



Agilent Technologies

**Meeting the Challenges of
Deploying and Maintaining new
cdma2000/IS-2000 Networks**

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presented by:

Steve Urvik

Using Powerful Protocol Analysis Tools to Improve Installation and Maintenance



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The Internet and Mobile Wireless are defining technologies of our times. Today they are converging and promising to dramatically reshape society.

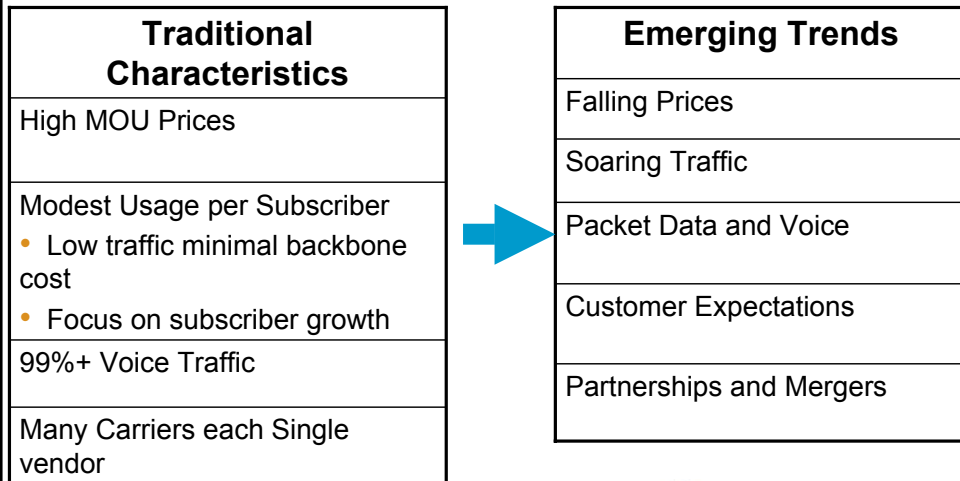
Whether you're a network operator or equipment vendor, you know there are many challenges in managing the transition from TDMA to CDMAone and to cdma2000 3G networks. The purpose of this paper is to help you solve some of the network challenges associated with the transition to one of the most popular 3G technologies – cdma2000.

Agenda

- **Introduction**
- **New challenges & advantages with cdma2000**
- **The cdma2000 network**
- **Installation & maintenance solutions**
- **Conclusions**

The New Era in Wireless Mobility

The Market we knew is undergoing radical change...



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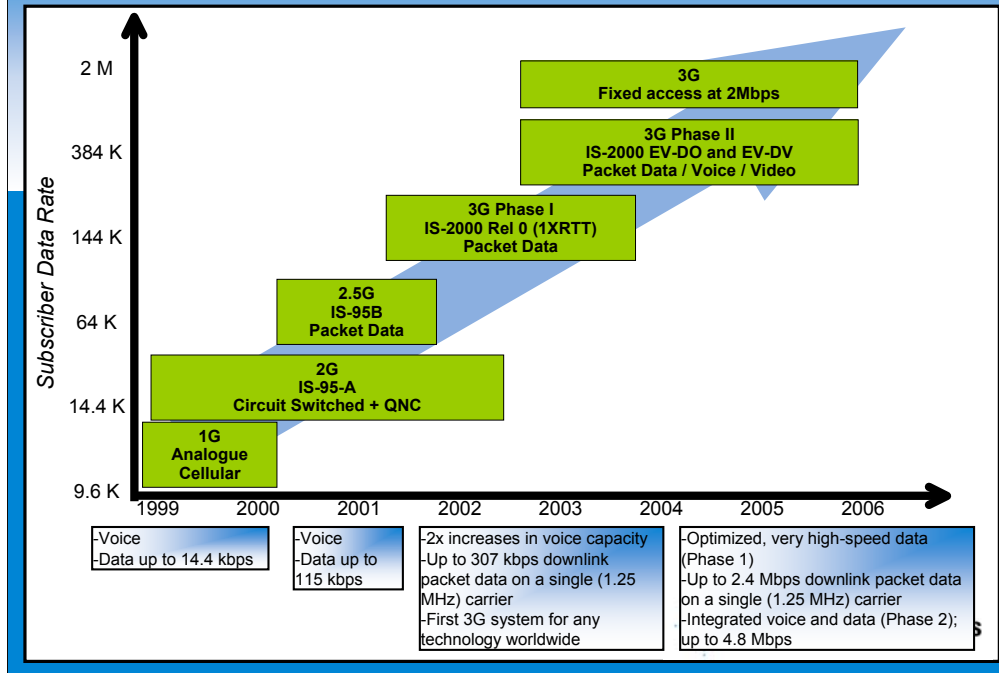
The mobile market we knew is undergoing radical change. This slide describes well what is happening today and with new trends come new needs.

Included in this change is the need for test instruments to efficiently build networks and to satisfy these new end-user needs. Agilent presents the most comprehensive line of test equipment for mobile networks. Companies that work closely with Agilent reaps the benefit of the partnership by lowering their time to market and hence time to revenue. Increased quality in all aspects of the service they provide enables Agilent's customers to add new customers to their customer base as well as keep existing ones.

