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(54) SYSTEM AND METHOD FOR ESTABLISHING AND/OR MAINTAINING A DATA SESSION ACROSS PACKET DATA NETWORKS

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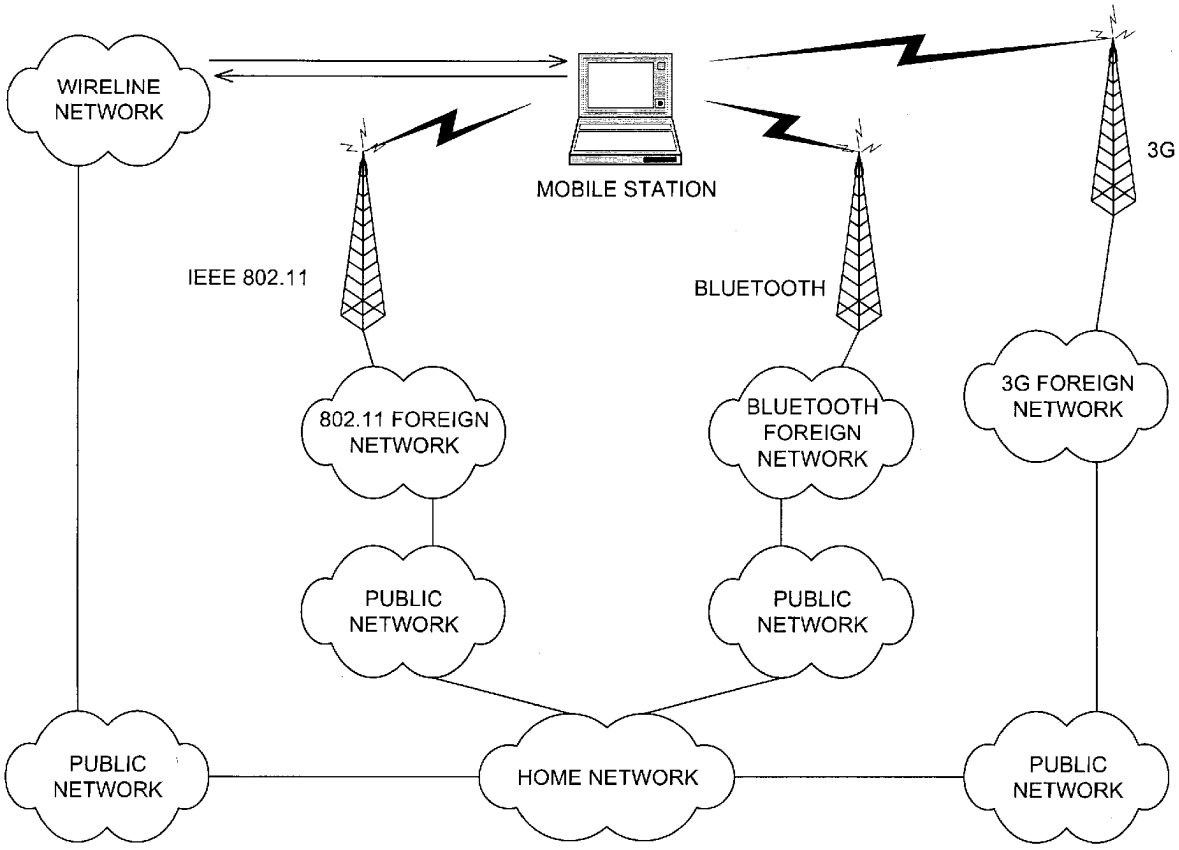
(57) **ABSTRACT**

A communication system selection algorithm (SSA) implemented by a mobile station chooses between available systems to select a system to serve the mobile station. During initialization, the SSA causes the mobile station to scan the environment and compare available communication systems to determine the best system to provide service. After an initial system is chosen, the SSA causes the mobile station to continuously, or at discrete time intervals, scan the environment for available systems, thus allowing for a seamless switch to an available system whenever a handoff is desired. The SSA chooses the best available system based on measurements of each available system and applying preference rules defined by a service provider and/or user of the mobile station.



