality of output ports 110-2 through 110-N (N~3); a wavelength-separator which in one form may be a diffraction grating 101; a beam-focuser in the form of a focusing lens 102; and an array of channel micromirrors 103." 6: 52-58 "For purposes of illustration and clarity, only a selective few (e.g., three) of the spectral channels, along with the input multi-wavelength optical signal, are graphically illustrated in FIG. 1A and the following figures. It should be noted, however, that there can be	micromirror may be pivotable about one or two axes. The fiber collimators serving as the input and output ports may be arranged in a one-dimensional or two-dimensional array. In the latter case, the channel micromirrors must be pivotable biaxially." ('368 Patent at 4:16) "At least one error upon which reissue is based is described as follows: Claim 1 is deemed to be too broad and invalid in view of U.S. Patent No. 6,498,872 to Bouevitch and further in view of one or more of U.S. Patent No. 6,567,574 to Ma, U.S. Patent No. 6,256,430 to Jin, or U.S. Patent No. 6,631,222 to Wagener by failing to include limitations regarding the pivotability of channel micromirrors and control of power of received spectral channels coupled to output ports, as indicated by the amendments to Claim 1 in the Preliminary Amendments referred to above." '678 Patent file wrapper, Replacement Reissue Application Declaration By Assignee, pages 2-3, filed January 30, 2011. "At least one error upon which reissue is based is described as follows: Claim 1 is deemed to be too broad and invalid in view of U.S. Patent No. 6,498,872 to Bouevitch and further in view of one or more of U.S. Patent No. 6,567,574 to Ma, U.S. Patent No. 6,256,430 to Jin, or U.S. Patent No. 6,631,222 to Wagener by failing to include limitations regarding the spatial array of beam deflecting elements being individually and continuously controllable in two dimensions to control the power of the spectral channels reflected to selected output ports, as indicated by the amendments to Claim 1

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	any number of the spectral channels in a WSR apparatus of the present invention (so long as the number of spectral channels does not exceed the number of channel mirrors employed in the system). It should also be noted that the optical beams representing the spectral channels shown in FIG. 1A and the following figures are provided for illustrative purpose only. That is, their sizes and shapes may not be drawn according to scale. For instance, the input beam and the corresponding diffracted beams generally have different cross-sectional shapes, so long as the angle of incidence upon the diffraction grating is not equal to the angle of diffraction, as is known to those skilled in the art. In the embodiment of FIG. 1A, it is preferable that the diffraction grating 101 and the channel micromirrors 103 are placed respectively at the first and second (i.e., the front and back) focal points (on the opposing sides) of the focusing lens 102. Such a telecentric arrangement allows the chief rays of the focused beams to be parallel to each other and generally parallel to the optical axis. In this application, the telecentric configuration further allows the reflected spectral channels to be efficiently coupled into the respective output ports, thereby minimizing various translational walk-off effects that may otherwise arise. Moreover, the input multi-wavelength optical signal is preferably collimated and circular in cross-section. The corresponding spectral channels diffracted from the diffraction grating 101 are generally elliptical in cross-section; they may be of the	in the Preliminary Amendment referred to above." '368 Patent file wrapper, Replacement Reissue Application Declaration By Assignee, pages 2-3, filed March 1, 2011. "The dynamic power management and switching functions are enabled by a novel array of micromirrors that are individually and continuously controllable for switching and power control." IPR2014–01276, Paper No. 7 at 8. "But the Smith patent does not teach channel micromirrors that are pivotal about two axes, as required by independent claims 1, 44 and 61." IPR2014–01276, Paper no. 7 at 46. "H. The Smith Patent does not teach or suggest "channel micromirrors… being individually and continuously controllable' as recited in independent claims 1 and 44, and similar features recited in independent claim 61." IPR2014–01276, Paper No. 7 at 47. "As a result, the Smith patent fails to teach mirrors that are "continuously controllable in two dimensions to reflect [a] corresponding spectral channel to a selected one of said ports and to control the power of the spectral channel reflected to said selected port" as required by the independent claims of the '368 patent." IPR2014-01166, Paper No. 7 at at 45. Let the reflective surface of each channel micromirror lie in the x-y plane as defined in the figure and be movable, e.g., pivotable (or deflectable) about the x-axis

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	same size as the input beam in one dimension and elongated in the other dimension. It is known that the diffraction efficiency of a diffraction grating is generally polarization-dependent. That is, the diffraction efficiency of a grating in a standard mounting configuration may be considerably higher for P-polarization that is perpendicular to the groove lines on the grating than for S-polarization that is orthogonal to P-polarization, especially as the number of groove lines (per unit length) increases. To mitigate such polarization-sensitive effects, a quarter-wave plate 104 may be optically interposed between the diffraction grating 101 and the channel micromirrors 103, and preferably placed between the diffraction grating 101 and the focusing lens 102 as is shown in FIG. 1A. In this way, each spectral channel experiences a total of approximately 90-degree rotation in polarization upon traversing the quarter-wave plate 104 twice. (That is, if a beam of light has P-polarization when first encountering the diffraction grating, it would have predominantly (if not all) S-polarization upon the second encountering, and vice versa.) This ensures that all the spectral channels incur nearly the same amount of round-trip polarization dependent loss. In the WSR apparatus 100 of FIG. 1A, the diffraction grating 101, by way of example, is oriented such that the focused spots of the spectral channels fall onto the channel micromirrors 103 in a horizontal array, as illustrated in FIG. 1B. Depicted in FIG. 1B is a close-up view of the	in an analog (or continuous) manner. Each spectral channel, upon reflection, is deflected in the y-direction (e.g., downward) relative to its incident direction, so to be directed into one of the output ports 110-2 through 110-N shown in FIG. 1A. '368 Patent at 8:14-20 The channel micromirrors may be provided by silicon micromachined mirrors, reflective ribbons (or membranes), or other types of beam-deflecting means known in the art And each channel micromirror may be pivotable about one or two axes." '368 Patent at 4:22-25. "A distinct feature of the channel micromirrors in the present invention, in contrast to those used in the prior art, is that the motion, e.g., pivoting (or rotation), of each channel micromirror is under analog control such that its pivoting angle can be continuously adjusted. This enables each channel micromirror to scan its corresponding spectral channel across all possible output ports and thereby direct the spectral channel to any desired output ports." '368 Patent at 4:7-14. "The channel micromirrors may be provided by silicon micromachined mirrors, reflective ribbons (or membranes), or other types of beam-deflecting elements known in the art. And each micromirror may be pivoted about one or two axes. What is important is that the pivoting (or rotational) motion of each channel micromirror be individually controllable in an analog manner, whereby the pivoting angle can be continuously adjusted so as to enable the channel micromirror to scan a spectral channel across all possible output ports. The

Claim Term	Plaintiff's Proposed Construction and Evidence	Defendants' Proposed Construction and Evidence
	channel micromirrors 103 shown in the embodiment of FIG. 1A. By way of example, the channel micromirrors 103 are arranged in a one-dimensional array along the x-axis (i.e., the horizontal direction in the figure), so as to receive the focused spots of the spatially separated spectral channels in a one-to-one correspondence. (As in the case of FIG. 1A, only three spectral channels are illustrated, each represented by a converging beam.) Let the reflective surface of each channel micromirror lie in the x-y plane as defined in the figure and be movable, e.g., pivotable (or deflectable) about the x-axis in an analog (or continuous) manner. Each spectral channel, upon reflection, is deflected in the y-direction (e.g., downward) relative to its incident direction, so to be directed into one of the output ports 110-2 through 110-N shown in FIG. 1A. As described above, a unique feature of the present invention is that the motion of each channel micromirror is individually and continuously controllable, such that its position, e.g., pivoting angle, can be continuously adjusted. This enables each channel micromirror to scan its corresponding spectral channel across all possible output ports and thereby direct the spectral channel to any desired output port. To illustrate this capability, FIG. 1C shows a plot of coupling efficiency as a function of a channel micromirror's pivoting angle θ, provided by a ray-tracing model of a WSR apparatus in the embodiment of FIG. 1A. As used herein, the coupling efficiency for a spectral channel is defined as	underlying fabrication techniques for micromachined mirrors and associated actuation mechanisms are well documented in the art, see U.S. Pat. No. 5,629,790 for example." '368 Patent at 9:5-16. "the collimator-alignment mirrors are preferably rotatable about two axes. They may be silicon micromachined mirrors, for fast rotational speeds. They may also be other types of mirrors or beam-deflecting elements known in the art." '368 Patent at 10:57-61. By way of example, WSR apparatus 200 is built upon and hence shares a number of the elements used in the embodiment of FIG. 1A . . . . '368 Patent at 9:41-43 By way of example, WSR apparatus 250 of FIG. 2B is built upon and hence shares many of the elements used in the embodiment of FIG. 2A . . . . '368 Patent at 10:1-3 By way of example, WSR apparatus 300 is built upon and hence shares a number of the elements used in the embodiment of FIG. 2B . . . . '368 Patent at 10:26-28 The WSR -S apparatus 450 comprises a WSR apparatus 480 and a servo-control assembly 490. In addition to the channel micromirrors 430 (and other elements identified by the same numerals as those used in FIG. 4A) . . . . '368 Patent at 11:40-43 <u>Extrinsic Evidence</u> The American Heritage Dictionary, Third Edition

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	the ratio of the amount of optical power coupled into the fiber core in an output port to the total amount of optical power incident upon the entrance surface of the fiber (associated with the fiber collimator serving as the output port). In the ray-tracing model, the input optical signal is incident upon a diffraction grating with 700 lines per millimeter at a grazing angle of 85 degrees, where the grating is blazed to optimize the diffraction efficiency for the "−1" order. The focusing lens has a focal length of 100 mm. Each output port is provided by a quarter-pitch GRIN lens (2 mm in diameter) coupled to an optical fiber (see FIG. 1D). As displayed in FIG. 1C, the coupling efficiency varies with the pivoting angle θ, and it requires about a 0.2-degree change in θ for the coupling efficiency to become practically negligible in this exemplary case. As such, each spectral channel may practically acquire any coupling efficiency value by way of controlling the pivoting angle of its corresponding channel micromirror. This is also to say that variable optical attenuation at the granularity of a single wavelength can be obtained in a WSR apparatus of the present invention. FIG. 1D provides ray-tracing illustrations of two extreme points on the coupling efficiency vs. θ curve of FIG. 1C: on-axis coupling corresponding to $\theta=0$, where the coupling efficiency is maximum; and off-axis coupling corresponding to $\theta=0.2$ degrees, where the representative collimated beam (representing an exemplary spectral channel) undergoes a significant translational walk-off and	(1994) – deflect, at Cappella_Defs_EE000000050. Dictionary.com definitions (retrieved 2014 – deflect, at Cappella_Defs_EE0000000051-53.

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	renders the coupling efficiency practically negligible. All in all, the exemplary modeling results thus described demonstrate the unique capabilities of the WSR apparatus of the present invention. FIG. 1A provides one of many embodiments of a WSR apparatus according to the present invention. In general, the wavelength-separator is a wavelength-separating means that may be a ruled diffraction grating, a holographic diffraction grating, an echelle grating, a dispersing prism, or other types of spectral-separating means known in the art. The beam-focuser may be a focusing lens, an assembly of lenses, or other beam-focusing means known in the art. The focusing function may also be accomplished by using a curved diffraction grating as the wavelength-separator. The channel micromirrors may be provided by silicon micromachined mirrors, reflective ribbons (or membranes), or other types of beam-deflecting elements known in the art. And each micromirror may be pivoted about one or two axes. What is important is that the pivoting (or rotational) motion of each channel micromirror be individually controllable in an analog manner, whereby the pivoting angle can be continuously adjusted so as to enable the channel micromirror to scan a spectral channel across all possible output ports. The underlying fabrication techniques for micromachined mirrors and associated actuation mechanisms are well documented in the art, see U.S. Pat. No. 5,629,790 for example. Moreover, a fiber collimator is typically in the form of a collimating	

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	lens (such as a GRIN lens) and a ferrule-mounted fiber packaged together in a mechanically rigid stainless steel (or glass) tube. The fiber collimators serving as the input and output ports may be arranged in a one-dimensional array, a two-dimensional array, or other desired spatial pattern. For instance, they may be conveniently mounted in a linear array along a V-groove fabricated on a substrate made of silicon, plastic, or ceramic, as commonly practiced in the art. It should be noted, however, that the input port and the output ports need not necessarily be in close spatial proximity with each other, such as in an array configuration (although a close packing would reduce the rotational range required for each channel micromirror). Those skilled in the art will know how to design a WSR apparatus according to the present invention, to best suit a given application. A WSR apparatus of the present invention may further comprise an array of collimator-alignment mirrors, for adjusting the alignment of the input multi-wavelength optical signal and facilitating the coupling of the spectral channels into the respective output ports, as shown in FIGS. 2A-2B and 3. Depicted in FIG. 2A is a second embodiment of a WSR apparatus according to the present invention. By way of example, WSR apparatus 200 is built upon and hence shares a number of the elements used in the embodiment of FIG. 1A, as identified by those labeled with identical numerals. Moreover, a one-dimensional array 220 of collimator-alignment mirrors 220-1 through 220-N is	