The mobile market is growing fast. In some parts of the world we are already seeing 70-80% cell phone penetration. With high penetration numbers on the horizon, how will you grow your future business as this technology matures? The competitive environment is rapidly changing from expanding your network coverage and customer base, to a focus on ARPU (Average Revenue Per User) and rapid new service roll out. 3G will be the main revenue driver in the future, and will enable a vast number of new applications in the mobile arena. Agilent's mobile test solutions are directly aimed at helping your engineering staff roll out value added services to ensure that you stay ahead of the competition.

Agilent's test solutions will enable you to roll out your new services faster and with higher quality. In hard economic times Agilent goes the extra mile to ensure their customers position in the market, your competitive advantage can be Agilent.

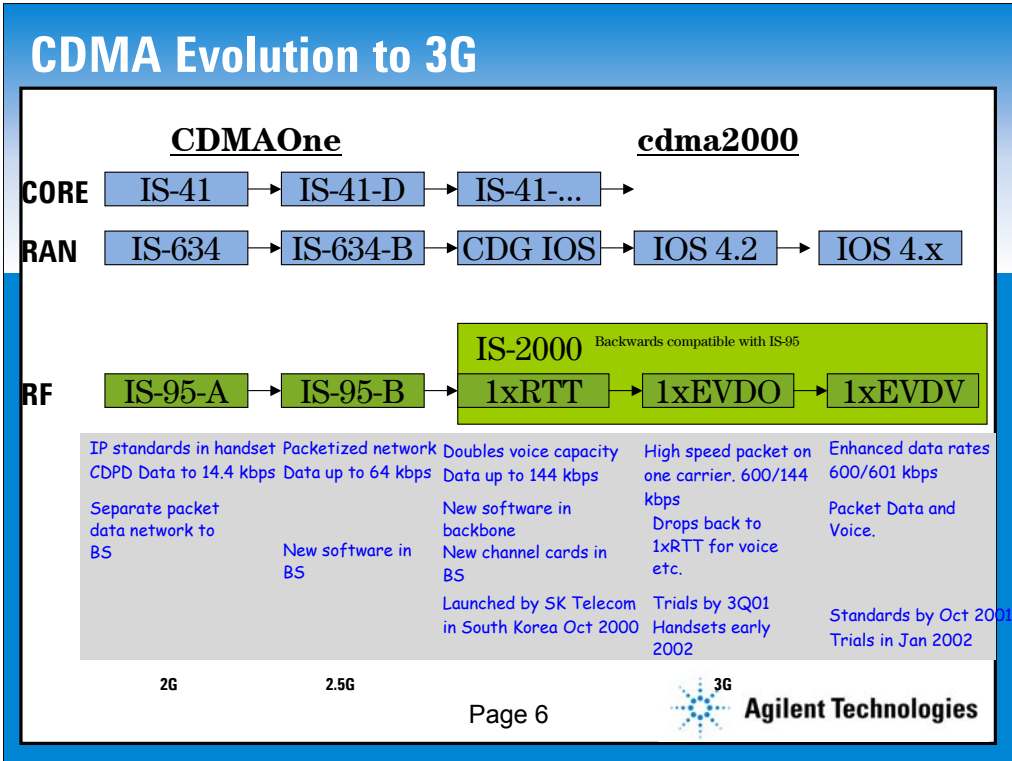
CDMA Data Migration Path



This slide shows the data migration path of the CDMA wireless technology. Today we are in the middle of a revolutionary transition and we have very interesting times ahead.

There are already several 1xRTT networks in commercial use around the world today. This technology was the first 3G standard to be in commercial use, and to date this technology has roughly 10 Million subscribers worldwide

cdma2000 is evolving to continue to meet the future demand in the wireless marketplace. The cdma2000 1xEV standards will provide data-optimized channels, offering data rates well in excess of the ITU IMT-2000 2Mbps requirement.



This is another slide showing the evolution from 2G CDMA to 3G CDMA. This is another approach showing a more detailed picture of what technology is in use in the core, RAN(Radio Access Network) and on the RF side. The slide also describes what the implications are with each technology as well as what data rates can be expected.

1xEVDO (Evolution - Data Only) has also become officially known as IS-856. This technology embodies a new air interface technology specifically designed for packet data and offers a bandwidth efficiency for data traffic that is 3-4 times greater than current 3G standards such as W-CDMA or 1xRTT. 1xEV-DO achieves a peak data rate of 2.45 Mbps on the forward link (from the Base station, BTS, to the user) using only 1.25Mhz of spectrum.

The upcoming shift in wireless networks from voice to 3G packet voice and data networks also raises the question of what Radio Access Network (RAN) architecture is best suited to meet the demands of 3G multimedia traffic. Many believe the answer lies in the Internet Protocol (IP). There is wide expectation that operators can reduce operating and equipment costs and make their networks more scalable by migrating to All-IP architectures.

Agilent offers industry leading test solutions for installation, maintenance, optimization and monitoring/management of all aspects of the mobile network. The Signaling Advisor is the installation and maintenance tool of choice for the RAN and Core Network, while Viper/Drive Test offers best-in-class test instrument for RF testing.

