

Optical switch port density for major Metropolitan areas

# SWITCHING THE Lightwave

**OXC's - The Centerpiece  
of all Optical Network**

**UPDATE - 2001**

MARKETED BY:

PREPARED BY:



**INFORMATION GATEKEEPERS INC.**

214 Harvard Ave. Boston MA 02134 USA  
Toll Free: 800-323-1088, Tel: 617-232-3111  
Fax: 617-348-5662, E-Mail: info@iggroup.com  
Visit Our Web Pages <http://www.iggroup.com>

**B&C Consulting Services**

[c.holliday@ieee.org](mailto:c.holliday@ieee.org)

**[www.iggroup.com](http://www.iggroup.com)**

Copyrighted material

## Table of Contents

<b>TABLE OF CONTENTS</b> .....	2
<b>TABLE OF FIGURES</b> .....	7
<b>SUMMARY OF CONCEPTS</b> .....	9
<b>UPDATE INTRODUCTION</b> .....	12
<b>INTRODUCTION</b> .....	12
<b>WE HAD A BOTTLENECK; NOW WE HAVE GRIDLOCK</b> .....	12
<b>WHAT ARE OXCS?</b> .....	14
<b>UPDATE STATEMENT</b> .....	14
<b>WHEN IS A SWITCH REALLY A SWITCH?</b> .....	14
<i>"Switch" Types</i> .....	14
<b>Routers</b> .....	14
<b>TDM Switches</b> .....	15
<b>ATM</b> .....	15
<b>IP Switches</b> .....	16
<b>DACS</b> .....	16
<i>OXCs – The Centerpiece of the All-Optical Network</i> .....	16
<b>Drivers to DACS Deployment</b> .....	16
<b>The Parallel Universe of OXCs</b> .....	17
<b>General Features of an OXC</b> .....	18
<b>TECHNOLOGIES</b> .....	19
<b>UPDATE STATEMENT</b> .....	19
<b>UNDERLYING TECHNOLOGIES</b> .....	19
<b>REVIEW OF BASIC TECHNOLOGIES</b> .....	19
<i>OEO</i> .....	19
<b>OEO Vendors</b> .....	20
<b>MEMS</b> .....	20
<i>Two Approaches to MEMS</i> .....	20
<b>Digital Approach</b> .....	20
<b>Analog Approach</b> .....	21
<i>MEMS Developers and Vendors</i> .....	22
<b>ADC</b> .....	22
<b>Agere Systems</b> .....	22
<b>Astarte Fiber Networks</b> .....	23
<b>C Speed Corp.</b> .....	23
<b>Calient Networks</b> .....	23

Corning .....	24
CoreTek (Nortel) .....	24
Cronos (JDS Uniphase) .....	25
IntelliSense Corp. (Corning) .....	25
Lucent .....	26
Nanovation .....	26
Onix Microsystems, Inc. ....	27
Optical Micro Machines (OMM) .....	28
Texas Instruments .....	28
Xros (Nortel) .....	29
<b>LCD</b> .....	<b>29</b>
<i>LCD Developers and Vendors</i> .....	<i>30</i>
Corning .....	30
Chorum .....	30
SpectraSwitch .....	31
<b>Bubbles (Inkjet) – Planer Lightwave Circuits</b> .....	<b>31</b>
<i>PLC Developers and Vendors</i> .....	<i>32</i>
Agilent .....	32
Lightwave Microsystems .....	33
Kymata, Ltd.(Alcatel) .....	33
<i>OMO</i> .....	<i>34</i>
<i>1 D Technology</i> .....	<i>35</i>
<b>SUMMARY OF CHARACTERISTICS OF EACH TECHNOLOGY</b> .....	<b>35</b>
<b>BASIC NEEDS OF TECHNOLOGY FOR OXCS</b> .....	<b>36</b>
<i>Comparison of Transparent and Opaque Switches</i> .....	<i>36</i>
<i>Examples of Applications of Transparent and Opaque OXCs</i> .....	<i>37</i>
<b>INSERTION LOSS PROBLEMS OF TRANSPARENT SWITCHES</b> .....	<b>38</b>
<b>STRUCTURE OF OXCS</b> .....	<b>40</b>
<i>Importance of Clos Networks</i> .....	<i>40</i>
<b>CLASSES OF OXCS</b> .....	<b>41</b>
<i>FXC</i> .....	<i>42</i>
<i>WSXC</i> .....	<i>42</i>
<i>WIXC</i> .....	<i>43</i>
<i>Summary of Features by Class</i> .....	<i>44</i>
<i>Importance of Tunable Lasers</i> .....	<i>45</i>
Developers and Vendors of Tunable Lasers .....	46
Tunable Lasers Vendors List .....	47
ADC .....	47
Altitun AB .....	47
Alcatel .....	48