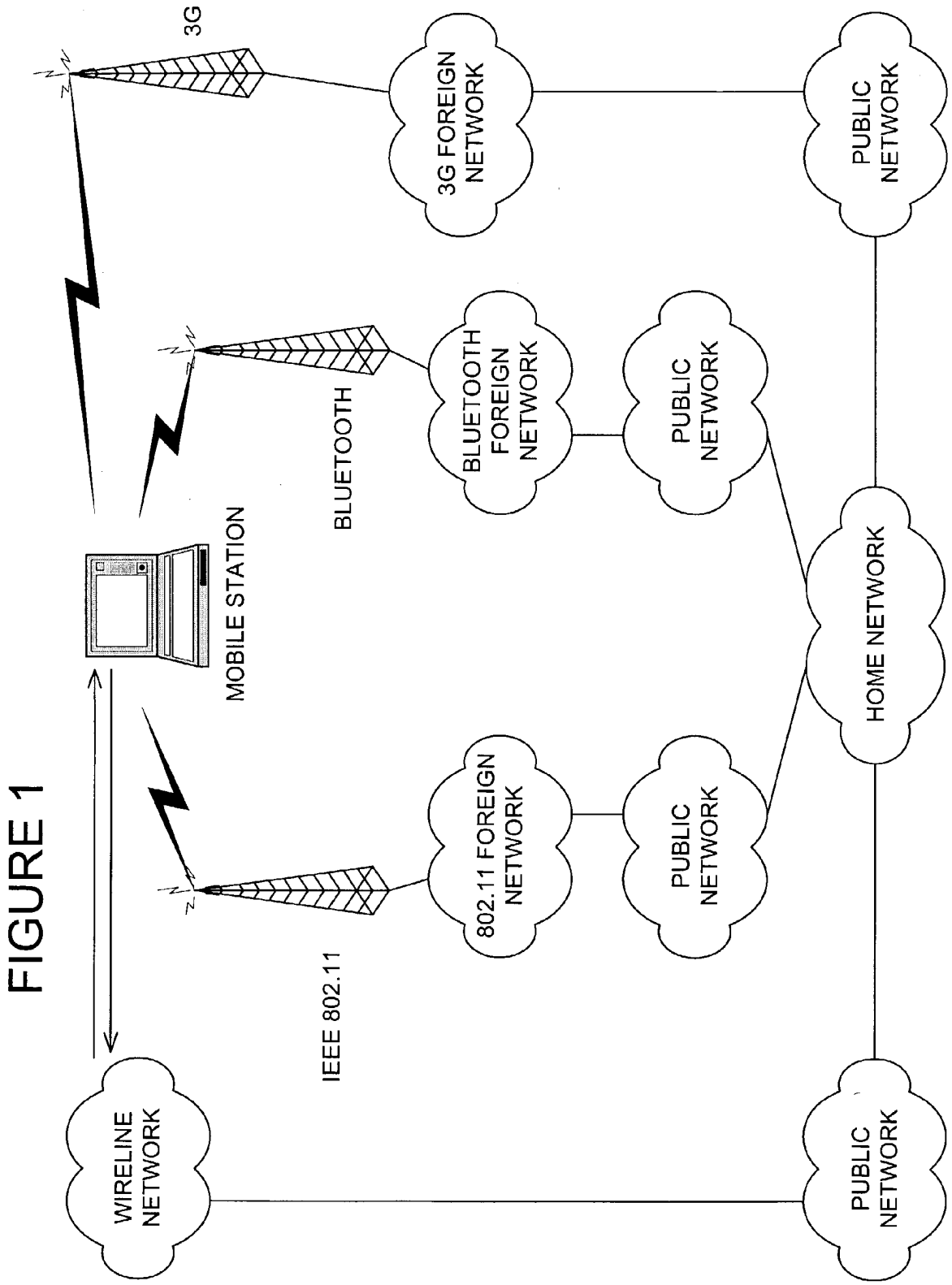