Agenda

- Introduction

- ➔•**New challenges and advantages with cdma2000**

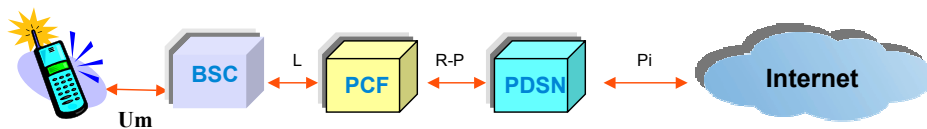
- The cdma2000 network

- Installation and maintenance solutions

- Conclusions



cdma2000/IS-2000 Challenges



- The RF interface is no longer the bottleneck
 - Network capacity has to be expanded and managed better
- Introducing a new Packet Switched Backbone Network
 - 10/100/1000 Ethernet transport technology
 - New equipment → More complexity
- Realize Promised Data Rates (144Kbps – 2Mbps)
 - Profitable data rates will be critical for today's business model

* With cdma2000 The RF interface will no longer be the bottleneck of the network. This means that the wireline part of the mobile network will have to be expanded for capacity that can satisfy expected end user data rates. This means that the network must be upgraded and capacity will have to be expanded while introducing a completely new packet switched backbone.

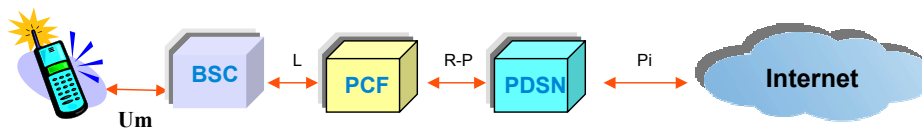
* Introducing a new packet switched backbone network, the cdma2000 PCN, is one of the first steps in the evolution of cdma2000 systems to an all-IP and multi-media architecture.

* What about packet based mobile to mobile calls, and what new challenges do this technology bring to the table? European and US Landline operators have more than 30 years of experience in developing translation gateways to carry circuit switched calls between incompatible signaling systems. They have 15 years of experience in carrying circuit switched calls between the incompatible signaling systems of mobile networks. There is no equivalent experience with packet calls. What little there has been there has centered around implementing GPRS and CDMAone. To date that experience has not been good. How then will we be able to reach the promised data rates for cdma2000, and when will it happen?

* Engineers are used to circuit switched technology, packet switching introduces new problems and a learning curve for network engineers. Given the level of experience already discussed, how long is it going to take for engineers to be able to deploy this technology successfully?

* For now, 10/100 Ethernet will do the job of transporting data through the network for cdma2000 1xRTT. What will the future hold for access and core network transport ATM, Gigabit? Whatever it might be Agilent will be there with an industry leading test solution as this technology evolves.

cdma2000/IS-2000 Advantages



- Handsets readily available and has been in commercial use for some time
- Higher data rates
- More efficient spectrum utilization
- Utilizes the existing RAN and core network
- Utilizes the existing RAN and core protocols
- RAN and core protocols enhanced for new features
- Introduction of SIM card
- No large increase in base stations - unlike UMTS



* Having handsets readily available makes the “reality gap” disappear, and real world performance can be assessed easier. cdma2000 is becoming a proven and profitable technology in Korea where it has been in commercial use since Oct 2000. Handsets for cdma2000 are already in commercial production and being used on all three commercial Korean networks.

* cdma2000 has projected higher theoretical data rates than UMTS. For this to happen, backbone capacity must be managed much better than what is the case today. When the RF side is no longer the bottleneck it is very much up to the RAN and Core network to ensure end user QoS (optimization), and hence create competitive advantage for the service provider. The RAN and Core network capacity and optimization will be key in the service providers quest towards high promised data rates.

* More efficient spectrum utilization and more importantly the same spectrum can be reused going from CDMAone to cdma2000 is a major advantage for operators who choose to go with cdma2000 as their 3G technology.

* cdma2000 operators were not forced to join outrageous Government bidding rounds for spectrum licenses.

* Utilization of existing RAN and core networks and also protocols allows for full backward compatibility with legacy networks and the full cost of infrastructure. This is not to imply that incorporating CDMAone and eventually cdma2000 into TDMA/IS-136 infrastructure will be without problems. It will not! No one has yet done it without running into problems. Without the engineering experience, unexpected challenges will surely arise.

* In addition there will be new protocols and new enhancements of existing protocols for operation of the new packet switched backbone introduced in the mobile network. This will also present new challenges for service providers. In an environment where packet switched technologies are not part of the history nor part of most of the engineers’ experience this will surely be an area of interest in the years to come.

* SIM cards will be introduced with cdma2000. This is an advantage to the end user as his identity is no longer tied to the phone, but to a small card that can be changed and work with any cdma2000 phone on the market. This provides the user with more flexibility than has been available before. SIM cards has been in use for GSM since early 1990’s.

* There will be no large increase in base stations for service providers deploying cdma2000. Unlike UMTS where there must be new base stations for 3G coverage and the entire RAN network changes, cdma2000 offers full backward compatibility with the existing RAN network. This translates in to vast savings for service providers deciding to move forward with cdma2000 as apposed to deploying UMTS for 3G. (What about coverage?)