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	optically interposed between the diffraction grating 101 and the fiber collimator array 110. The collimator-alignment mirror 220-1 is designated to correspond with the input port 110-1, for adjusting the alignment of the input multi-wavelength optical signal and therefore ensuring that the spectral channels impinge onto the corresponding channel micromirrors. The collimator-alignment mirrors 220-2 through 220-N are designated to the output ports 110-2 through 110-N in a one-to-one correspondence, serving to provide angular control of the collimated beams of the reflected spectral channels and thereby facilitating the coupling of the spectral channels into the respective output ports according to desired coupling efficiencies. Each collimator-alignment mirror may be rotatable about one axis, or two axes. The embodiment of FIG. 2A is attractive in applications where the fiber collimators (serving as the input and output ports) are desired to be placed in close proximity to the collimator-alignment mirror array 220. To best facilitate the coupling of the spectral channels into the output ports, arrays of imaging lenses may be implemented between the collimator-alignment mirror array 220 and the fiber collimator array 110, as depicted in FIG. 2B. By way of example, WSR apparatus 250 of FIG. 2B is built upon and hence shares many of the elements used in the embodiment of FIG. 2A, as identified by those labeled with identical numerals. Additionally, first and second arrays 260, 270 of imaging lenses are placed in a 4-f telecentric	

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	arrangement with respect to the collimator-alignment mirror array 220 and the fiber collimator array 110. The dashed box 280 shown in FIG. 2C provides a top view of such a telecentric arrangement. In this case, the imaging lenses in the first and second arrays 260, 270 all have the same focal length f. The collimator-alignment mirrors 220-1 through 220-N are placed at the respective first (or front) focal points of the imaging lenses in the first array 260. Likewise, the fiber collimators 110-1 through 110-N are placed at the respective second (or back) focal points of the imaging lenses in the second array 270. And the separation between the first and second arrays 260, 270 of imaging lenses is 2f. In this way, the collimator-alignment mirrors 220-1 through 220-N are effectively imaged onto the respective entrance surfaces (i.e., the front focal planes) of the GRIN lenses in the corresponding fiber collimators 110-1 through 110-N. Such a telecentric imaging system substantially eliminates translational walk-off of the collimated beams at the output ports that may otherwise occur as the mirror angles change." 7:15-10:25 "In addition to facilitating the coupling of the spectral channels into the respective output ports as described above, the collimator-alignment mirrors in the above embodiments also serve to compensate for misalignment (e. g., due to fabrication and assembly errors) in the fiber collimators that provide for the input	

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	and output ports. For instance, relative misalignment between the fiber cores and their respective collimating lenses in the fiber collimators can lead to pointing errors in the collimated beams, which may be corrected for by the collimator- alignment mirrors. For these reasons, the collimator alignment mirrors are preferably rotatable about two axes. They may be silicon micromachined mirrors, for fast rotational speeds. They may also be other types of mirrors or beam-deflecting elements known in the art." 10:48-62 FIGs 1A, 1B, 1C, 1D, 2A, 2B, 3, 4A, 4B, 5, 6. The Abstract. Claims 1, 3, 5, 6, 8, 11, 13, 14, 15-17, 20-22 of the '368 patent. All claims of the '678 patent. Statements from the Examiner in the prosecution histories of the asserted patents, including: "Bouevitch (USPN 6,498,872) teaches (Figs.1-12) an optical device which is used in conjunction with configurable optical add/drop multiplexers (COADM) which includes optical fiber input/output ports 80a,80b,99a,99b which sends wavelength of light which are collimated through lens 90 to spherical reflector 10 which is incident of diffraction grating 20 to MEMS reflector(s) 51 ,52,	

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	which are movable in either the horizontal or vertical directions to return specific wavelengths lambda 1, lambda2 to the output ports 3. Bouevitch does not teach or suggest using channel micromirrors which are both individually and continuously controllable to reflect received spectral channels to anyone of the output ports and to control the power of the received spectral channels coupled to the output ports. Wagener (USPN 6,631,222) (Figs.1-4), Jin (USPN 6,256,430) (Figs.1-7) and Ma (USPN 6,567,574) (Figs.1-12) all teach that at the time the invention was made it was known that pivotable micromirrors orvMEMS can be used with wavelengthvmultiplexers to switch or selectvwavelengths between input and outputvports. [But these four references taken together do not teach amended claim 1.]" *See* Notice of Allowance in the reissue prosecution histories of the asserted patents (emphasizing specific points of novelty, including "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said ports and to control the power of the spectral channel reflected to said selected port.") Statements from the Examiner in the prosecution history of USPN 6,879,750 (which includes the prosecution history of USPN 6,687,431), including that	

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	the new claims in the '750 patent are fully supported by the specification and are broader than those previously presented (*e.g.*, in the '431 patent). '368 Reissue Prosecution, Claims, Amendments, Applicant Comments and Notice of Allowance '678 Reissue Prosecution, Claims, Amendments, Applicant Comments and Notice of Allowance Extrinsic Evidence US Patent Application No. 13/532,735 (the '735 application), filed Jun. 25, 2012, titled Optical Wavelength Selective Switch Calibration System, assigned to Finisar Corporation, which refers to PCT Application Publication WO 02/075410, which is assigned to Capella and claims priority to, inter alia, US Patent Nos. 6,625,346 and 6,687,431, in the background of the invention section and describes WO 02/075410 as disclosing "MEMS based WSS devices" that include "a 2-dimensional array of individually tiltable mirrors. Each mirror operates on the local optical wavefront to selectively steer and manipulate optical signals incident thereon." Plaintiff reserves the right to comment on and to rebut any and all extrinsic evidence used by Defendants to	

Claim Term	**Plaintiff's Proposed Construction and Evidence**	**Defendants' Proposed Construction and Evidence**
	support their proposed construction.	
channel micromirror	small mirror surfaces for reflecting light in channels Intrinsic Evidence "The present invention provides a wavelength-separating routing (WSR) apparatus and method which employ an array of fiber collimators serving as an input port and a plurality of output ports; a wavelength-separator; a beam-focuser; and an array of channel micromirrors. In operation, a multi-wavelength optical signal emerges from the input port. The wavelength-separator separates the multi-wavelength optical signal into multiple spectral channels, each characterized by a distinct center wavelength and associated bandwidth. The beam-focuser focuses the spectral channels into corresponding spectral spots. The channel micromirrors are positioned such that each channel micromirror receives one of the spectral channels. The channel micromirrors are individually controllable and movable, e.g., continuously pivotable (or rotatable), so as to reflect the spectral channels into selected ones of the output ports. As such, each channel micromirror is assigned to a specific spectral channel, hence the name "channel micromirror". And each output port may receive any number of the reflected spectral channels. A distinct feature of the channel micromirrors in the	a moveable mirror such that each wavelength channel is associated with a single mirror Intrinsic Evidence A distinct feature of the channel micromirrors in the present invention, in contrast to those used in the prior art, is that the motion, e.g., pivoting (or rotation), of each channel micromirror is under analog control such that its pivoting angle can be continuously adjusted. '368 Patent at 4:7-15. "As such, each channel micromirror is assigned to a specific spectral channel, hence the name "channel micromirror." '368 Patent at 4:2-4. "The channel micromirrors may be provided by silicon micromachined mirrors, reflective ribbons (or membranes), or other types of beam-deflecting elements known in the art. And each micromirror may be pivoted about one or two axes." '368 Patent at 9:5-9. "A distinct feature of the channel micromirrors in the present invention, in contrast to those used in the prior art, is that the motion, e.g., pivoting (or rotation), of each channel micromirror is under analog control such that its pivoting angle can be continuously adjusted. This enables each channel micromirror to scan its corresponding spectral channel across all possible output ports and thereby direct the spectral channel to

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	present invention, in contrast to those used in the prior art, is that the motion, e.g., pivoting (or rotation), of each channel micromirror is under analog control such that its pivoting angle can be continuously adjusted. This enables each channel micromirror to scan its corresponding spectral channel across all possible output ports and thereby direct the spectral channel to any desired output port. In the WSR apparatus of the present invention, the wavelength- separator may be provided by a ruled diffraction grating, a holographic diffraction grating, an echelle grating, a curved diffraction grating, a dispersing prism, or other wavelength- separating means known in the art. The beam-focuser may be a single lens, an assembly of lenses, or other beamfocusing means known in the art. The channel micromirrors may be provided by silicon micromachined mirrors, reflective rib bans (or membranes), or other types of beam –deflecting means known in the art. And each channel micromirror may be pivotable about one or two axes. The fiber collimators serving as the input and output ports may be arranged in a one-dimensional or two-dimensional array. In the latter case, the channel micromirrors must be pivotable biaxially. The WSR apparatus of the present invention may further comprise an array of collimator-alignment mirrors, in optical communication with the wavelength-separator and the fiber collimators, for adjusting the alignment of the input multiwavelength signal and directing the spectral channels into the selected output	any desired output ports." '368 Patent at 4:7-14. The lens has the property that it brings the different wavelength channels to focus at separate spatial locations such that each channel is associated with a unique focused spot. Each wavelength channel is associated with a single mirror in the micromirror array. U.S. Pat. App. No. 60/277,217 Provisional, p. 4.

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	ports by way of angular control of the collimated beams. Each collimator-alignment mirror may be rotatable about one or two axes. The collimator-alignment mirrors may be arranged in a one-dimensional or two-dimensional array. First and second arrays of imaging lenses may 40 additionally be optically interposed between the collimatoralignment mirrors and the fiber collimators in a telecentric arrangement, thereby "imaging" the collimator-alignment mirrors onto the corresponding fiber collimators to ensure an optimal alignment." 3:58-4:45 "FIG. 1A depicts a first embodiment of a wavelength-separating- routing (WSR) apparatus according to the present invention. By way of example to illustrate the general principles and the topological structure of a wavelength-separating- routing (WSR) apparatus of the present invention, the WSR apparatus 100 comprises multiple input/output ports which may be in the form of an array of fiber collimators 110, providing an input port 110-1 and a plurality of output ports 110-2 through 110-N (N~3); a wavelength-separator which in one form may be a diffraction grating 101; a beam-focuser in the form of a focusing lens 102; and an array of channel micromirrors 103." 6: 52-58 "For purposes of illustration and clarity, only a selective few (e.g., three) of the spectral channels, along with the input multi-wavelength optical signal, are	

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	graphically illustrated in FIG. 1A and the following figures. It should be noted, however, that there can be any number of the spectral channels in a WSR apparatus of the present invention (so long as the number of spectral channels does not exceed the number of channel mirrors employed in the system). It should also be noted that the optical beams representing the spectral channels shown in FIG. 1A and the following figures are provided for illustrative purpose only. That is, their sizes and shapes may not be drawn according to scale. For instance, the input beam and the corresponding diffracted beams generally have different cross-sectional shapes, so long as the angle of incidence upon the diffraction grating is not equal to the angle of diffraction, as is known to those skilled in the art. In the embodiment of FIG. 1A, it is preferable that the diffraction grating 101 and the channel micromirrors 103 are placed respectively at the first and second (i.e., the front and back) focal points (on the opposing sides) of the focusing lens 102. Such a telecentric arrangement allows the chief rays of the focused beams to be parallel to each other and generally parallel to the optical axis. In this application, the telecentric configuration further allows the reflected spectral channels to be efficiently coupled into the respective output ports, thereby minimizing various translational walk-off effects that may otherwise arise. Moreover, the input multi-wavelength optical signal is preferably collimated and circular in cross-section. The corresponding spectral	

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	channels diffracted from the diffraction grating 101 are generally elliptical in cross-section; they may be of the same size as the input beam in one dimension and elongated in the other dimension. It is known that the diffraction efficiency of a diffraction grating is generally polarization-dependent. That is, the diffraction efficiency of a grating in a standard mounting configuration may be considerably higher for P-polarization that is perpendicular to the groove lines on the grating than for S-polarization that is orthogonal to P-polarization, especially as the number of groove lines (per unit length) increases. To mitigate such polarization-sensitive effects, a quarter-wave plate 104 may be optically interposed between the diffraction grating 101 and the channel micromirrors 103, and preferably placed between the diffraction grating 101 and the focusing lens 102 as is shown in FIG. 1A. In this way, each spectral channel experiences a total of approximately 90-degree rotation in polarization upon traversing the quarter-wave plate 104 twice. (That is, if a beam of light has P-polarization when first encountering the diffraction grating, it would have predominantly (if not all) S-polarization upon the second encountering, and vice versa.) This ensures that all the spectral channels incur nearly the same amount of round-trip polarization dependent loss. In the WSR apparatus 100 of FIG. 1A, the diffraction grating 101, by way of example, is oriented such that the focused spots of the spectral channels fall onto the channel	

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	micromirrors 103 in a horizontal array, as illustrated in FIG. 1B. Depicted in FIG. 1B is a close-up view of the channel micromirrors 103 shown in the embodiment of FIG. 1A. By way of example, the channel micromirrors 103 are arranged in a one-dimensional array along the x-axis (i.e., the horizontal direction in the figure), so as to receive the focused spots of the spatially separated spectral channels in a one-to-one correspondence. (As in the case of FIG. 1A, only three spectral channels are illustrated, each represented by a converging beam.) Let the reflective surface of each channel micromirror lie in the x-y plane as defined in the figure and be movable, e.g., pivotable (or deflectable) about the x-axis in an analog (or continuous) manner. Each spectral channel, upon reflection, is deflected in the y-direction (e.g., downward) relative to its incident direction, so to be directed into one of the output ports 110-2 through 110-N shown in FIG. 1A. As described above, a unique feature of the present invention is that the motion of each channel micromirror is individually and continuously controllable, such that its position, e.g., pivoting angle, can be continuously adjusted. This enables each channel micromirror to scan its corresponding spectral channel across all possible output ports and thereby direct the spectral channel to any desired output port. To illustrate this capability, FIG. 1C shows a plot of coupling efficiency as a function of a channel micromirror's pivoting angle θ, provided by a ray-tracing model of a WSR apparatus in	