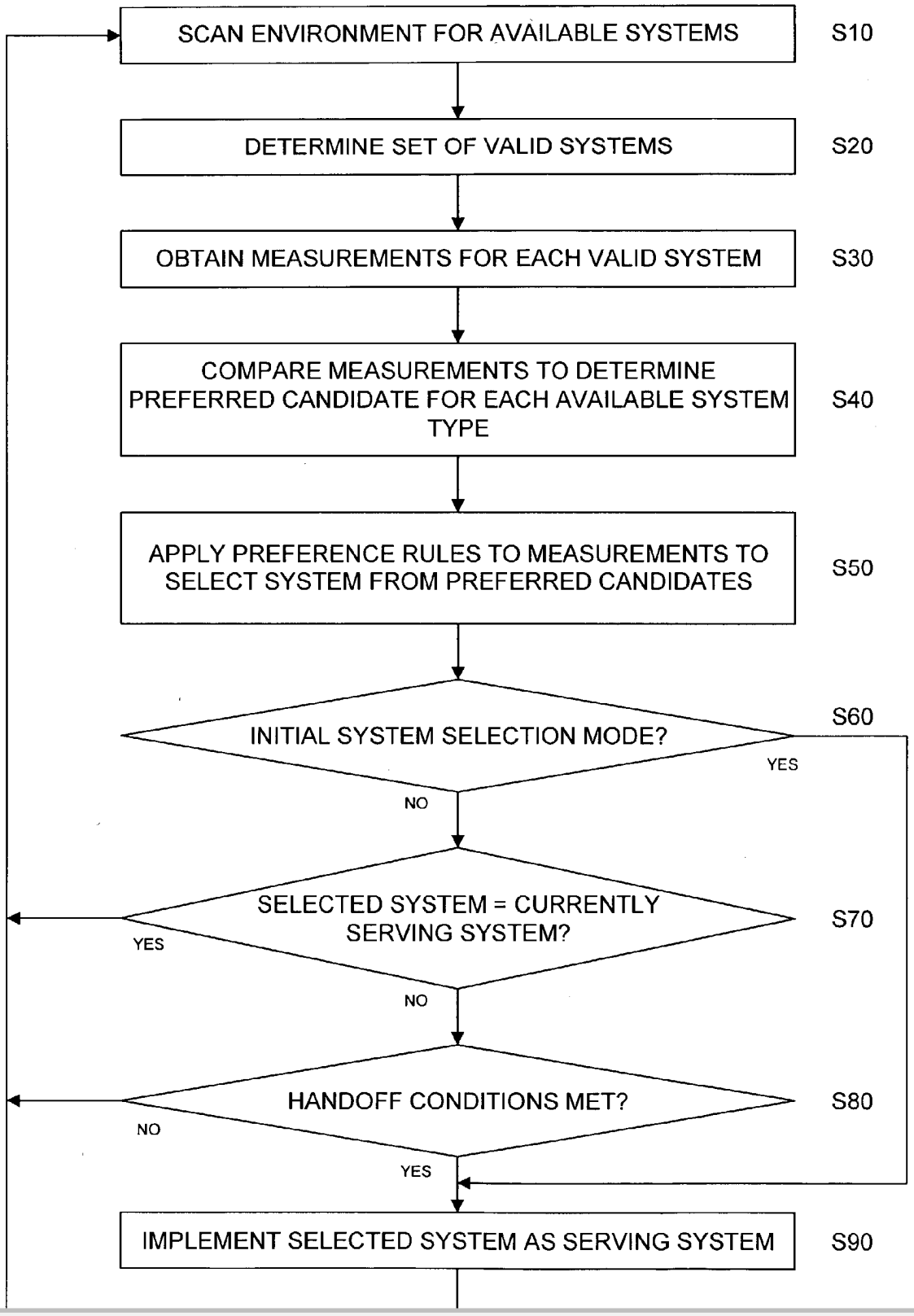