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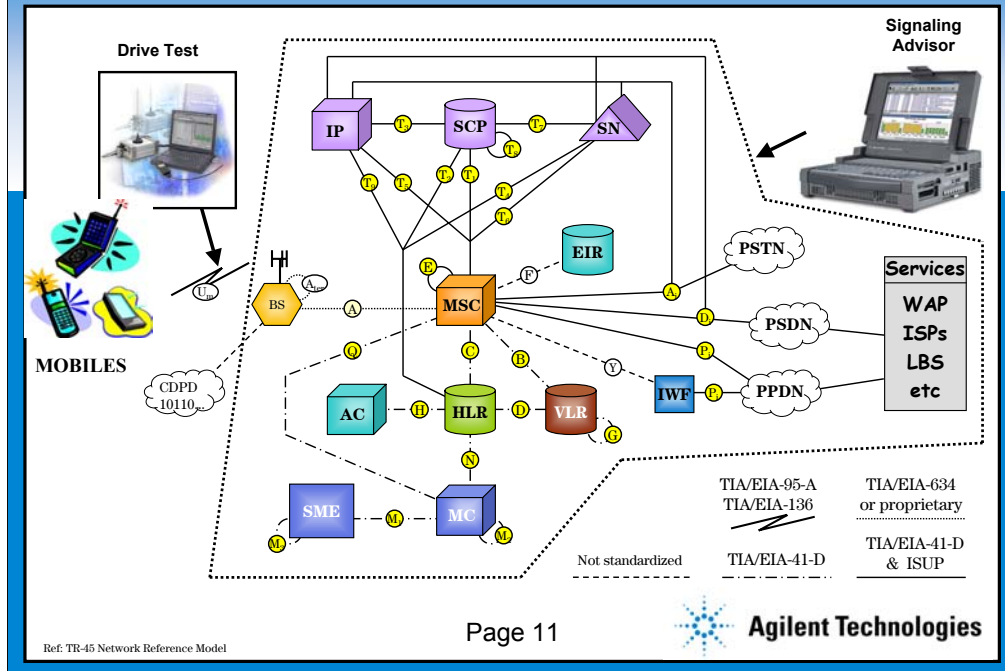
- Introduction
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➔ • The cdma2000 Network

- Installation and maintenance solutions
- Conclusions



cdma2000 Network Architecture

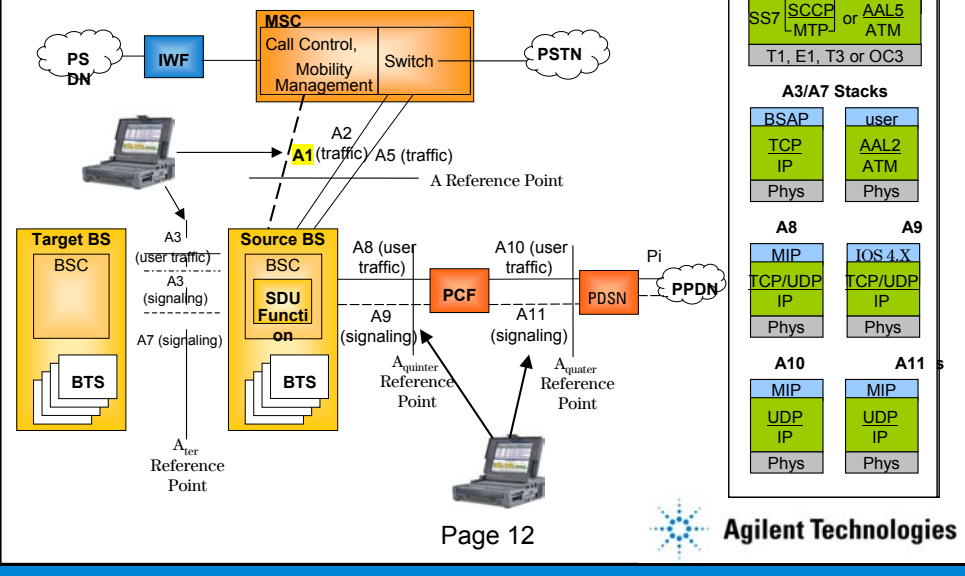


This is a picture of a standard cdma2000 network taken from the TR-45 Network Reference Model. Agilent presents test solutions for the complete picture of the CDMA – cdma2000 network. Agilent’s Drive test solution coupled with Signaling Advisor will give you visibility of problems as well as problem free areas that can be even further optimized in your RF, RAN and Core.

With Agilent mobile solutions for Ethernet, IS-634 and IS-41 in the RAN and core network you can optimize your network as well as identifying any issues with placing circuit switched calls or packet switched data calls. As discussed earlier the area of interest and the major challenge will be the new packet switched backbone which will be looked at in more detail on the next slide.

cdma2000 'A' Interface Reference Model

(Source: 3GPP2 TSG-A)



This is a reference model picture of the RAN network showing how the new packet switched backbone will be integrated into the cdma2000 network as a step on the way to an all IP network infrastructure.

Signaling Advisor can connect and analyze every interface in the cdma2000 network including A1, A10, A11, A9 over 10/100 IP and/or ATM. Support for A3 and A7 interfaces will launch in August-September timeframe. Signaling Advisor supports Agilent Technologies powerful LAN 10/100 Ethernet troubleshooting software, which will play an important role in installation, maintenance and optimization of the new packet switched backbone in the cdma2000 network. We will go into more detail of what this software can offer later in this presentation. Identifying problems on the new 10/100 IP backbone between the BSC/ Aggregation Node and the PCF as well as between the PCF and the PDSN or between multiple PDSNs is going to be crucial for operating a successful cdma2000 network.