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	the embodiment of FIG. 1A. As used herein, the coupling efficiency for a spectral channel is defined as the ratio of the amount of optical power coupled into the fiber core in an output port to the total amount of optical power incident upon the entrance surface of the fiber (associated with the fiber collimator serving as the output port). In the ray-tracing model, the input optical signal is incident upon a diffraction grating with 700 lines per millimeter at a grazing angle of 85 degrees, where the grating is blazed to optimize the diffraction efficiency for the "−1" order. The focusing lens has a focal length of 100 mm. Each output port is provided by a quarter-pitch GRIN lens (2 mm in diameter) coupled to an optical fiber (see FIG. 1D). As displayed in FIG. 1C, the coupling efficiency varies with the pivoting angle θ, and it requires about a 0.2-degree change in θ for the coupling efficiency to become practically negligible in this exemplary case. As such, each spectral channel may practically acquire any coupling efficiency value by way of controlling the pivoting angle of its corresponding channel micromirror. This is also to say that variable optical attenuation at the granularity of a single wavelength can be obtained in a WSR apparatus of the present invention. FIG. 1D provides ray-tracing illustrations of two extreme points on the coupling efficiency vs. θ curve of FIG. 1C: on-axis coupling corresponding to θ=0, where the coupling efficiency is maximum; and off-axis coupling corresponding to θ=0.2 degrees, where the representative collimated	

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	beam (representing an exemplary spectral channel) undergoes a significant translational walk-off and renders the coupling efficiency practically negligible. All in all, the exemplary modeling results thus described demonstrate the unique capabilities of the WSR apparatus of the present invention. FIG. 1A provides one of many embodiments of a WSR apparatus according to the present invention. In general, the wavelength-separator is a wavelength-separating means that may be a ruled diffraction grating, a holographic diffraction grating, an echelle grating, a dispersing prism, or other types of spectral-separating means known in the art. The beam-focuser may be a focusing lens, an assembly of lenses, or other beam-focusing means known in the art. The focusing function may also be accomplished by using a curved diffraction grating as the wavelength-separator. The channel micromirrors may be provided by silicon micromachined mirrors, reflective ribbons (or membranes), or other types of beam-deflecting elements known in the art. And each micromirror may be pivoted about one or two axes. What is important is that the pivoting (or rotational) motion of each channel micromirror be individually controllable in an analog manner, whereby the pivoting angle can be continuously adjusted so as to enable the channel micromirror to scan a spectral channel across all possible output ports. The underlying fabrication techniques for micromachined mirrors and associated actuation mechanisms are well documented in the art,	

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	see U.S. Pat. No. 5,629,790 for example. Moreover, a fiber collimator is typically in the form of a collimating lens (such as a GRIN lens) and a ferrule-mounted fiber packaged together in a mechanically rigid stainless steel (or glass) tube. The fiber collimators serving as the input and output ports may be arranged in a one-dimensional array, a two-dimensional array, or other desired spatial pattern. For instance, they may be conveniently mounted in a linear array along a V-groove fabricated on a substrate made of silicon, plastic, or ceramic, as commonly practiced in the art. It should be noted, however, that the input port and the output ports need not necessarily be in close spatial proximity with each other, such as in an array configuration (although a close packing would reduce the rotational range required for each channel micromirror). Those skilled in the art will know how to design a WSR apparatus according to the present invention, to best suit a given application. A WSR apparatus of the present invention may further comprise an array of collimator-alignment mirrors, for adjusting the alignment of the input multi-wavelength optical signal and facilitating the coupling of the spectral channels into the respective output ports, as shown in FIGS. 2A-2B and 3. Depicted in FIG. 2A is a second embodiment of a WSR apparatus according to the present invention. By way of example, WSR apparatus 200 is built upon and hence shares a number of the elements used in the embodiment of FIG. 1A, as identified by those labeled with identical	

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	numerals. Moreover, a one-dimensional array 220 of collimator-alignment mirrors 220-1 through 220-N is optically interposed between the diffraction grating 101 and the fiber collimator array 110. The collimator-alignment mirror 220-1 is designated to correspond with the input port 110-1, for adjusting the alignment of the input multi-wavelength optical signal and therefore ensuring that the spectral channels impinge onto the corresponding channel micromirrors. The collimator-alignment mirrors 220-2 through 220-N are designated to the output ports 110-2 through 110-N in a one-to-one correspondence, serving to provide angular control of the collimated beams of the reflected spectral channels and thereby facilitating the coupling of the spectral channels into the respective output ports according to desired coupling efficiencies. Each collimator-alignment mirror may be rotatable about one axis, or two axes. The embodiment of FIG. 2A is attractive in applications where the fiber collimators (serving as the input and output ports) are desired to be placed in close proximity to the collimator-alignment mirror array 220. To best facilitate the coupling of the spectral channels into the output ports, arrays of imaging lenses may be implemented between the collimator-alignment mirror array 220 and the fiber collimator array 110, as depicted in FIG. 2B. By way of example, WSR apparatus 250 of FIG. 2B is built upon and hence shares many of the elements used in the embodiment of FIG. 2A, as identified by those labeled with identical numerals.	

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	Additionally, first and second arrays 260, 270 of imaging lenses are placed in a 4-f telecentric arrangement with respect to the collimator-alignment mirror array 220 and the fiber collimator array 110. The dashed box 280 shown in FIG. 2C provides a top view of such a telecentric arrangement. In this case, the imaging lenses in the first and second arrays 260, 270 all have the same focal length f. The collimator-alignment mirrors 220-1 through 220-N are placed at the respective first (or front) focal points of the imaging lenses in the first array 260. Likewise, the fiber collimators 110-1 through 110-N are placed at the respective second (or back) focal points of the imaging lenses in the second array 270. And the separation between the first and second arrays 260, 270 of imaging lenses is 2f. In this way, the collimator-alignment mirrors 220-1 through 220-N are effectively imaged onto the respective entrance surfaces (i.e., the front focal planes) of the GRIN lenses in the corresponding fiber collimators 110-1 through 110-N. Such a telecentric imaging system substantially eliminates translational walk-off of the collimated beams at the output ports that may otherwise occur as the mirror angles change." 7:15-10:25 "In addition to facilitating the coupling of the spectral channels into the respective output ports as described above, the collimator-alignment mirrors in the above embodiments also serve to compensate for	

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	misalignment (e. g., due to fabrication and assembly errors) in the fiber collimators that provide for the input and output ports. For instance, relative misalignment between the fiber cores and their respective collimating lenses in the fiber collimators can lead to pointing errors in the collimated beams, which may be corrected for by the collimator- alignment mirrors. For these reasons, the collimator alignment mirrors are preferably rotatable about two axes. They may be silicon micromachined mirrors, for fast rotational speeds. They may also be other types of mirrors or beam-deflecting elements known in the art." 10:48-62 FIGs 1A, 1B, 1C, 1D, 2A, 2B, 3, 4A, 4B, 5, 6. The Abstract. Claims 1, 3, 5, 6, 8, 11, 13, 14, 15-17, 20-22 of the '368 patent. All claims of the '678 patent. Statements from the Examiner in the prosecution histories of the asserted patents, including: "Bouevitch (USPN 6,498,872) teaches (Figs.1-12) an optical device which is used in conjunction with configurable optical add/drop multiplexers (COADM) which includes optical fiber input/output ports 80a,80b,99a,99b which sends wavelength of light which are collimated through	

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	lens 90 to spherical reflector 10 which is incident of diffraction grating 20 to MEMS reflector(s) 51 ,52, which are movable in either the horizontal or vertical directions to return specific wavelengths lambda 1, lambda2 to the output ports 3. Bouevitch does not teach or suggest using channel micromirrors which are both individually and continuously controllable to reflect received spectral channels to anyone of the output ports and to control the power of the received spectral channels coupled to the output ports. Wagener (USPN 6,631,222) (Figs.1-4), Jin (USPN 6,256,430) (Figs.1-7) and Ma (USPN 6,567,574) (Figs.1-12) all teach that at the time the invention was made it was known that pivotable micromirrors orvMEMS can be used with wavelengthvmultiplexers to switch or selectvwavelengths between input and outputvports. [But these four references taken together do not teach amended claim 1.]" *See* Notice of Allowance in the reissue prosecution histories of the asserted patents (emphasizing specific points of novelty, including "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said ports and to control the power of the spectral channel reflected to said selected port.") Statements from the Examiner in the prosecution	

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	history of USPN 6,879,750 (which includes the prosecution history of USPN 6,687,431), including that the new claims in the '750 patent are fully supported by the specification and are broader than those previously presented (*e.g.*, in the '431 patent). '368 Reissue Prosecution, Claims, Amendments, Applicant Comments and Notice of Allowance '678 Reissue Prosecution, Claims, Amendments, Applicant Comments and Notice of Allowance Extrinsic Evidence US Patent Application No. 13/532,735 (the '735 application), filed Jun. 25, 2012, titled Optical Wavelength Selective Switch Calibration System, assigned to Finisar Corporation, which refers to PCT Application Publication WO 02/075410, which is assigned to Capella and claims priority to, inter alia, US Patent Nos. 6,625,346 and 6,687,431, in the background of the invention section and describes WO 02/075410 as disclosing "MEMS based WSS devices" that include "a 2-dimensional array of individually tiltable mirrors. Each mirror operates on the local optical wavefront to selectively steer and manipulate optical signals incident thereon." Plaintiff reserves the right to comment on and to rebut	

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	any and all extrinsic evidence used by Defendants to support their proposed construction.	
Elements being individually… controllable	Plain and ordinary meaning *or if there is disagreement* capable of active control in two dimensions (*e.g.*, x and y dimensions) Intrinsic Evidence "The present invention provides a wavelength-separating routing (WSR) apparatus and method which employ an array of fiber collimators serving as an input port and a plurality of output ports; a wavelength-separator; a beam-focuser; and an array of channel micromirrors. In operation, a multi-wavelength optical signal emerges from the input port. The wavelength-separator separates the multi-wavelength optical signal into multiple spectral channels, each characterized by a distinct center wavelength and associated bandwidth. The beam-focuser focuses the spectral channels into corresponding spectral spots. The channel micromirrors are positioned such that each channel micromirror receives one of the spectral channels. The channel micromirrors are individually controllable and movable, e.g., continuously pivotable (or rotatable), so as to reflect the spectral channels into selected ones of the	each element being controlled separately from all other elements Intrinsic Evidence "The servo-control assembly serves to monitor the power levels of the spectral channels coupled into the output ports and further provide control of the channel micromirrors on an individual basis, so as to maintain a predetermined coupling efficiency of each spectral channel in one of the output ports." '368 Patent at 4:47-52. "As described above, a unique feature of the present invention is that the motion of each channel micromirror is individually and continuously controllable, such that its position, e.g., pivoting angle, can be continuously adjusted. This enables each channel micromirror to scan its corresponding spectral channel across all possible output ports and thereby direct the spectral channel to any desired output port." '368 Patent at 8:21-24 "The processing unit 470 uses the power measurements from the spectral monitor 460 to provide feedback control of the channel micromirrors 430 on an individual basis, so as to maintain a desired coupling efficiency for each spectral channel into a selected output port. As such, the servo-control assembly 440 provides dynamic control of the coupling of the spectral

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	output ports. As such, each channel micromirror is assigned to a specific spectral channel, hence the name "channel micromirror". And each output port may receive any number of the reflected spectral channels. A distinct feature of the channel micromirrors in the present invention, in contrast to those used in the prior art, is that the motion, e.g., pivoting (or rotation), of each channel micromirror is under analog control such that its pivoting angle can be continuously adjusted. This enables each channel micromirror to scan its corresponding spectral channel across all possible output ports and thereby direct the spectral channel to any desired output port. In the WSR apparatus of the present invention, the wavelength- separator may be provided by a ruled diffraction grating, a holographic diffraction grating, an echelle grating, a curved diffraction grating, a dispersing prism, or other wavelength- separating means known in the art. The beam-focuser may be a single lens, an assembly of lenses, or other beamfocusing means known in the art. The channel micromirrors may be provided by silicon micromachined mirrors, reflective rib bans (or membranes), or other types of beam –deflecting means known in the art. And each channel micromirror may be pivotable about one or two axes. The fiber collimators serving as the input and output ports may be arranged in a one-dimensional or two-dimensional array. In the latter case, the channel micromirrors must be pivotable biaxially. The WSR apparatus of the present invention	channels into the respective output ports on a channel-by-channel basis and thereby manages the power levels of the spectral channels coupled into the output ports." '368 Patent at 11:21-30. "By advantageously employing an array of channel micromirrors that are individually and continuously controllable, an OADM of the present invention is capable of routing the spectral channels on a channel-by-channel basis and directing any spectral channel into any one of the output ports." '368 Patent at 5:50-56. "The channel micromirrors are individually controllable and movable, e.g., continuously pivotable (or rotatable), so as to reflect the spectral channels into selected ones of the output ports. As such, each channel micromirror is assigned to a specific spectral channel, hence the name "channel micromirror." '368 at 4:2-4. '368 Patent at Figs 1B, 4A. "1-D tilt of each individual mirror in the SLM in the E>y direction to provide control over the channel-by-channel coupling efficiency." '368 Provisional at slide entitled "Reconfigurable OADM with Dynamic Equalization" "A binary micromachined mirror array redirects each of the individual channels to one of two outputs. Each mirror in the linear array either retroreflects its corresponding channel back along the original input path towards the pass-through port, or it reflects its channel to the drop port." U.S. Pat. App. No.