Bandwidth9 .....	48
Corning .....	48
Hewlett-Packard .....	49
JDS Uniphase .....	49
Marconi .....	49
New Focus, Inc. ....	50
Nortel .....	50
Novalux .....	50
<b>APPLICATIONS .....</b>	<b>51</b>
UPGRADE STATEMENT .....	51
OPTICAL SWITCHES AS CROSS-CONNECTS .....	51
<i>Implementing Cross Connects with Different Class Transparent Switches</i> .....	52
FXC .....	52
WSXC .....	53
WICX .....	54
<i>Implementing Cross-Connects with Opaque OXC's</i> .....	54
GROOMING .....	55
CIRCUIT ROUTING .....	55
<i>The OXC as an Offensive Device</i> .....	56
<i>Example of Using OXC's to Expand Business Horizons</i> .....	56
CIRCUIT RESTORAL .....	57
<i>Substituting for Expensive Router Ports</i> .....	58
JOINING RINGS .....	59
<i>How Are the Rings Interconnected?</i> .....	59
Bridges .....	61
Baseband .....	61
Traffic Engineered .....	61
Electronic Cross-Connect Systems .....	61
Terabit Routers as Ring Connectors .....	61
OXCs as Ring Connectors .....	63
<b>MARKET DRIVERS .....</b>	<b>64</b>
INTERNET GROWTH .....	64
<i>Other Internet Traffic Sources</i> .....	66
VoIP – Voice over IP .....	66
B2B – Business-to-Business Traffic .....	67
Offshore IP Growth .....	68
<i>Summary of Other Internet Traffic Sources</i> .....	68
OTHER DRIVERS .....	68
GROWTH IN 'JUNCTION POINTS' .....	70
<b>MARKET PROJECTIONS .....</b>	<b>72</b>

<b>UPDATE STATEMENT .....</b>	<b>72</b>
<b>CURRENT INDUSTRY PROJECTIONS .....</b>	<b>72</b>
<b>MODEL BASED PROJECTIONS .....</b>	<b>72</b>
<i>Forecasting Local OXC Market Using Metro Model .....</i>	<i>73</i>
<b>Example of Model Use .....</b>	<b>73</b>
<b>Results from Use of Local Model .....</b>	<b>75</b>
<b>Determining Local Market Forecast from Potential .....</b>	<b>76</b>
<i>Local Market Forecast for OXCs .....</i>	<i>77</i>
<i>Forecasting IXC Market for OXCs .....</i>	<i>78</i>
<b>Determining the Wavelengths per Junction Point .....</b>	<b>78</b>
<b>Determining Number of Junction Points .....</b>	<b>79</b>
<b>Developing IXC Market Potential .....</b>	<b>79</b>
<i>IXC Market Forecast for OXCs .....</i>	<i>79</i>
<i>Total Market Forecast for OXCs .....</i>	<i>80</i>
<i>Detailed Forecasts of OXCs from the Models .....</i>	<i>81</i>
<b>Total Number of OXCs .....</b>	<b>81</b>
<b>Forecasts by Types of OXCs .....</b>	<b>82</b>
<b>Forecast of OXCs by Application .....</b>	<b>83</b>
<b>UPDATED FORECASTS .....</b>	<b>83</b>
<i>Step One, Downturn Impact .....</i>	<i>83</i>
<i>Step Two, 9-11 Impacts .....</i>	<i>84</i>
<i>Step Three, Resulting New Forecasts .....</i>	<i>86</i>
<b>Comparison of Local vs. IXC Applications .....</b>	<b>87</b>
<b>Comparison of Large vs. Small Switches .....</b>	<b>87</b>
<b>Comparison of OEO vs. OO Market .....</b>	<b>89</b>
<b>PRICING FORECASTS .....</b>	<b>91</b>
<b>UPDATE STATEMENT .....</b>	<b>91</b>
<b>FORECAST FOR SMALL (32 PORTS AND LESS) SWITCHES .....</b>	<b>91</b>
<b>FORECAST FOR LARGE (ABOVE 32 PORTS) SWITCHES .....</b>	<b>92</b>
<b>VENDOR PROFILES .....</b>	<b>93</b>
<b>STATEMENT OF UPDATE .....</b>	<b>93</b>
<b>SUMMARY OF VENDORS .....</b>	<b>93</b>
<b>ADC .....</b>	<b>95</b>
<b>Alcatel .....</b>	<b>95</b>
<b>Altamar Networks .....</b>	<b>96</b>
<b>Agilent Technologies (HP) .....</b>	<b>96</b>
<b>BrightLink Networks (Corvia) .....</b>	<b>97</b>
<b>C Speed Corp. ....</b>	<b>98</b>
<b>Callient Networks .....</b>	<b>99</b>
<b>Chiaro Networks .....</b>	<b>100</b>

# Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

## Real-Time Litigation Alerts



Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

## Advanced Docket Research



With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

## Analytics At Your Fingertips



Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

## API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

## LAW FIRMS

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

## FINANCIAL INSTITUTIONS

Litigation and bankruptcy checks for companies and debtors.

## E-DISCOVERY AND LEGAL VENDORS

Sync your system to PACER to automate legal marketing.