The Signaling Advisor can also successfully test, troubleshoot and monitor all IS-41 interfaces of the cdma2000 core network. Roaming is one of the most complex procedures in the mobile network, and the Signaling Advisor have specialized tools to help you resolve your roaming problems. Communication between HLRs and VLRs is very intricate and is the root cause of many problems on the CDMA network. Again, Signaling Advisor has tools aimed at solving these very complex problems quickly and efficiently.

As seen in this slide, the Signaling Advisor can connect and efficiently troubleshoot virtually every interface in the cdma2000 network.

CDMA 3G Data, An All IP Network

- Uses IP to the BS
- Same IWF architecture as 2.5G
- Always-On operation
- Worldwide interoperability
- Will evolve to 'All IP' architecture



As previously mentioned cdma2000 3G uses IP all the way to the base station for cdma2000 data calls. For 1xRTT the technology uses IP to the BSC (Base Station Controller). There are great expectations for the cdma2000 IP based backbone. Operators expect tremendous cost savings based on cheaper and more flexible bandwidth.

Same IWF (Interworking Function) architecture allows for full backward compatibility on protocols as well as infrastructure, and the cost savings that comes with it. From a financial perspective this is an important advantage with deploying cdma2000 for 3G.

Always on operation is an important feature of any high-speed Internet access system. This means that the terminal is always able to send and receive data and does so without lengthy connection set-up procedures.

World wide interoperability is another advantage with cdma2000. 1xRTT and 1xEV-DO are international standards supported by several standards bodies, including 3GPP2, TTA, CDG and ITU. This ensures interoperability between terminals/handsets and the radio network. The interoperability specifications for cdma2000 are referred to as Interoperability Specification (IOS) 4.X. These standards give wireless operators greater freedom in vendor selection allowing them to use the best available equipment in every part of the network. 1xEV-DO supports interoperability with 1xRTT and IS-95A/B CDMA voice networks, which means that a user with a dual mode (CDMA/1xEV-DO) handset can receive and initiate voice calls even when actively engaged in a 1xEV-DO data session.

The CDMA evolution for 3G points towards an All IP architecture. Strong confidence in the flexibility and scalability as well as great cost savings are driving the 'All IP' migration.

Why IP in the RAN and Core?

An IP based network uses IP for transport of all user data and signaling between all network entities, including the user terminal. The All IP network comprises the access network, the core network and the service network.

(3GPP2 TSG-S: 'Requirements for a 3G Network Based on Internet Protocol (All IP) with support for TIA/EIA-41 Interoperability')

One of the main drivers is cost:

'An All IP core would result in capex savings of up to 70%.

The core represents only 25 - 30% of the total capex.

The RAN represents 70% of the capex.

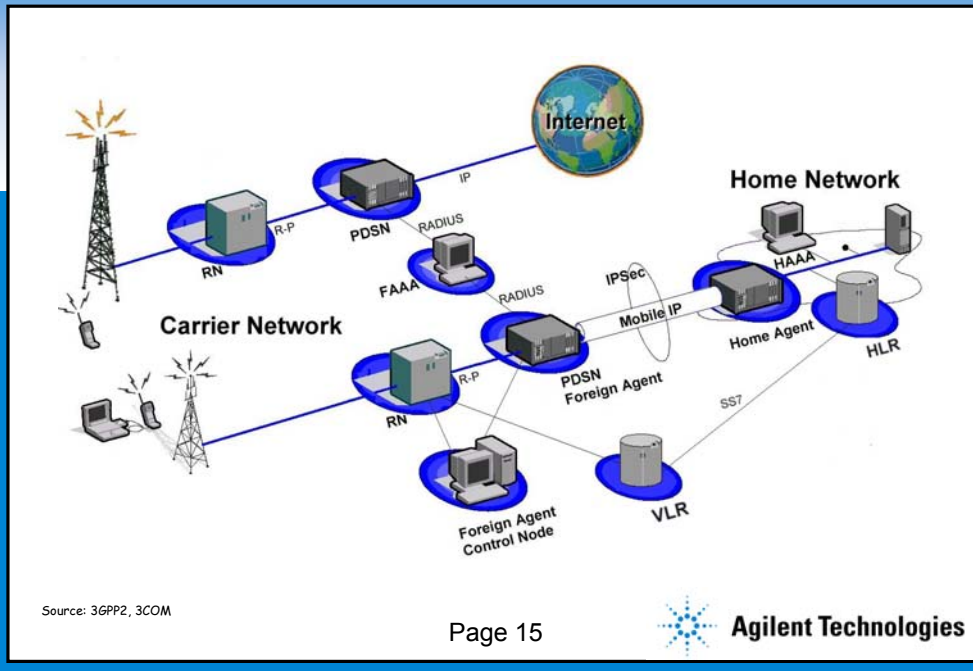
Real savings will come from implementing IP in the RAN.'

Caution: The RAN also includes the RF. The comparison is with internet IP implementations which do not support telephony levels of service and billing.