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	may further comprise an array of collimator-alignment mirrors, in optical communication with the wavelength-separator and the fiber collimators, for adjusting the alignment of the input multiwavelength signal and directing the spectral channels into the selected output ports by way of angular control of the collimated beams. Each collimator-alignment mirror may be rotatable about one or two axes. The collimator-alignment mirrors may be arranged in a one-dimensional or two-dimensional array. First and second arrays of imaging lenses may 40 additionally be optically interposed between the collimatoralignment mirrors and the fiber collimators in a telecentric arrangement, thereby "imaging" the collimator-alignment mirrors onto the corresponding fiber collimators to ensure an optimal alignment." 3:58-4:45 "FIG. 1A depicts a first embodiment of a wavelength-separating- routing (WSR) apparatus according to the present invention. By way of example to illustrate the general principles and the topological structure of a wavelength-separating- routing (WSR) apparatus of the present invention, the WSR apparatus 100 comprises multiple input/output ports which may be in the form of an array of fiber collimators 110, providing an input port 110-1 and a plurality of output ports 110-2 through 110-N (N~3); a wavelength-separator which in one form may be a diffraction grating 101; a beam-focuser in the form of a focusing lens 102; and an array of	60/277,217, p. 4at 2. Extrinsic Evidence The American Heritage Dictionary, Third Edition (1994) – individually, at Cappella_Defs_EE0000000061 Webster's New World College Dictionary, Third Edition (1994) – individually, at Cappella_Defs_EE0000000064.

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	channel micromirrors 103." 6: 52-58 "For purposes of illustration and clarity, only a selective few (e.g., three) of the spectral channels, along with the input multi-wavelength optical signal, are graphically illustrated in FIG. 1A and the following figures. It should be noted, however, that there can be any number of the spectral channels in a WSR apparatus of the present invention (so long as the number of spectral channels does not exceed the number of channel mirrors employed in the system). It should also be noted that the optical beams representing the spectral channels shown in FIG. 1A and the following figures are provided for illustrative purpose only. That is, their sizes and shapes may not be drawn according to scale. For instance, the input beam and the corresponding diffracted beams generally have different cross-sectional shapes, so long as the angle of incidence upon the diffraction grating is not equal to the angle of diffraction, as is known to those skilled in the art. In the embodiment of FIG. 1A, it is preferable that the diffraction grating 101 and the channel micromirrors 103 are placed respectively at the first and second (i.e., the front and back) focal points (on the opposing sides) of the focusing lens 102. Such a telecentric arrangement allows the chief rays of the focused beams to be parallel to each other and generally parallel to the optical axis. In this application, the telecentric configuration further allows the reflected spectral channels to be efficiently	

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	coupled into the respective output ports, thereby minimizing various translational walk-off effects that may otherwise arise. Moreover, the input multi-wavelength optical signal is preferably collimated and circular in cross-section. The corresponding spectral channels diffracted from the diffraction grating 101 are generally elliptical in cross-section; they may be of the same size as the input beam in one dimension and elongated in the other dimension. It is known that the diffraction efficiency of a diffraction grating is generally polarization-dependent. That is, the diffraction efficiency of a grating in a standard mounting configuration may be considerably higher for P-polarization that is perpendicular to the groove lines on the grating than for S-polarization that is orthogonal to P-polarization, especially as the number of groove lines (per unit length) increases. To mitigate such polarization-sensitive effects, a quarter-wave plate 104 may be optically interposed between the diffraction grating 101 and the channel micromirrors 103, and preferably placed between the diffraction grating 101 and the focusing lens 102 as is shown in FIG. 1A. In this way, each spectral channel experiences a total of approximately 90-degree rotation in polarization upon traversing the quarter-wave plate 104 twice. (That is, if a beam of light has P-polarization when first encountering the diffraction grating, it would have predominantly (if not all) S-polarization upon the second encountering, and vice versa.) This ensures that	

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	all the spectral channels incur nearly the same amount of round-trip polarization dependent loss. In the WSR apparatus 100 of FIG. 1A, the diffraction grating 101, by way of example, is oriented such that the focused spots of the spectral channels fall onto the channel micromirrors 103 in a horizontal array, as illustrated in FIG. 1B. Depicted in FIG. 1B is a close-up view of the channel micromirrors 103 shown in the embodiment of FIG. 1A. By way of example, the channel micromirrors 103 are arranged in a one-dimensional array along the x-axis (i.e., the horizontal direction in the figure), so as to receive the focused spots of the spatially separated spectral channels in a one-to-one correspondence. (As in the case of FIG. 1A, only three spectral channels are illustrated, each represented by a converging beam.) Let the reflective surface of each channel micromirror lie in the x-y plane as defined in the figure and be movable, e.g., pivotable (or deflectable) about the x-axis in an analog (or continuous) manner. Each spectral channel, upon reflection, is deflected in the y-direction (e.g., downward) relative to its incident direction, so to be directed into one of the output ports 110-2 through 110-N shown in FIG. 1A. As described above, a unique feature of the present invention is that the motion of each channel micromirror is individually and continuously controllable, such that its position, e.g., pivoting angle, can be continuously adjusted. This enables each channel micromirror to scan its corresponding spectral channel across all possible	

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	output ports and thereby direct the spectral channel to any desired output port. To illustrate this capability, FIG. 1C shows a plot of coupling efficiency as a function of a channel micromirror's pivoting angle θ, provided by a ray-tracing model of a WSR apparatus in the embodiment of FIG. 1A. As used herein, the coupling efficiency for a spectral channel is defined as the ratio of the amount of optical power coupled into the fiber core in an output port to the total amount of optical power incident upon the entrance surface of the fiber (associated with the fiber collimator serving as the output port). In the ray-tracing model, the input optical signal is incident upon a diffraction grating with 700 lines per millimeter at a grazing angle of 85 degrees, where the grating is blazed to optimize the diffraction efficiency for the "−1" order. The focusing lens has a focal length of 100 mm. Each output port is provided by a quarter-pitch GRIN lens (2 mm in diameter) coupled to an optical fiber (see FIG. 1D). As displayed in FIG. 1C, the coupling efficiency varies with the pivoting angle θ, and it requires about a 0.2-degree change in θ for the coupling efficiency to become practically negligible in this exemplary case. As such, each spectral channel may practically acquire any coupling efficiency value by way of controlling the pivoting angle of its corresponding channel micromirror. This is also to say that variable optical attenuation at the granularity of a single wavelength can be obtained in a WSR apparatus of the present invention. FIG. 1D provides ray-tracing	

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	illustrations of two extreme points on the coupling efficiency vs. θ curve of FIG. 1C: on-axis coupling corresponding to $\theta=0$, where the coupling efficiency is maximum; and off-axis coupling corresponding to $\theta=0.2$ degrees, where the representative collimated beam (representing an exemplary spectral channel) undergoes a significant translational walk-off and renders the coupling efficiency practically negligible. All in all, the exemplary modeling results thus described demonstrate the unique capabilities of the WSR apparatus of the present invention. FIG. 1A provides one of many embodiments of a WSR apparatus according to the present invention. In general, the wavelength-separator is a wavelength-separating means that may be a ruled diffraction grating, a holographic diffraction grating, an echelle grating, a dispersing prism, or other types of spectral-separating means known in the art. The beam-focuser may be a focusing lens, an assembly of lenses, or other beam-focusing means known in the art. The focusing function may also be accomplished by using a curved diffraction grating as the wavelength-separator. The channel micromirrors may be provided by silicon micromachined mirrors, reflective ribbons (or membranes), or other types of beam-deflecting elements known in the art. And each micromirror may be pivoted about one or two axes. What is important is that the pivoting (or rotational) motion of each channel micromirror be individually controllable in an analog manner, whereby the pivoting	

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	angle can be continuously adjusted so as to enable the channel micromirror to scan a spectral channel across all possible output ports. The underlying fabrication techniques for micromachined mirrors and associated actuation mechanisms are well documented in the art, see U.S. Pat. No. 5,629,790 for example. Moreover, a fiber collimator is typically in the form of a collimating lens (such as a GRIN lens) and a ferrule-mounted fiber packaged together in a mechanically rigid stainless steel (or glass) tube. The fiber collimators serving as the input and output ports may be arranged in a one-dimensional array, a two-dimensional array, or other desired spatial pattern. For instance, they may be conveniently mounted in a linear array along a V-groove fabricated on a substrate made of silicon, plastic, or ceramic, as commonly practiced in the art. It should be noted, however, that the input port and the output ports need not necessarily be in close spatial proximity with each other, such as in an array configuration (although a close packing would reduce the rotational range required for each channel micromirror). Those skilled in the art will know how to design a WSR apparatus according to the present invention, to best suit a given application. A WSR apparatus of the present invention may further comprise an array of collimator-alignment mirrors, for adjusting the alignment of the input multi-wavelength optical signal and facilitating the coupling of the spectral channels into the respective output ports, as shown in FIGS. 2A-2B and 3. Depicted	

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	in FIG. 2A is a second embodiment of a WSR apparatus according to the present invention. By way of example, WSR apparatus 200 is built upon and hence shares a number of the elements used in the embodiment of FIG. 1A, as identified by those labeled with identical numerals. Moreover, a one-dimensional array 220 of collimator-alignment mirrors 220-1 through 220-N is optically interposed between the diffraction grating 101 and the fiber collimator array 110. The collimator-alignment mirror 220-1 is designated to correspond with the input port 110-1, for adjusting the alignment of the input multi-wavelength optical signal and therefore ensuring that the spectral channels impinge onto the corresponding channel micromirrors. The collimator-alignment mirrors 220-2 through 220-N are designated to the output ports 110-2 through 110-N in a one-to-one correspondence, serving to provide angular control of the collimated beams of the reflected spectral channels and thereby facilitating the coupling of the spectral channels into the respective output ports according to desired coupling efficiencies. Each collimator-alignment mirror may be rotatable about one axis, or two axes. The embodiment of FIG. 2A is attractive in applications where the fiber collimators (serving as the input and output ports) are desired to be placed in close proximity to the collimator-alignment mirror array 220. To best facilitate the coupling of the spectral channels into the output ports, arrays of imaging lenses may be implemented between the collimator-alignment mirror	

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	array 220 and the fiber collimator array 110, as depicted in FIG. 2B. By way of example, WSR apparatus 250 of FIG. 2B is built upon and hence shares many of the elements used in the embodiment of FIG. 2A, as identified by those labeled with identical numerals. Additionally, first and second arrays 260, 270 of imaging lenses are placed in a 4-f telecentric arrangement with respect to the collimator-alignment mirror array 220 and the fiber collimator array 110. The dashed box 280 shown in FIG. 2C provides a top view of such a telecentric arrangement. In this case, the imaging lenses in the first and second arrays 260, 270 all have the same focal length f. The collimator-alignment mirrors 220-1 through 220-N are placed at the respective first (or front) focal points of the imaging lenses in the first array 260. Likewise, the fiber collimators 110-1 through 110-N are placed at the respective second (or back) focal points of the imaging lenses in the second array 270. And the separation between the first and second arrays 260, 270 of imaging lenses is 2f. In this way, the collimator-alignment mirrors 220-1 through 220-N are effectively imaged onto the respective entrance surfaces (i.e., the front focal planes) of the GRIN lenses in the corresponding fiber collimators 110-1 through 110-N. Such a telecentric imaging system substantially eliminates translational walk-off of the collimated beams at the output ports that may otherwise occur as the mirror	

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	angles change." 7:15-10:25 "In addition to facilitating the coupling of the spectral channels into the respective output ports as described above, the collimator-alignment mirrors in the above embodiments also serve to compensate for misalignment (e. g., due to fabrication and assembly errors) in the fiber collimators that provide for the input and output ports. For instance, relative misalignment between the fiber cores and their respective collimating lenses in the fiber collimators can lead to pointing errors in the collimated beams, which may be corrected for by the collimator- alignment mirrors. For these reasons, the collimator alignment mirrors are preferably rotatable about two axes. They may be silicon micromachined mirrors, for fast rotational speeds. They may also be other types of mirrors or beam-deflecting elements known in the art." 10:48-62 FIGs 1A, 1B, 1C, 1D, 2A, 2B, 3, 4A, 4B, 5, 6. The Abstract. Claims 1, 3, 5, 6, 8, 11, 13, 14, 15-17, 20-22 of the '368 patent. All claims of the '678 patent. Statements from the Examiner in the prosecution	

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	histories of the asserted patents, including: "Bouevitch (USPN 6,498,872) teaches (Figs.1-12) an optical device which is used in conjunction with configurable optical add/drop multiplexers (COADM) which includes optical fiber input/output ports 80a,80b,99a,99b which sends wavelength of light which are collimated through lens 90 to spherical reflector 10 which is incident of diffraction grating 20 to MEMS reflector(s) 51 ,52, which are movable in either the horizontal or vertical directions to return specific wavelengths lambda 1, lambda2 to the output ports 3. Bouevitch does not teach or suggest using channel micromirrors which are both individually and continuously controllable to reflect received spectral channels to anyone of the output ports and to control the power of the received spectral channels coupled to the output ports. Wagener (USPN 6,631,222) (Figs.1-4), Jin (USPN 6,256,430) (Figs.1-7) and Ma (USPN 6,567,574) (Figs.1-12) all teach that at the time the invention was made it was known that pivotable micromirrors orvMEMS can be used with wavelength multiplexers to switch or select wavelengths between input and output ports. [But these four references taken together do not teach amended claim 1.]" *See* Notice of Allowance in the reissue prosecution histories of the asserted patents (emphasizing specific points of novelty, including "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and	