FIGURE 1

FIGURE 2



SYSTEM AND METHOD FOR ESTABLISHING AND/OR MAINTAINING A DATA SESSION ACROSS PACKET DATA NETWORKS

BACKGROUND OF THE INVENTION

[0001] The present invention relates to wireless and wireline communications networks and, more particularly, to a method for a mobile client to choose amongst wireless and wireline service providers.

DESCRIPTION OF THE RELATED ART

[0002] Currently, a subscriber using a mobile station, such as that shown in **FIG. 1**, can connect to a wireless or wireline communication network in order to conduct a data session, e.g., an Internet session. For example, mobile stations such as personal digital assistants (PDAs) or laptop computers may be used to conduct a data session.

[0003] The Mobile IP standard currently provides seamless mobility in the IP layer by maintaining the same IP address across different systems. However, Mobile IP does not proactively seek another communication system until the current system cannot maintain a connection.

SUMMARY OF THE INVENTION

[0004] The present invention provides a system selection algorithm (SSA), which is run on the mobile client of a mobile station, to choose between available communication systems during initialization of the mobile station, or to seamlessly switch between systems while a data session is being conducted on the mobile station. The SSA continuously monitors the disparate wireless and wireline communication systems to initiate a "make before break" seamless handoff to the "best" system based on various criteria, in contrast to Mobile IP.

[0005] During initialization, the SSA causes the mobile station to scan the environment for available systems, and perform comparisons to determine the best system available for providing service. After a system is initially chosen, the mobile station continuously (or at configurable discrete intervals) scans available systems according to the SSA and performs comparisons to choose a best available system. The conditions of the currently serving system are also monitored, and the SSA initiates or assists in handoff to the chosen system whenever necessary. According to this algorithm, the mobile station may be seamlessly handed off to the best available system, regardless of whether or not the best system is disparate from the current system. The SSA compares the available systems according to measurable conditions, which are monitored for each available system. While comparing systems, the SSA applies a set of preference rules to the service provider preference rules, which are downloaded to the mobile client from the primary service provider with whom the user subscribes. These rules may also include preferences configured by the user.

[0006] By continuously determining a best available system according to the conditions and preference rules, while monitoring the conditions of the currently serving system, the mobile client is prepared to switch from the current system to another when necessary. Accordingly, the SSA of the present invention allows for the mobile station to switch session during the switch. The switch can therefore be seamless, so that the user does not realize a switch has occurred.

[0007] Other advantages of the present invention will become more apparent from the detailed description given hereafter. However, it should be understood that the detailed description and specific examples, while indicating preferred embodiments of the invention, are given by way of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art from this detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] The present invention will become more fully understood from the detailed description given below and the accompanying drawing, which is given for purposes of illustration only, and thus do not limit the present invention.

[0009] **FIG. 1** illustrates a high level architecture of a generic network in which a mobile device is capable of conducting a data session using one of multiple types of communication systems.

[0010] **FIG. 2** is a flowchart illustrating the steps performed by the system selection algorithm (SSA) according to an exemplary embodiment of the present invention.

DETAILED DESCRIPTION OF THE EXEMPLARY EMBODIMENTS

[0011] The present invention relates to a system selection procedure (SSA) that is incorporated in a mobile client. A "mobile client" is defined as application software that runs on a mobile station. A mobile station may be any data processing device with wireless and wireline communication capabilities, such as, but not limited to, laptop computer, personal digital assistant, etc. For wireless communication systems, radio frequency and baseband processing may be performed by a PCMCIA card or other RF front end circuitry. Also, a mobile station may be capable of using data services from two or more different wireless and wireline systems, either one at a time or simultaneously.

[0012] According to an exemplary embodiment, the SSA runs continuously in the mobile client, causing the mobile station to scan the environment and monitor available systems, either continuously or at discrete time intervals. The mobile station collects measurements in order to monitor the conditions of each available system. The measurements are reported to the SSA, and a set of preference rules are applied to these measurements to determine the best available system. The SSA is configured to run according to the following three modes:

[0013] 1) Initial system selection mode: during initialization of the mobile client, the SSA causes the mobile station to check the environment, scanning for available systems. The SSA then chooses one of the available system to serve the mobile station. The SSA may choose the best available system based on a comparison of monitored conditions, or a system mandated by the service provider in a downloaded set of service provider preferences, described in more detail in the Preference Management section below.

[0014] 2) Normal traffic mode: after initial service has

to initiate a handoff to a best available system (determined according to ongoing monitoring and comparison steps), when certain conditions are met.

[0015] 3) Handoff Mode: if the SSA determines that the currently serving system cannot maintain the service, based on changes in monitored conditions (e.g., channel conditions) of the serving system, the SSA initiates a handoff of the mobile station to the best available system (if the best available system is a better alternative to the current system).

[0016] Exemplary embodiments of the present invention will be described below in connection with high-speed wireline systems, Third Generation (3G) systems, wireless local area network (WLAN) systems (including both IEEE 802.11 systems and Bluetooth systems), and Bluetooth-based personal area network (PAN) systems. The term 3G system will be used to refer to different types of Third Generation systems, including cdma2000, UMTS, 3G-EVDO, 3G-EVDV, HSDPA, as well as other evolving 3G systems.