How these savings will be realized is covered in detail on our next slide.

cdma2000 All IP Architecture



- * This slide is a reference model from 3Com, showing how the cdma2000 network might evolve to an all IP network infrastructure in the future.
- * Globally IP networks have become the de-facto standard for transporting data traffic. Wireline service providers have leveraged IP's global economies of scale to reduce their equipment and operating costs. Operators have also benefited from IP's status as an open, evolving standard to rapidly create new services such as Internet access, streaming media, VoIP and Virtual Private Networking. The same benefits are now available to the wireless service providers.
- * The use of IP as a backhaul transport technology can deliver significant benefits to wireless operators. In IP transport, Base Stations communicate with Base Station Controllers (BSC) using IP as the common layer 3 protocol. This brings tremendous flexibility to an operator in choosing a layer 1 / 2 backhaul technology, Frame relay, ATM Metro Ethernet or even dedicated E1/T1. This enables them to chose layer 1 / 2 on criteria such as cost, availability delay etc. Multiple studies have shown that packet based L1/L2 backhaul technologies can offer significant cost savings compared to traditional dedicated E1/T1. Metro Ethernet can have even greater impact on backhaul costs, especially since 3G services like 1xEV-DO consume large amounts of bandwidth.
- * Another great benefit of using IP transport for backhaul is that one central office can support Base Stations spread out over a large geographic area, which eliminates the need for multiple central offices and duplicate network equipment. This makes the use of a protocol analyzer even more useful and beneficial. In traditional cellular network, the cost of operating a backhaul network is one of the largest operating expenses. Because the tariffs on E1/T1 dedicated lines are often based on distance, operators often build multiple central offices to house Base Station Controllers, even in a relatively small geographic area. IP transport technology is ideal to overcome these limitations and reduce a service provider's operating and equipment costs.
- * An all IP architecture give operators the choice to use low-cost, off the shelf network components. Not only are IP switches and routers cheaper and have faster technology evolution as compared to traditional voice telecom equipment, but they also bring the additional benefits discussed earlier.
- * Bringing traditional Local Area Networking technologies into the wireless space introduces new challenges for network engineers who will have to learn how this new technology will integrate. Agilent has many years of experience with 10/100/1000 IP test tools and can help make the wireless evolution much easier for operators.

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Drive Test and Signaling are Complementary

Drive Test

- Call specific analysis
- Direct RF measurements
- Limited access to non-RF call failure causes

Signaling Test

- All calls on a RAN and Core Network allowing statistical analysis
- Indirect reporting of RF performance (uplink)
e.g. RxQual= BER
- Able to monitor multiple network interfaces for root cause analysis



How can a protocol analyzer make a difference in optimizing a wireless network?

Here's an example. Quality of service in wireless networks is commonly monitored on the air interface using Drive Test systems. But Drive Test generally only shows data about the quality of the downlink from the network to the handset. Therefore it provides only a partial picture of network performance.

The protocol analyzer monitors the core network and therefore can collect data about the uplink from the handset to the network.

post process-analysis software can correlate data from both Drive Test and from protocol analyzers. Therefore, for any given geographical location, a complete picture of radio performance can be produced.

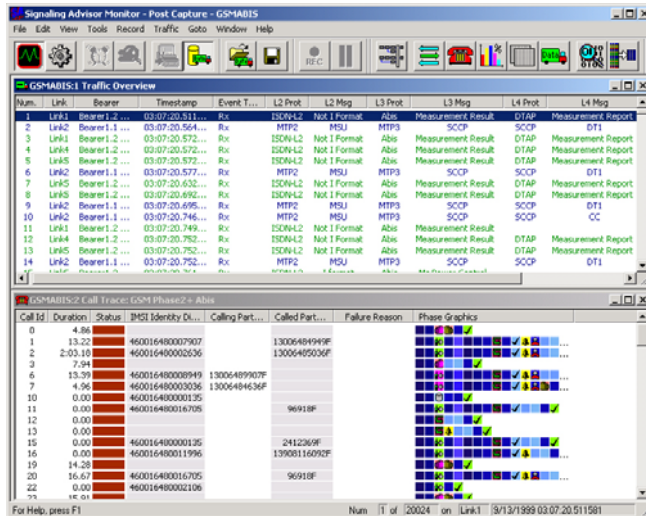
The protocol analyzer can also identify utilization and configuration issues on the packet switched network as well as location update and roaming issues on signaling between network entities.

Data Measurement Requirements

- ➔ 1. Call Trace
- 2. Statistics
(Connection Stats, Utilization, Message Types Etc.)
- 3. Emulation/Active Tests
- 4. Expert Analyzer, Commentators, Node Discovery
and Mobile IP Filters
- 5. Decodes



Graphical Call Trace



Key Application for Rapid Problem Identification & Isolation

- Best in Class
- Fully Graphical
- Multi Link
- Multi Protocol



This is a Screenshot of the Signaling Advisor's, and the industry's only fully graphical call trace, which allows groundbreaking and rapid troubleshooting and problem identification.

The call trace application traces calls (or message sequences) across all links and groups the messages together. It is therefore a very powerful facility for troubleshooting, particularly since it operates in both post capture and real time modes.

The Signaling Advisor call trace allows for multi-link, multi-protocol call traces to quickly find 'the needle in the haystack'.

The call trace application can rapidly detect any call failures and failure causes in 3 mouse clicks.

From Haystack to needle in 3 steps !!