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	continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said ports and to control the power of the spectral channel reflected to said selected port.") '368 Reissue Prosecution, Claims, Amendments, Applicant Comments and Notice of Allowance '678 Reissue Prosecution, Claims, Amendments, Applicant Comments and Notice of Allowance All evidence relied-on in support of "continuously," "controllable in two dimensions," and "beam deflecting elements" above. Extrinsic Evidence US Patent Application No. 13/532,735 (the '735 application), filed Jun. 25, 2012, titled Optical Wavelength Selective Switch Calibration System, assigned to Finisar Corporation, which refers to PCT Application Publication WO 02/075410, which is assigned to Capella and claims priority to, inter alia, US Patent Nos. 6,625,346 and 6,687,431, in the background of the invention section and describes WO 02/075410 as disclosing "MEMS based WSS devices" that include "a 2-dimensional array of individually tiltable mirrors. Each mirror operates on the local optical wavefront to selectively steer and manipulate optical signals incident	

Claim Term	**Plaintiff's Proposed Construction and Evidence**	**Defendants' Proposed Construction and Evidence**
	thereon." Plaintiff reserves the right to comment on and to rebut any and all extrinsic evidence used by Defendants to support their proposed construction.	
maintaining a predetermined coupling	Plain and ordinary meaning *or if there is disagreement* maintaining predetermined power levels Intrinsic Evidence "U.S. Pat. No. 6,204,946 to Askyuk et al. discloses an OADM that makes use of free-space optics in a parallel construction In this case, a multi-wavelength optical signal emerging from an input port is incident onto a ruled diffraction grating. The constituent spectral channels thus separated are then focused by a focusing lens onto a linear array of binary micromachined mirrors. Each micromirror is configured to operate between two discrete states, such that it either retrofits its corresponding spectral channel back into the input port as a pass-through channel, or directs its spectral channel to an output port as a drop channel. As such, the pass-through signal (i.e., the combined pass-through channels) shares the same input port as the input signal. An optical circulator is therefore coupled to the input	constantly keeping a predetermined alignment Intrinsic Evidence The servo-control assembly serves to monitor the power levels of the spectral channels coupled into the output ports and further provide control of the channel micromirrors on an individual basis, so as to maintain a predetermined coupling efficiency of each spectral channel in one of the output ports. As such, the servo-control assembly provides dynamic control of the coupling of the spectral channels into the respective output ports and actively manages the power levels of the spectral channels coupling into the output ports. '368 Patent at 4:47-56. The coupling of the spectral channels into the output ports is dynamically controlled by a servo-control assembly, rendering the OADM less susceptible to environmental effects (such as thermal and mechanical disturbances) and therefore more robust in performance. By maintaining an optimal optical alignment, the optical losses incurred by the spectral channels are also significantly reduced. '368 Patent at 5:63-6:2.

Claim Term	Plaintiff's Proposed Construction and Evidence	Defendants' Proposed Construction and Evidence
	port, to provide necessary routing of these two signals. Likewise, the drop channels share the output port with the add channels. An additional optical circulator is thereby coupled to the output port, from which the drop channels exit and the add channels are introduced into the output ports. The add channels are subsequently combined with the pass-through signal by way of the diffraction grating and the binary micromirrors. Although the aforementioned OADM disclosed by Askyuk et al. has the advantage of performing wavelength separating and routing in free space and thereby incurring less optical loss, it suffers a number of limitations. First, it requires that the pass-through signal share the same port/fiber as the input signal. An optical circulator therefore has to be implemented, to provide necessary routing of these two signals. Likewise, all the add and drop channels enter and leave the OADM through the same output port, hence the need for another optical circulator. Moreover, additional means must be provided to multiplex the add channels before entering the system and to demultiplex the drop channels after exiting the system. This additional multiplexing/demultiplexing requirement adds more cost and complexity that can restrict the versatility of the OADM thus-constructed. Second, the optical circulators implemented in this OADM for various routing purposes introduce additional optical losses, which can accumulate to a substantial amount. Third, the constituent optical components must be in a precise	<u>Extrinsic Evidence</u> Dictionary.com (retrieved 2014), at , at Cappella_Defs_EE0000000031-35 Webster's Collegiate Dictionary (1999) – Maintain, at Cappella_Defs_EE0000000044 Meriam-Webster (online, retieved 2014) – maintain, at Cappella_Defs_EE0000000045-46.

Claim Term	Plaintiff's Proposed Construction and Evidence	Defendants' Proposed Construction and Evidence
	alignment, in order for the system to achieve its intended purpose. There are, however, no provisions provided for maintaining the requisite alignment; and no mechanisms implemented for overcoming degradation in the alignment owing to environmental effects such as thermal and mechanical disturbances over the course of operation. U.S. Pat. No. 5,906,133 to Tomlinson discloses an OADM that makes use of a design similar to that of Aksyuk et al. There are input, output, drop and add ports implemented in this case. By positioning the four ports in a specific arrangement, each micromirror, notwithstanding switchable between two discrete positions, either reflects its corresponding channel (coming from the input port) to the output port, or concomitantly reflects its channel to the drop port and an incident add channel to the output port. As such, this OADM is able to perform both the add and drop functions without involving additional optical components (such as optical circulators used in the system of Aksyuk et al.). However, because a single drop port is designated for all the drop channels and a single add port is designated for all the add channels, the add channels would have to be multiplexed before entering the add port and the drop channels likewise need to be demutiplexed upon exiting from the drop port. Moreover, as in the case of Askyuk et al., there are no provisions provided for maintaining requisite optical alignment in the system, and no mechanisms implemented for combating degradation in the	

Claim Term	Plaintiff's Proposed Construction and Evidence	Defendants' Proposed Construction and Evidence
	alignment due to environmental effects over the course of operation. As such, the prevailing drawbacks suffered by the OADMs currently in the art are summarized as follows: 1) The wavelength routing is intrinsically static, rendering it difficult to dynamically reconfigure these OADMs. 2) Add and/or drop channels often need to be multiplexed and/or demultiplexed, thereby imposing additional complexity and cost. 3) Stringent fabrication tolerance and painstaking optical alignment are required. Moreover, the optical alignment is not actively maintained, rendering it susceptible to environmental effects such as thermal and mechanical disturbances over the course of operation. 4) In an optical communication network, OADMs are typically in a ring or cascaded configuration. In order to mitigate the interference amongst OADMs, which often adversely affects the overall performance of the network, it is essential that the power levels of spectral channels entering and exiting each OADM be managed in a systematic way, for instance, by introducing power (or gain) equalization at each stage. Such a power equalization capability is also needed for compensating for non-uniform gain caused by optical amplifiers (e.g., erbium doped fiber amplifiers) in the network. There lacks, however, a systematic and dynamic management of the power levels of various spectral channels in these OADMs 5) The inherent high cost and heavy optical loss further impede the wide application of these OADMs. In view of the foregoing, there is an urgent	

Claim Term	Plaintiff's Proposed Construction and Evidence	Defendants' Proposed Construction and Evidence
	need in the art for optical add-drop multiplexers that overcome the aforementioned shortcomings in a simple, effective, and economical construction." 2:19-3:50 "The WSR apparatus of the present invention may further include a servo-control assembly, in communication with the channel micromirrors and the output ports. The servo-control assembly serves to monitor the power levels of the spectral channels coupled into the output ports and further provide control of the channel micromirrors on an individual basis, so as to maintain a predetermined coupling efficiency of each spectral channel in one of the output ports. As such, the servo-control assembly provides dynamic control of the coupling of the spectral channels into the respective output ports and actively manages the power levels of the spectral channels coupled into the output ports. (If the WSR apparatus includes an array of collimator-alignment mirrors as described above, the servo-control assembly may additionally provide dynamic control of the collimator-alignment mirrors.) Moreover, the utilization of such a servo-control assembly effectively relaxes the requisite fabrication tolerances and the precision of optical alignment during assembly of a WSR apparatus of the present invention, and further enables the system to correct for shift in optical alignment over the course of operation. A WSR apparatus incorporating a servo-control assembly thus described is termed a WSR-S apparatus, thereinafter in	

Claim Term	**Plaintiff's Proposed Construction and Evidence**	**Defendants' Proposed Construction and Evidence**
	the present invention." 3:45-68 "All in all, the OADMs of the present invention provide many advantages over the prior art devices, notably: 1) By advantageously employing an array of channel micromirrors that are individually and continuously controllable, an OADM of the present invention is capable of routing the spectral channels on a channel-by-channel basis and directing any spectral channel into any one of the output ports. As such, its underlying operation is dynamically reconfigurable, and its underlying architecture is intrinsically scalable to a large number of channel counts. 2) The add and drop spectral channels need not be multiplexed and demultiplexed before entering and after leaving the OADM respectively. And there are not fundamental restrictions on the wavelengths to be added or dropped. 3) The coupling of the spectral channels into the output ports is dynamically controlled by a servo-control assembly, rendering the OADM less susceptible to environmental effects (such as thermal and mechanical disturbances) and therefore more robust in performance. By maintaining an optimal optical alignment, the optical losses incurred by the spectral channels are also significantly reduced. 4) The power levels of the spectral channels coupled into the output ports can be dynamically managed according to demand, or maintained at desired values (e.g., equalized at a predetermined value) by way of the servo-control	

Claim Term	Plaintiff's Proposed Construction and Evidence	Defendants' Proposed Construction and Evidence
	assembly. This spectral power-management capability as an integral part of the OADM will be particularly desirable in WDM optical networking applications. 5) The use of free-space optics provides a simple, low loss, and cost-effective construction. Moreover, the utilization of the servo-control assembly effectively relaxes the requisite fabrication tolerances and the precision of optical alignment during initial assembly, enabling the OADM to be simpler and more adaptable in structure, lower in cost and optical loss. 6) The underlying OADM architecture allows a multiplicity of the OADMs according to the present invention to be readily assembled (e.g., cascaded) for WDM optical networking applications." 5:49-6:24 "To optimize the coupling of the spectral channels into the output ports and further maintain the optimal optical alignment against environmental effects such as temperature variations and mechanical instabilities over the course of operation, a WSR apparatus of the present invention may incorporate a servo-control assembly, for providing dynamic control of the coupling of the spectral channels into the respective output ports on a channel-by-channel basis. A WSR apparatus incorporating a servo-control assembly is termed a WSR-S apparatus, thereinafter in this specification. FIG. 4A depicts a schematic illustration of a first embodiment of a WSR-S apparatus according to the present invention. The WSR-S apparatus 400 comprises	

Claim Term	Plaintiff's Proposed Construction and Evidence	Defendants' Proposed Construction and Evidence
	a WSR apparatus 410 and a servo-control assembly 440. The WSR 410 may be in the embodiment of FIG. 1A, or any other embodiment in accordance with the present invention. The servo-control assembly 440 includes a spectral monitor 460, for monitoring the power levels of the spectral channels coupled into the output ports 420-1 through 420-N of the WSR apparatus 410. By way of example, the spectral monitor 460 is coupled to the output ports 420-1 through 420-N by way of fiber-optic couplers 420-1-C through 420-N-C, wherein each fiber-optic coupler serves to tap off a predetermined fraction of the optical signal in the corresponding output port. The servo-control assembly 440 further includes a processing unit 470, in communication with the spectral monitor 460 and the channel micromirrors 430 of the WSR apparatus 410. The processing unit 470 uses the power measurements from the spectral monitor 460 to provide feedback control of the channel micromirrors 430 on an individual basis, so as to maintain a desired coupling efficiency for each spectral channel into a selected output port. As such, the servo-control assembly 440 provides dynamic control of the coupling of the spectral channels into the respective output ports on a channel-by-channel basis and thereby manages the power levels of the spectral channels coupled into the output ports. The power levels of the spectral channels in the output ports may be dynamically managed according to demand, or maintained at desired values (e.g., equalized at a predetermined value) in the present	

Claim Term	Plaintiff's Proposed Construction and Evidence	Defendants' Proposed Construction and Evidence
	invention. Such a spectral power-management capability is essential in WDM optical networking applications, as discussed above. FIG. 4B depicts a schematic illustration of a second embodiment of a WSR-S apparatus according to the present invention. The WSR-S apparatus 450 comprises a WSR apparatus 480 and a servo-control assembly 490. In addition to the channel micromirrors 430 (and other elements identified by the same numerals as those used in FIG. 4A), the WSR apparatus 480 further includes a plurality of collimator-alignment mirrors 485, and may be configured according to the embodiment of FIGS. 2A, 2B, 3, or any other embodiment in accordance with the present invention. By way of example, the servo-control assembly 490 includes the spectral monitor 460 as described in the embodiment of FIG. 4A, and a processing unit 495. In this case, the processing unit 495 is in communication with the channel micromirrors 430 and the collimator-alignment mirrors 485 of the WSR apparatus 480, as well as the spectral monitor 460. The processing unit 495 uses the power measurements from the spectral monitor 460 to provide dynamic control of the channel micromirrors 430 along with the collimator-alignment mirrors 485, so to maintain the coupling efficiencies of the spectral channels into the output ports at desired values. In the embodiment of FIG. 4A or 4B, the spectral monitor 460 may be one of spectral power monitoring devices known in the art that is capable of detecting the power levels of spectral components in a	