[0017] It should be noted that 3G, WLAN, and PAN systems are merely examples of the types of systems, which may be used to service the mobile station in the present invention; and the present invention is not limited to these types of wireless systems. For instance, the mobile station may be serviced by various types of cellular communication systems including, but not limited to, 3G systems and various types of wireless packet data networks including, but not limited to, 802.11-based systems. Thus, according to an exemplary embodiment, the present invention may allow for seamless switching between cellular networks and wireless packet data networks.

[0018] Overview of the SSA

[0019] **FIG. 2** is a flowchart of the steps performed by the SSA according to an exemplary embodiment of the present invention. For the purpose of explanation only, the process illustrated in **FIG. 2** will be described as being implemented in the system shown in **FIG. 1**. However, the process illustrated in **FIG. 2** is not limited to such an implementation. In step **S10**, the SSA instructs the mobile station to scan the environment to detect available systems. The systems detected by the mobile station may include systems of a type, which is different than, and disparate (i.e., not compatible) with respect to, the system currently serving the mobile station.

[0020] In step **S20**, the SSA determines which of the available systems detected in step **S10** are valid, i.e., which systems the mobile station is authorized to use. This step may involve checking each available system detected in step **S10** to a list of allowable systems in the mobile client. Accordingly, the SSA would determine a set of valid systems as including the currently serving system (which must be valid since it was already selected by the SSA), and any system detected in step **S10**, which is on the list of allowable systems.

[0021] In an exemplary embodiment, the list of allowable systems includes those systems either operated by, or having a Service Level Agreement (SLA) with, the primary service provider. An SLA is a type of agreement whereby a wireless service provider (e.g., 802.11 hot spot operator) agrees to network operator), usually in exchange for a share of the subscriber fees collected by the primary service provider.

[0022] It should be noted that even though the primary service provider permits the mobile station to roam to other systems having an SLA, the primary service provider still "owns" (controls the rights of) the roaming subscriber. Accordingly, the primary service provider sets the service provider rules for the mobile unit of the subscriber.

[0023] The SSA receives measurement reports for each valid system for the mobile station in step **S30**. Accordingly, step **S30** allows the SSA to monitor conditions, e.g., radio link conditions for each valid wireless system and the availability of high-speed wireline system. The types of measurements and conditions monitored by the SSA will be described in the section below entitled Monitoring Conditions for Available Systems.

[0024] The scanning and monitoring processes of steps **S10**-**S30** may be performed continuously while the mobile station is operating. Alternatively, the SSA may be configured to repeat steps **S10**-**S30** after a particular time duration has passed.

[0025] While steps **S10**-**S30** illustrate exemplary steps to allow the mobile station to find available systems, the present invention should not be construed as being limited to these scanning steps. Instead of relying on the mobile station to frequently scan the environment for signals from available systems, the present invention may utilize a message-based approach to notify the mobile client of other valid systems, which are available in an alternative embodiment. In this embodiment, the serving wireless system sends a message to the mobile unit identifying other valid wireless systems when they become available.

[0026] For example, in 3G systems such as cdma2000, system parameters are broadcast over the cell to mobile units. The cdma2000 system could notify mobile stations of the presence of a valid alternative system, e.g., a valid 802.11 hot spot, in the broadcast message. In another example, if the mobile station is currently being served by a 802.11 system, a broadcast message can be added to the 802.11 beacon to identify valid 3G systems available in the area.

[0027] Referring back to **FIG. 2**, in step **S40**, the SSA compares the various measurements in order to determine a preferred candidate system for each of the disparate types of networks available. The preferred candidate system represents the "best" available network for each network according to the measurements. For example, when multiple valid 3G service providers are detected in the environment, along with a set of valid 802.11 WLANs and a set of valid Bluetooth WLANs, a preferred candidate system is selected for each of the set of 3G systems, the set of 802.11 systems, and the set of Bluetooth systems.

[0028] In an exemplary embodiment, the SSA assigns a score to each available system based on the measurements, and compares these scores to determine the preferred candidate for each network type. The preference rules may include rules defining how measurements relating to different conditions (e.g., radio link, system performance, high-speed wireline availability, etc.) are scored. The scoring will

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