The screenshot shows a software interface for network monitoring. At the top, a red telephone icon is labeled '1: Click on "call trace" to start'. Below it, a large grid of call sequences is labeled '2: Configure & trace calls graphically'. This grid shows various event types such as 'Clear Request', 'Handover Failure', and 'Assignment Failure', each with a corresponding icon and a red 'X' indicating an error. A specific call sequence is highlighted with a blue box, and a red arrow points to it. Below the grid, a table titled '2 - GSM Phase2+ AInt - HO Fail.tol:1 Traffic Overview (Grouped)' is shown. The table has columns for 'Num.', 'Link', 'Bearer', 'Timestamp', 'Event Type', 'L4 Msg', and 'L5 Prot'. The data rows show various call events with timestamps and event types like 'Rx' and 'DT1'. At the bottom, a blue box contains the text '3: See The individual messages for each call' and the Agilent Technologies logo.

1: Click on "call trace" to start

2: Configure & trace calls graphically

Clear Request
Clear Request
Clear Request
Handover Failure Normal call clearing
Clear Request
Clear Request
Clear Request
Assignment Failure Temporary failure
Clear Request
Clear Request

2 - GSM Phase2+ AInt - HO Fail.tol:1 Traffic Overview (Grouped)

Num.	Link	Bearer	Timestamp	Event Type	L4 Msg	L5 Prot
1518	Link6	Bearer2.3 RxB	18:37:28.843841	Rx	DT1	BSSAP
1555	Link5	Bearer2.2 RxB	18:37:29.511913	Rx	DT1	BSSAP
1641	Link6	Bearer2.3 RxB	18:37:31.117088	Rx	DT1	BSSAP
1742	Link5	Bearer2.2 RxB	18:37:32.734283	Rx	DT1	BSSAP
1772	Link6	Bearer2.3 RxB	18:37:33.112834	Rx	DT1	BSSAP
1775	Link5	Bearer2.2 RxB	18:37:33.144657	Rx	DT1	BSSAP
1777	Link5	Bearer2.2 RxB	18:37:33.161155	Rx	DT1	BSSAP
1800	Link6	Bearer2.3 RxB	18:37:33.514285	Rx	DT1	BSSAP

3: See The individual messages for each call

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How do you find one problem in 40 000 messages?

This is often the scenario for a wireless operator with a problem on a CDMA network. This task can be almost impossible for not to say extremely time consuming without the right test tools. The Signaling Advisor allows engineers to rapidly identify problems with graphical representation of error conditions in call sequences.

1 mouse click starts the call trace.

2nd click transforms 40 000 messages into 180 calls with each message represented graphically within each call sequence.

3rd click on the call sequence that marks a red exclamation point or red X groups the messages that belongs to that particular call together to show the user the cause value of the network failure.

With one more click the user can drill right into the decode of the message carrying the network failure cause value.

Troubleshooting can not be made easier than this..

Data Measurement Requirements

1. Call Trace
2. Statistics
(Connection Stats, Utilization, Message Types Etc.)
3. Emulation/Active Tests
4. Expert Analyzer, Commentators, Node Discovery
and cdma2000 Filters
5. Decodes



Statistics for Control and User Plane

Statistics and utilization levels are key figures for Network Optimization.

Agilent Mobile Solutions feature IP and Signaling Stats:

Signaling Stats on IS-634 and IS-41 Interfaces

- User definable statistics:
 - Graphical
 - Tabular

IP Stats

- Connection Stats
- Line Vital Stats
- Protocol Vital Stats



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Statistics and utilization figures must not be underestimated in network optimization work. These are the most important numbers one can collect from the RAN and Core for optimization work.

A simple statistics measurement such as call completion ratio will instantly tell you how your network is performing.

Agilent's mobile solutions offers fully user definable signaling statistics on IS-634 and IS-41 interfaces. There are several Message Transfer Part (MTP) statistics, as well as user part specific statistics (message types, reject causes etc.). Statistics are typically counts or ratios. The signaling statistics can be displayed graphically in bar charts or radar diagrams. Signaling statistics can also be printed in tabular format for enhanced sort capability and export to third party spreadsheets.

Agilent mobile solutions also offer numerous predefined IP statistics available to help you troubleshoot your IP connection. Some of these are:

- Connection Stats
- Line Vital Stats
- Protocol Vital Stats

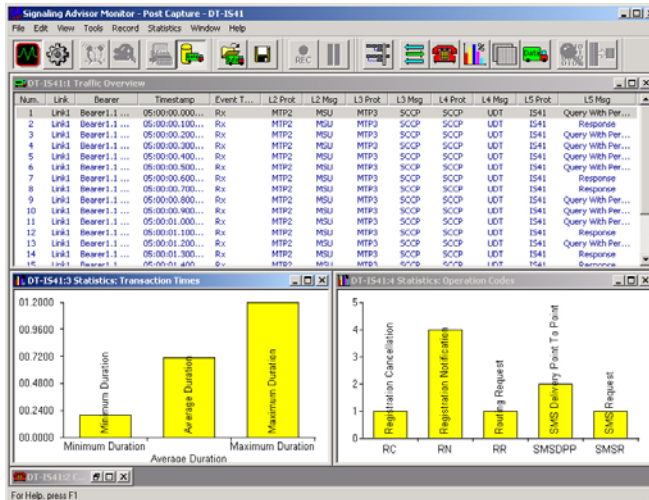
The IP statistics can be viewed as pie charts, gauges or counts.

Statistics are available in post capture and real time for both IP and IS-634 and IS-41 signaling statistics.

The following slides will go into more detail on various statistics available.