Claim Term	Plaintiff's Proposed Construction and Evidence	Defendants' Proposed Construction and Evidence
	multi-wavelength optical signal. Such devices are typically in the form of a wavelength-separating means (e.g., a diffraction grating) that spatially separates a multi-wavelength optical signal by wavelength into constituent spectral components, and one or more optical sensors (e.g., an array of photodiodes) that are configured such to detect the power levels of these spectral components. The processing unit 470 in FIG. 4A (or the processing unit 495 in FIG. 4B) typically includes electrical circuits and signal processing programs for processing the power measurements received from the spectral monitor 460 and generating appropriate control signals to be applied to the channel micromirrors 430 (and the collimator-alignment mirrors 485 in the case of FIG. 4B), so to maintain the coupling efficiencies of the spectral channels into the output ports at desired values. The electronic circuitry and the associated signal processing algorithm/software for such processing unit in a servo-control system are known in the art. A skilled artisan will know how to implement a suitable spectral monitor along with an appropriate processing unit to provide a servo-control assembly in a WSP-S apparatus according to the present invention, for a given application. The incorporation of a servo-control assembly provides additional advantages of effectively relaxing the requisite fabrication tolerances and the precision of optical alignment during initial assembly of a WSR apparatus of the present invention, and further enabling the system to correct for shift in the alignment	

Claim Term	Plaintiff's Proposed Construction and Evidence	Defendants' Proposed Construction and Evidence
	over the course of operation. By maintaining an optimal optical alignment, the optical losses incurred by the spectral channels are also significantly reduced. As such, the WSR-S apparatus thus constructed is simpler and more adaptable in structure, more robust in performance, and lower in cost and optical loss. Accordingly, the WSR-S (or WSR) apparatus of the present invention may be used to construct a variety of optical devices and utilized in many applications. For instance, by directing the spectral channels into the output ports in a one-channel-per-port fashion and coupling the output ports of a WSR-S (or WSR) apparatus to an array of optical sensors (e.g., photodiodes), or a single optical sensor that is capable of scanning across the output ports, a dynamic and versatile spectral power monitor (or channel analyzer) is provided, which would be highly desired in WDM optical networking applications. Moreover, a novel class of optical add-drop multiplexers (OADMs) may be built upon the WSR-S (or WSR) apparatus of the present invention, as exemplified in the following embodiments." 10:62-12:40 FIGs 3, 4A, 4B, 5, 6. The Abstract. Claims 1, 3, 4, 15-17 of the '368 patent.	

Claim Term	Plaintiff's Proposed Construction and Evidence	Defendants' Proposed Construction and Evidence
	Claims 1-4, 21-33, 37-39, 44-46, 61-67 of the '678 patent. '368 Reissue Prosecution, Claims, Amendments, Applicant Comments and Notice of Allowance '678 Reissue Prosecution, Claims, Amendments, Applicant Comments and Notice of Allowance Extrinsic Evidence US Patent Application No. 13/532,735 (the '735 application), filed Jun. 25, 2012, titled Optical Wavelength Selective Switch Calibration System, assigned to Finisar Corporation, which refers to PCT Application Publication WO 02/075410, which is assigned to Capella and claims priority to, inter alia, US Patent Nos. 6,625,346 and 6,687,431, in the background of the invention section and describes WO 02/075410 as disclosing "MEMS based WSS devices" that include "a 2-dimensional array of individually tiltable mirrors. Each mirror operates on the local optical wavefront to selectively steer and manipulate optical signals incident thereon." Plaintiff reserves the right to comment on and to rebut any and all extrinsic evidence used by Defendants to support their proposed construction.	

Claim Term	**Plaintiff's Proposed Construction and Evidence**	**Defendants' Proposed Construction and Evidence**
servo-control assembly	Plain and ordinary meaning *or if there is disagreement* assembly that controls a device in response to a control signal Intrinsic Evidence "U.S. Pat. No. 6,204,946 to Askyuk et al. discloses an OADM that makes use of free-space optics in a parallel construction In this case, a multi-wavelength optical signal emerging from an input port is incident onto a ruled diffraction grating. The constituent spectral channels thus separated are then focused by a focusing lens onto a linear array of binary micromachined mirrors. Each micromirror is configured to operate between two discrete states, such that it either retrofits its corresponding spectral channel back into the input port as a pass-through channel, or directs its spectral channel to an output port as a drop channel. As such, the pass-through signal (i.e., the combined pass-through channels) shares the same input port as the input signal. An optical circulator is therefore coupled to the input port, to provide necessary routing of these two signals. Likewise, the drop channels share the output port with the add channels. An additional optical circulator is thereby coupled to the output port, from which the drop channels exit and the add channels are introduced into the output ports. The add channels are subsequently combined with the pass-through signal by way of the diffraction grating and the binary micromirrors. Although the aforementioned OADM disclosed by Askyuk et al. has the advantage of performing	assembly that automatically takes measurements, and controls a mechanical device in response to those measurements Intrinsic Evidence '368 Patent, Fig. 4A - 440 = servo control assembly The servo-control assembly serves to monitor the power levels of the spectral channels coupled into the output ports and further provide control of the channel micromirrors on an individual basis, so as to maintain a predetermined coupling efficiency of each spectral channel in one of the output ports. As such, the servo-control assembly provides dynamic control of the coupling of the spectral channels into the respective output ports and actively manages the power levels of the spectral channels coupling into the output ports. '368 Patent at 4:47-56 FIG. 4A depicts a schematic illustration of a first embodiment of a WSR-S apparatus according to the present invention. The WSR-S apparatus 400 comprises a WSR apparatus 410 and a servo-control assembly 440. The WSR 410 may be in the embodiment of FIG. 1A, or any other embodiment in accordance with the present invention. The servo-control assembly 440 includes a spectral monitor 460, for monitoring the power levels of the spectral channels coupled into the output ports 420-1 through 420-N of the WSR apparatus 410. By way of example, the spectral monitor 460 is coupled to the

Claim Term	Plaintiff's Proposed Construction and Evidence	Defendants' Proposed Construction and Evidence
	wavelength separating and routing in free space and thereby incurring less optical loss, it suffers a number of limitations. First, it requires that the pass-through signal share the same port/fiber as the input signal. An optical circulator therefore has to be implemented, to provide necessary routing of these two signals. Likewise, all the add and drop channels enter and leave the OADM through the same output port, hence the need for another optical circulator. Moreover, additional means must be provided to multiplex the add channels before entering the system and to demultiplex the drop channels after exiting the system. This additional multiplexing/demultiplexing requirement adds more cost and complexity that can restrict the versatility of the OADM thus-constructed. Second, the optical circulators implemented in this OADM for various routing purposes introduce additional optical losses, which can accumulate to a substantial amount. Third, the constituent optical components must be in a precise alignment, in order for the system to achieve its intended purpose. There are, however, no provisions provided for maintaining the requisite alignment; and no mechanisms implemented for overcoming degradation in the alignment owing to environmental effects such as thermal and mechanical disturbances over the course of operation. U.S. Pat. No. 5,906,133 to Tomlinson discloses an OADM that makes use of a design similar to that of Aksyuk et al. There are input, output, drop and add ports implemented in this case. By positioning the four ports in a specific arrangement, each micromirror, notwithstanding switchable between two discrete positions, either reflects its corresponding channel (coming from the input port) to the output port, or concomitantly reflects its channel to the drop port and	output ports 420-1 through 420-N by way of fiber-optic couplers 420-1-C through 420-N-C, wherein each fiber-optic coupler serves to tap off a predetermined fraction of the optical signal in the corresponding output port. The servocontrol assembly 440 further includes a processing unit 470, in communication with the spectral monitor 460 and the channel micromirrors 430 of the WSR apparatus 410. The processing unit 470 uses the power measurements from the spectral monitor 460 to provide feedback control of the channel micromirrors 430 on an individual basis, so as to maintain a desired coupling efficiency for each spectral channel into a selected output port. As such, the servo-control assembly 440 provides dynamic control of the coupling of the spectral channels into the respective output ports on a channel-bychannel basis and thereby manages the power levels of the spectral channels coupled into the output ports. The power levels of the spectral channels in the output ports may be dynamically managed according to demand, or maintained at desired values (e.g., equalized at a predetermined value) in the present invention. Such a spectral power-management capability is essential in WDM optical networking applications, as discussed above. '368 Patent at 11:5-36. Extrinsic Evidence Newton's Telecom Dictionary (2001) - Servo Short for servomechanism, at Cappella_Defs_EE0000000014. Webster's New World College Dictionary, Third Edition (1997) – servo and servomechanism, at Cappella_Defs_EE0000000017.

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	an incident add channel to the output port. As such, this OADM is able to perform both the add and drop functions without involving additional optical components (such as optical circulators used in the system of Aksyuk et al.). However, because a single drop port is designated for all the drop channels and a single add port is designated for all the add channels, the add channels would have to be multiplexed before entering the add port and the drop channels likewise need to be demutiplexed upon exiting from the drop port. Moreover, as in the case of Askyuk et al., there are no provisions provided for maintaining requisite optical alignment in the system, and no mechanisms implemented for combating degradation in the alignment due to environmental effects over the course of operation. As such, the prevailing drawbacks suffered by the OADMs currently in the art are summarized as follows: 1) The wavelength routing is intrinsically static, rendering it difficult to dynamically reconfigure these OADMs. 2) Add and/or drop channels often need to be multiplexed and/or demultiplexed, thereby imposing additional complexity and cost. 3) Stringent fabrication tolerance and painstaking optical alignment are required. Moreover, the optical alignment is not actively maintained, rendering it susceptible to environmental effects such as thermal and mechanical disturbances over the course of operation. 4) In an optical communication network, OADMs are typically in a ring or cascaded configuration. In order to mitigate the interference amongst OADMs, which often adversely affects the overall performance of the network, it is essential that the power levels of spectral channels entering and exiting each OADM be managed in a systematic way, for instance, by introducing power	The American Heritage Dictionary, Third Edition (1994) – servomechanism, at Cappella_Defs_EE0000000020. The Authoritative Dictionary of IEEE Standards Terms, Seventh Edition (2000) – servomechanism, at Cappella_Defs_EE0000000030. Fiber Optics Dictionary, 3rd Ed. (1997) - Servomechanism, at Cappella_Defs_EE0000000026. Dictionary.com (retrieved 2014) –servo, at Cappella_Defs_EE0000000021-22 Dictionary.com (retrieved 2014) - feedback, at Cappella_Defs_EE0000000065-66. Capella_Defs_EE000000065 Definition of "feedback" used in the IPRs

Claim Term	Plaintiff's Proposed Construction and Evidence	Defendants' Proposed Construction and Evidence
	(or gain) equalization at each stage. Such a power equalization capability is also needed for compensating for non-uniform gain caused by optical amplifiers (e.g., erbium doped fiber amplifiers) in the network. There lacks, however, a systematic and dynamic management of the power levels of various spectral channels in these OADMs 5) The inherent high cost and heavy optical loss further impede the wide application of these OADMs. In view of the foregoing, there is an urgent need in the art for optical add-drop multiplexers that overcome the aforementioned shortcomings in a simple, effective, and economical construction." 2:19-3:50 "The WSR apparatus of the present invention may further include a servo-control assembly, in communication with the channel micromirrors and the output ports. The servo-control assembly serves to monitor the power levels of the spectral channels coupled into the output ports and further provide control of the channel micromirrors on an individual basis, so as to maintain a predetermined coupling efficiency of each spectral channel in one of the output ports. As such, the servo-control assembly provides dynamic control of the coupling of the spectral channels into the respective output ports and actively manages the power levels of the spectral channels coupled into the output ports. (If the WSR apparatus includes an array of collimator-alignment mirrors as described above, the servo-control assembly may additionally provide dynamic control of the collimator-alignment mirrors.) Moreover, the utilization of such a servo-control assembly effectively relaxes the requisite fabrication tolerances and the precision of optical alignment during assembly of a WSR apparatus of the present invention, and further	

Claim Term	Plaintiff's Proposed Construction and Evidence	Defendants' Proposed Construction and Evidence
	enables the system to correct for shift in optical alignment over the course of operation. A WSR apparatus incorporating a servo-control assembly thus described is termed a WSR-S apparatus, thereinafter in the present invention." 3:45-68 "All in all, the OADMs of the present invention provide many advantages over the prior art devices, notably: 1) By advantageously employing an array of channel micromirrors that are individually and continuously controllable, an OADM of the present invention is capable of routing the spectral channels on a channel-by-channel basis and directing any spectral channel into any one of the output ports. As such, its underlying operation is dynamically reconfigurable, and its underlying architecture is intrinsically scalable to a large number of channel counts. 2) The add and drop spectral channels need not be multiplexed and demultiplexed before entering and after leaving the OADM respectively. And there are not fundamental restrictions on the wavelengths to be added or dropped. 3) The coupling of the spectral channels into the output ports is dynamically controlled by a servo-control assembly, rendering the OADM less susceptible to environmental effects (such as thermal and mechanical disturbances) and therefore more robust in performance. By maintaining an optimal optical alignment, the optical losses incurred by the spectral channels are also significantly reduced. 4) The power levels of the spectral channels coupled into the output ports can be dynamically managed according to demand, or maintained at desired values (e.g., equalized at a predetermined value) by way of the servo-control assembly. This spectral power-management capability	

Claim Term	**Plaintiff's Proposed Construction and Evidence**	**Defendants' Proposed Construction and Evidence**
	as an integral part of the OADM will be particularly desirable in WDM optical networking applications. 5) The use of free-space optics provides a simple, low loss, and cost-effective construction. Moreover, the utilization of the servo-control assembly effectively relaxes the requisite fabrication tolerances and the precision of optical alignment during initial assembly, enabling the OADM to be simpler and more adaptable in structure, lower in cost and optical loss. 6) The underlying OADM architecture allows a multiplicity of the OADMs according to the present invention to be readily assembled (e.g., cascaded) for WDM optical networking applications." 5:49-6:24 "To optimize the coupling of the spectral channels into the output ports and further maintain the optimal optical alignment against environmental effects such as temperature variations and mechanical instabilities over the course of operation, a WSR apparatus of the present invention may incorporate a servo-control assembly, for providing dynamic control of the coupling of the spectral channels into the respective output ports on a channel-by-channel basis. A WSR apparatus incorporating a servo-control assembly is termed a WSR-S apparatus, thereinafter in this specification. FIG. 4A depicts a schematic illustration of a first embodiment of a WSR-S apparatus according to the present invention. The WSR-S apparatus 400 comprises a WSR apparatus 410 and a servo-control assembly 440. The WSR 410 may be in the embodiment of FIG. 1A, or any other embodiment in accordance with the present invention. The servo-control assembly 440 includes a spectral monitor 460, for monitoring the power levels of the spectral channels coupled into the output ports 420-1	

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	through 420-N of the WSR apparatus 410. By way of example, the spectral monitor 460 is coupled to the output ports 420-1 through 420-N by way of fiber-optic couplers 420-1-C through 420-N-C, wherein each fiber-optic coupler serves to tap off a predetermined fraction of the optical signal in the corresponding output port. The servo-control assembly 440 further includes a processing unit 470, in communication with the spectral monitor 460 and the channel micromirrors 430 of the WSR apparatus 410. The processing unit 470 uses the power measurements from the spectral monitor 460 to provide feedback control of the channel micromirrors 430 on an individual basis, so as to maintain a desired coupling efficiency for each spectral channel into a selected output port. As such, the servo-control assembly 440 provides dynamic control of the coupling of the spectral channels into the respective output ports on a channel-by-channel basis and thereby manages the power levels of the spectral channels coupled into the output ports. The power levels of the spectral channels in the output ports may be dynamically managed according to demand, or maintained at desired values (e.g., equalized at a predetermined value) in the present invention. Such a spectral power-management capability is essential in WDM optical networking applications, as discussed above. FIG. 4B depicts a schematic illustration of a second embodiment of a WSR-S apparatus according to the present invention. The WSR-S apparatus 450 comprises a WSR apparatus 480 and a servo-control assembly 490. In addition to the channel micromirrors 430 (and other elements identified by the same numerals as those used in FIG. 4A), the WSR apparatus 480 further includes a plurality of collimator-alignment mirrors 485, and may be	

Claim Term	Plaintiff's Proposed Construction and Evidence	Defendants' Proposed Construction and Evidence
	configured according to the embodiment of FIGS. 2A, 2B, 3, or any other embodiment in accordance with the present invention. By way of example, the servo-control assembly 490 includes the spectral monitor 460 as described in the embodiment of FIG. 4A, and a processing unit 495. In this case, the processing unit 495 is in communication with the channel micromirrors 430 and the collimator-alignment mirrors 485 of the WSR apparatus 480, as well as the spectral monitor 460. The processing unit 495 uses the power measurements from the spectral monitor 460 to provide dynamic control of the channel micromirrors 430 along with the collimator-alignment mirrors 485, so to maintain the coupling efficiencies of the spectral channels into the output ports at desired values. In the embodiment of FIG. 4A or 4B, the spectral monitor 460 may be one of spectral power monitoring devices known in the art that is capable of detecting the power levels of spectral components in a multi-wavelength optical signal. Such devices are typically in the form of a wavelength-separating means (e.g., a diffraction grating) that spatially separates a multi-wavelength optical signal by wavelength into constituent spectral components, and one or more optical sensors (e.g., an array of photodiodes) that are configured such to detect the power levels of these spectral components. The processing unit 470 in FIG. 4A (or the processing unit 495 in FIG. 4B) typically includes electrical circuits and signal processing programs for processing the power measurements received from the spectral monitor 460 and generating appropriate control signals to be applied to the channel micromirrors 430 (and the collimator-alignment mirrors 485 in the case of FIG. 4B), so to maintain the coupling efficiencies of the spectral channels into the output ports	

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	at desired values. The electronic circuitry and the associated signal processing algorithm/software for such processing unit in a servo-control system are known in the art. A skilled artisan will know how to implement a suitable spectral monitor along with an appropriate processing unit to provide a servo-control assembly in a WSP-S apparatus according to the present invention, for a given application. The incorporation of a servo-control assembly provides additional advantages of effectively relaxing the requisite fabrication tolerances and the precision of optical alignment during initial assembly of a WSR apparatus of the present invention, and further enabling the system to correct for shift in the alignment over the course of operation. By maintaining an optimal optical alignment, the optical losses incurred by the spectral channels are also significantly reduced. As such, the WSR-S apparatus thus constructed is simpler and more adaptable in structure, more robust in performance, and lower in cost and optical loss. Accordingly, the WSR-S (or WSR) apparatus of the present invention may be used to construct a variety of optical devices and utilized in many applications. For instance, by directing the spectral channels into the output ports in a one-channel-per-port fashion and coupling the output ports of a WSR-S (or WSR) apparatus to an array of optical sensors (e.g., photodiodes), or a single optical sensor that is capable of scanning across the output ports, a dynamic and versatile spectral power monitor (or channel analyzer) is provided, which would be highly desired in WDM optical networking applications. Moreover, a novel class of optical add-drop multiplexers (OADMs) may be built upon the WSR-S (or WSR) apparatus of the present invention, as exemplified in the following	

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	embodiments." 10:62-12:40 FIGs 3, 4A, 4B, 5, 6. The Abstract. Claims 1, 3, 4, 15-17 of the '368 patent. Claims 1-4, 21-33, 37-39, 44-46, 61-67 of the '678 patent. '368 Reissue Prosecution, Claims, Amendments, Applicant Comments and Notice of Allowance '678 Reissue Prosecution, Claims, Amendments, Applicant Comments and Notice of Allowance Extrinsic Evidence US Patent Application No. 13/532,735 (the '735 application), filed Jun. 25, 2012, titled Optical Wavelength Selective Switch Calibration System, assigned to Finisar Corporation, which refers to PCT Application Publication WO 02/075410, which is assigned to Capella and claims priority to, inter alia, US Patent Nos. 6,625,346 and 6,687,431, in the background of the invention section and describes WO 02/075410 as disclosing "MEMS based WSS devices" that include "a 2-dimensional array of individually tiltable mirrors. Each mirror operates on the local optical wavefront to selectively steer and manipulate optical signals incident	

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	thereon." Plaintiff reserves the right to comment on and to rebut any and all extrinsic evidence used by Defendants to support their proposed construction.	
GENERALLY APPLICABLE EVIDENCE	Intrinsic Evidence ABSTRACT This invention provides a novel wavelength-separating-routing (WSR) apparatus that uses a diffraction grating to separate a multi-wavelength optical signal by wavelength into multiple spectral channels, which are then focused onto an array of corresponding channel micromirrors. The channel micromirrors are individually controllable and continuously pivotable to reflect the spectral channels into selected output ports. As such, the inventive WSR apparatus is capable of routing the spectral channels on a channel-by-channel basis and coupling any spectral channel into any one of the output ports. The WSR apparatus of the present invention may be further equipped with servo-control and spectral power-management capabilities, thereby maintaining the coupling efficiencies of the spectral channels into the output ports at desired values. The WSR apparatus of the present invention can be used to construct a novel class of dynamically reconfigurable optical add-drop multiplexers (OADMs) for WDM optical networking	

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	applications. '368 Patent Abstract. '368 Patent Figures 1A-6. "U.S. Pat. No. 5,906,133 to Tomlinson discloses an OADM that makes use of a design similar to that of Aksyuk et al. There are input, output, drop and add ports implemented in this case. By positioning the four ports in a specific arrangement, each micromirror, notwithstanding switchable between two discrete positions, either reflects its corresponding channel (coming from the input port) to the output port, or concomitantly reflects its channel to the drop port and an incident add channel to the output port. As such, this OADM is able to perform both the add and drop functions without involving additional optical components (such as optical circulators used in the system of Aksyuk et al.). However, because a single drop port is designated for all the drop channels and a 10 single add port is designated for all the add channels, the add channels would have to be multiplexed before entering the add port and the drop channels likewise need to be demutiplexed upon exiting from the drop port. Moreover, as in the case of Askyuk et al., there are no provisions provided for 15 maintaining requisite optical alignment in the system, and no mechanisms implemented for combating degradation in the alignment due to environmental effects over the course of operation. As such, the prevailing drawbacks suffered by the OADMs 20 currently in the art are summarized as follows:	

Claim Term	**Plaintiff's Proposed Construction and Evidence**	**Defendants' Proposed Construction and Evidence**
	1) The wavelength routing is intrinsically static, rendering it difficult to dynamically reconfigure these OADMs. 2) Add and/or drop channels often need to be multiplexed and/or demultiplexed, thereby imposing additional complexity and cost. 3) Stringent fabrication tolerance and painstaking optical alignment are required. Moreover, the optical alignment is not actively maintained, rendering it susceptible to environmental effects such as thermal and mechanical distur-bances over the course of operation. 4) In an optical communication network, OADMs are typically in a ring or cascaded configuration. In order to mitigate the interference amongst OADMs, which often adversely affects the overall performance of the network, it is essential that the power levels of spectral channels entering and exiting each OADM be managed in a systematic way, for instance, by introducing power (or gain) equalization at each stage. Such a power equalization capability is also needed for compensating for non-uniform gain caused by optical amplifiers (e.g., erbium doped fiber amplifiers) in the network. There lacks, however, a systematic and dynamic management of the power levels of various spectral channels in these OADMs. 5) The inherent high cost and heavy optical loss further 45 impede the wide application of these OADMs. '368 Patent Col. 2:65 – Col. 3:51.	

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	"SUMMARY … The channel micromirrors are individually controllable and movable, e.g.,continuously pivotable (or rotatable), so as to reflect the spectral channels into selected ones of the output ports. As such, each channel micromirror is assigned to a specific spectral channel, hence the name "channel micromirror". And each output port may receive any number of the reflected spectral channels. A distinct feature of the channel micromirrors in the present invention, in contrast to those used in the prior art, is that the motion, e.g., pivoting (or rotation), of each channel micromirror is under analog control such that its pivoting angle can be continuously adjusted. This enables each channel micromirror to scan its corresponding spectral channel across all possible output ports and thereby direct the spectral channel to any desired output port. In the WSR apparatus of the present invention, the … channel micromirrors may be provided by silicon micromachined mirrors, reflective ribbons (or membranes), or other types of beam –deflecting means known in the art. And each channel micromirror may be pivotable about one or two axes. The fiber collimators serving as the input and output ports may be arranged in a one-dimensional or two-dimensional array. In the latter case, the channel micromirrors must be pivotable	

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	biaxially." '368 Patent Col. 3:52 – Col. 3:29. "The WSR apparatus of the present invention may further include a servo-control assembly, in communication with the channel micromirrors and the output ports. The servo-control assembly serves to monitor the power levels of the spectral channels coupled into the output ports and further provide control of the channel micro mirrors on an individual basis, so as to maintain a predetermined coupling efficiency of each spectral channel in one of the output ports. As such, the servo-control assembly provides dynamic control of the coupling of the spectral channels into the respective output ports and actively manages the power levels of the spectral channels coupled into the output ports. (If the WSR apparatus includes an array of collimator-alignment mirrors as described above, the servo-control assembly may additionally provide dynamic control of the collimator-alignment mirrors.) Moreover, the utilization of such a servo-control assembly effectively relaxes the requisite fabrication tolerances and the precision of optical alignment during assembly of a WSR apparatus of the present invention, and further enables the system to correct for shift in optical alignment over the course of operation. A WSR apparatus incorporating a servo-control assembly thus described is termed a WSR-S apparatus, thereinafter in the present invention." '368 Patent Col. 4:45-67. "Those skilled in the art will recognize that the aforementioned embodiments provide only two of many embodiments of a dynamically reconfigurable OADM according to the present invention. Various changes, substitutions, and alternations can be made herein,	

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	without departing from the principles and the scope of the invention. Accordingly, a skilled artisan can design an OADM in accordance with the present invention, to best suit a given application." '368 Patent Col. 5:40-48. "All in all, the OADMs of the present invention provide many advantages over the prior art devices, notably: 1) By advantageously employing an array of channel micromirrors that are individually and continuously controllable, an OADM of the present invention is capable of routing the spectral channels on a charmel-by-channel basis and directing any spectral charmel into any one of the output ports. As such, its underlying operation is dynamically reconfigurable, and its underlying architecture is intrinsically scalable to a large number of channel connts. 2) The add and drop spectral channels need not be multiplexed and demultiplexed before entering and after leaving the OADM respectively. And there are not fundamental restrictions on the wavelengths to be added or dropped. 3) The coupling of the spectral channels into the output ports is dynamically controlled by a servo-control assembly, rendering the OADM less susceptible to environmental effects (such as thermal and mechanical disturbances) and therefore more robust in performance. By maintaining an optimal optical alignment, the optical losses incurred by the spectral channels are also significantly reduced.	

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	4) The power levels of the spectral charmels coupled into the output ports can be dynamically managed according to demand, or maintained at desired values (e.g., equalized at a predetermined value) by way of the servo-control assembly. This spectral power-management capability as an integral part of the OADM will be particularly desirable in WDM optical networking applications. 5) The use of free-space optics provides a simple, low loss, and cost-effective construction. Moreover, the utilization of the servo-control assembly effectively relaxes the requisite fabrication tolerances and the precision of optical alignment during initial assembly, enabling the OADM to be simpler and more adaptable in structure, lower in cost and optical loss. … The novel features of this invention, as well as the invention itself, will be best understood from the following drawings and detailed description." '368 Patent Col. 5:49 – Col. 6:24. "The channel micromirrors 103 are positioned in accordance with the spatial array formed by the spectral spots, such that each channel micromirror receives one of the spectral channels. The channel micromirrors 103 are individually controllable and movable, e.g., pivotable (or rotatable) under analog (or continuous) control, such that, upon reflection, the spectral channels are directed into selected ones of the output ports 110-2	

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	through 110-N by way of the focusing lens 102 and the 10 diffraction grating 101. As such, each channel micro mirror is assigned to a specific spectral channel, hence the name "channel micromirror"." '368 Patent Col. 7:02 –:14. "Depicted in FIG. 1B is a close-up view of the channel micromirrors 103 shown in the embodiment of FIG. 1A. By way of example, the channel micromirrors 103 are arranged in a one-dimensional array along the x-axis (i.e., the horizontal direction in the figure), so as to receive the focused spots of the spatially separated spectral channels in a one-to-one correspondence. (As in the case of FIG. 1A, only three spectral channels are illustrated, each represented by a converging beam.) Let the reflective surface of each channel micromirror lie in the x-y plane as defined in the figure and be movable, e.g., pivotable (or deflectable) about the x-axis in an analog (or continuous) manner. Each spectral channel, upon reflection, is deflected in they-direction (e.g., downward) relative to its incident direction, so to be directed into one of the output ports 110-2 through 110-N shown in FIG. 1A. As described above, a unique feature of the present invention is that the motion of each channel micromirror is individually and continuously controllable, such that its position, e.g., pivoting angle, can be continuously adjusted. This enables each channel micromirror to scan its corresponding spectral channel across all possible output ports and thereby direct the spectral channel to any desired output port. To illustrate this capability, FIG. 1C shows a plot of coupling	

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	efficiency as a function of a channel micromirror's pivoting angle 8, provided by a ray-tracing model of a WSR apparatus in the embodiment of FIG. lA. As used herein, the coupling efficiency for a spectral channel is defined as the ratio of the amount of optical power coupled into the fiber core in an output port to the total amount of optical power incident upon the entrance surface of the fiber (associated with the fiber collimator serving as the output port). In the ray-tracing model, the input optical signal is incident upon a diffraction grating with 700 lines per millimeter at a grazing angle of 85 degrees, where the grating is blazed to optimize the diffraction efficiency for the "-1" order. The focusing lens has a focal length of 100 mm. Each output port is provided by a quarter-pitch GRIN lens (2 mm in diameter) coupled to an optical fiber (see FIG. lD). As displayed in FIG. lC, the coupling efficiency varies with the pivoting angle 8, and it requires about a 0.2-degree change in 8 for the coupling efficiency to become practically negligible in this exemplary case. As such, each spectral channel may practically acquire any coupling efficiency value by way of controlling the pivoting angle of its corresponding channel micromirror. This is also to say that variable optical attenuation at the granularity of a single wavelength can be obtained in a WSR apparatus of the present invention. FIG. lD provides ray-tracing illustrations of two extreme points on the coupling efficiency vs. 8 curve of FIG. lC: on-axis coupling corresponding to 8=0, where the coupling efficiency is maximum; and off-axis coupling corresponding to 8=0.2 degrees, where the representative collimated beam (representing an exemplary spectral channel) undergoes a significant translational walk-off and renders the coupling	

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	efficiency practically negligible. All in all, the exemplary modeling results thus described demonstrate the unique capabilities of the WSR apparatus of the present invention." '368 Patent Col. 8: 6-63. "The channel micromirrors may be provided by silicon micromachined mirrors, reflective ribbons (or membranes), or other types of beam deflecting elements known in the art. And each micromirror may be pivoted about one or two axes. What is important is that the pivoting (or rotational) motion of each channel micromirror be individually controllable in an analog manner, whereby the pivoting angle can be continuously adjusted so as to enable the channel micromirror to scan a spectral channel across all possible output ports. The underlying fabrication techniques for micromachined mirrors and associated actuation mechanisms are well documented in the art, see U.S. Pat. No. 5,629,790 for example." '368 Patent Col. 9:6-18. "FIG. 3 shows a fourth embodiment of a WSR apparatus according to the present invention. By way of example, WSR apparatus 300 is built upon and hence shares a number of the elements used in the embodiment ofFIG. 2B, as identified by those labeled with identical numerals. In this case, the onedimensional fiber collimator array 110 of FIG. 2B is replaced by a two-dimensional array 350 of fiber collimators, providing for an input-port and a plurality of output ports. Accordingly, the one-dimensional collimator-alignment mirror array 220 ofFIG. 2B is replaced by a two-dimensional array 320 of collimator-alignment mirrors, and first and second one-dimensional arrays 260,270 of imaging lenses of FIG. 2B are	

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	likewise replaced by first and second two-dimensional arrays 360, 370 of imagining lenses respectively. As in the case of the embodiment of FIG. 2B, the first and second two-dimensional arrays 360, 370 of imaging lenses are placed in a 4-f telecentric arrangement with respect to the two-dimensional collimator-alignment mirror array 320 and the two-dimensional fiber collimator array 350. The channel micromirrors 103 must be pivotable biaxially in this case (in order to direct 45 its corresponding spectral channel to any one of the output ports). As such, the WSR apparatus 300 is equipped to support a greater number of the output ports." '368 Patent Col. 10:25-48. "In addition to facilitating the coupling of the spectral channels into the respective output ports as described above, the 50 collimator-alignment mirrors in the above embodiments also serve to compensate for misalignment (e. g., due to fabrication and assembly errors) in the fiber collimators that provide for the input and output ports. For instance, relative misalignment between the fiber cores and their respective collimating lenses in the fiber collimators can lead to pointing errors in the collimated beams, which may be corrected for by the collimator-alignment mirrors. For these reasons, the collimatoralignment mirrors are preferably rotatable about two axes. They may be silicon micromachined mirrors, for fast rotational speeds. They may also be other types of mirrors or beam-deflecting elements known in the art." '368 Patent Col. 10:48-61. "To optimize the coupling of the spectral channels into the output ports and further maintain the optimal optical alignment against environmental effects such as	

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	temperature 65 variations and mechanical instabilities over the course of operation, a WSR apparatus of the present invention may incorporate a servo-control assembly, for providing dynamic control of the coupling of the spectral channels into the respective output ports on a channel-by-channel basis. A WSR apparatus incorporating a servo-control assembly is termed a WSR -S apparatus, thereinafter in this specification." '368 Patent 10:62-11:03 "FIG. 4A depicts a schematic illustration of a first embodiment of a WSR-S apparatus according to the present invention. The WSR-S apparatus 400 comprises a WSR apparatus 410 and a servo-control assembly 440. The WSR 410 may be in the embodiment of FIG. 1A, or any other embodiment in accordance with the present invention. The servo-control assembly 440 includes a spectral monitor 460, for monitoring the power levels of the spectral channels coupled into the output ports 420-1 through 420-N of the WSR apparatus 410. By way of example, the spectral monitor 460 is coupled to the output ports 420-1 through 420-N by way of fiber-optic couplers 420-1-C through 420-N-C, wherein each fiber-optic coupler serves to tap off a predetermined fraction of the optical signal in the corresponding output port. The servocontrol assembly 440 further includes a processing unit 470, in communication with the spectral monitor 460 and the channel micromirrors 430 of the WSR apparatus 410. The processing unit 470 uses the power measurements from the spectral monitor 460 to provide feedback control of the channel micromirrors 430 on an individual basis, so as to maintain a desired coupling efficiency for each spectral channel into a selected output port. As such, the servo-control	

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	assembly 440 provides dynamic control of the coupling of the spectral channels into the respective output ports on a channel-bychannel basis and thereby manages the power levels of the spectral channels coupled into the output ports. The power levels of the spectral channels in the output ports may be dynamically managed according to demand, or maintained at desired values (e.g., equalized at a predetermined value) in the present invention. Such a spectral power-management capability is essential in WDM optical networking applications, as discussed above." '368 Patent Col. 11:5-36. "FIG. 4B depicts a schematic illustration of a second embodiment of a WSR -S apparatus ccording to the present invention. The WSR -S apparatus 450 comprises a WSR apparatus 480 and a servo-control assembly 490. In addition to the 40 channel micromirrors 430 (and other elements identified by the same numerals as those used in FIG. 4A), the WSR apparatus 480 further includes a plurality of collimator-alignment mirrors 485, and may be configured according to the embodiment of FIGS. 2A, 2B, 3, or any other embodiment in accordance with the present invention. By way of example, the servo-control assembly 490 includes the spectral monitor 460 as described in the embodiment of FIG. 4A, and a processing unit 495. In this case, the processing unit 495 is in communication with the channel micromirrors 430 and the collimator-alignment mirrors 485 of the WSR apparatus 480, as well as the spectral monitor 460. The processing unit 495 uses the power measurements from the spectral monitor 460 to provide dynamic control of the channel micromirrors 430 along with the collimator-alignment mirrors 485, so	

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	to maintain the coupling efficiencies of the spectral channels into the output ports at desired values." '368 Patent Col. 11:36-57. "In the embodiment of FIG. 4A or 4B, the spectral monitor 460 may be one of spectral power monitoring devices known in the art that is capable of detecting the power levels of spectral components in a multi-wavelength optical signal. Such devices are typically in the form of a wavelength-separating means (e. g., a diffraction grating) that spatially separates a multi-wavelength optical signal by wavelength into constituent spectral components, and one or more optical sensors (e.g., an array of photodiodes) that are configured such to detect the power levels of these spectral components. The processing unit 470 in FIG. 4A (or the processing unit 495 in FIG. 4B) typically includes electrical circuits and signal processing programs for processing the power measurements received from the spectral monitor 460 and generating appropriate control signals to be applied to the channel micromirrors 430 (and the collimator-alignment mirrors 485 in the case of FIG. 4B), so to maintain the coupling efficiencies of the spectral channels into the output ports at desired values. The electronic circuitry and the associated signal processing algorithm/software for such processing unit in a servo-control system are known in the art. A skilled artisan will know how to implement a suitable spectral monitor along with an appropriate processing unit to provide a servo-control assembly in a WSP-S apparatus according to the present invention, for a given application." '368 patent Col. 11: 57 - Col. 12:15	

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	"The incorporation of a servo-control assembly provides additional advantages of effectively relaxing the requisite fabrication tolerances and the precision of optical alignment during initial assembly of a WSR apparatus of the present 20 invention, and further enabling the system to correct for shift in the alignment over the course of operation. By maintaining an optimal optical alignment, the optical losses incurred by the spectral channels are also significantly reduced. … For instance, by directing the spectral channels into the 30 output ports in a one-channel-per-port fashion and coupling the output ports of a WSR-S (or WSR) apparatus to an array of optical sensors (e.g., photodiodes), or a single optical sensor that is capable of scanning across the output ports, a dynamic and versatile spectral power monitor (or channel 35 analyzer) is provided, which would be highly desired in WDM optical networking applications." '368 patent Col. 12:16-40. "FIG. 5 depicts an exemplary embodiment of an opticaladd-drop multiplexer (OADM) according to the present invention. … In the above embodiment, the optical combiner 550 may be 60 a Kxl (K~2) broadband fiber-optic coupler, wherein there are K input-ends and one output-end. The pass-through spectral channels and the add spectral channels are fed into the K input-ends (e.g., in a one-to-one correspondence) and the combined optical signal exits from the output-end of the Kxl 65 fiber-optic coupler as the output multi-wavelength optical signal of the system. Such a multiple-input coupler also serves the purpose of multiplexing a multiplicity of add spectral channels to be coupled into	

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	the OADM 500. If the power levels of the spectral channels in the output multi-wavelength optical signal are desired to be actively managed, such as being equalized at a predetermined value, two spectral monitors may be utilized. As a way of example, the first spectral monitor may receive optical signals tapped off from the passthrough port 530 and the drop ports 540-1 through 540-N (e.g., by way of fiber-optic couplers as depicted in FIG. 4A or 4B). The second spectral monitor receives optical signals tapped off from the exiting port 570. A servo-control system may be constructed accordingly for monitoring and controlling the pass-through, drop and add spectral channels. As such, the embodiment of FIG. 5 provides a versatile optical add-drop multiplexer in a simple and low-cost assembly, while providing multiple physically separate drop/add ports in a dynamically reconfigurable fashion." '368 patent Col. 12:59-Col. 13:17. "Those skilled in the art will recognize that the aforementioned embodiments provide only two of many embodiments 55 of a dynamically reconfigurable OADM according to the present invention. Those skilled in the art will also appreciate that various changes, substitutions, and alternations can be made herein without departing from the principles and the scope of the invention as defined in the appended claims. 60 Accordingly, a skilled artisan can design an OADM in accordance with the principles of the present invention, to best suit a given application." '368 Patent Col. 13:54-63 "Although the present invention and its advantages have been described in detail, it should be understood	

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	that various 65 changes, substitutions, and alternations can be made herein without departing from the principles and the scope of the invention. Accordingly, the scope of the present invention should be determined by the following claims and their legal equivalents." '368 Patent Col. 13:64-Col. 14:03. All Claims of both asserted patents.	