Signaling Statistics Example

Quickly and easily identify service problem causes using graphical statistics



Using the signaling statistics, the network engineer can quickly identify causes of service problems on the wireless network. Service problems may stem from the sheer complexity of the database transactions required for them to work, or they may simply arise from the amount of traffic on the network. Signaling statistics can easily identify issues arising from the latter.

On the screenshot in this slide you can see transaction time statistics. Database transaction times are important in Advanced Intelligent Network (AIN) services such as 800 and LNP (Local Number Portability). The protocol analyzer will allow the user to study trends in transaction performance as the network becomes busier or quieter. If these transaction times increase too much then calls will start to fail due to time-outs while waiting for the transaction to complete.

Identifying handoff performance and potential handoff problems can be done in a similar fashion by running graphical or tabular statistics on BSMAP Message Types, on a file captured on the A1 interface (IS-634). This will immediately identify handoff performance by looking at successfully completed handoffs versus failed handoffs. The protocol analyzer can then be used to filter out handoff messages to quickly find failure causes of the already identified handoff problems.

Signaling Statistics

- User definable
- Graphical
 - 2D Bar Charts
 - Radar Diagram
- Tabular statistics
- Time based statistics
- Call-based statistics
- Data export to CSV



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Like previously mentioned the signaling statistics are completely user definable and fully graphical.

Tabular statistics

Tabular statistics are drawn by call traces. This provides a more detailed and dynamic view of network performance, incorporating several programmed measures (handovers, errors, call success rates etc).

Time-based statistics

It is possible to produce the graphical statistics as a tabular time series, where the intervals can be set from one minute to 24 hours.

Call-based statistics

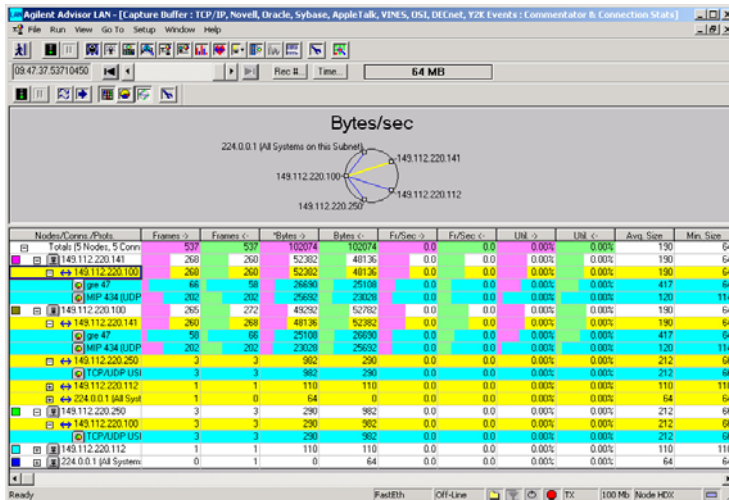
The most advanced statistics features involve using the call trace application to evaluate call based statistics such as call completion ratio, min/mean/max call setup times, min/mean/max call durations.

Data export

Statistics can be exported to a CSV (Comma Separated Value) file for further analysis in another application (e.g., Spreadsheet or Database).

IP Stats – Connection Statistics

Quickly identify who is using bandwidth and how bandwidth is being used on your network



Many network problems are reported by users in such terms as “I can not connect to a website”, or “The connection to the network is extremely slow. To resolve these kind of problems you need to view the activity on a particular network node (PDSN) or specific connection.

To see how is using bandwidth and how the bandwidth is being used, the protocol analyzer provides numerous connection statistics. By simply clicking on a network node such as a PDSN router, you will immediately see who the node is talking to most often, how many frames are being sent per second and what protocol is used.

IP Stats – Connection Statistics

How is bandwidth being used?...

- Easily and quickly identify who is using bandwidth
- See what the bandwidth is being used for
- Graphical radar diagram of bandwidth usage by user
- Columnized view by user
- Network diagram



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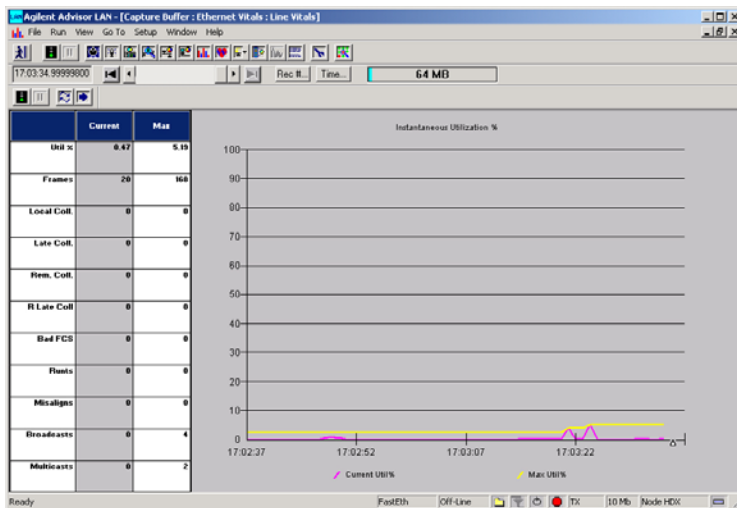
The connection statistics answers crucial 10/100 Ethernet troubleshooting questions.

Get visibility over:

- **Who is using bandwidth, quickly and easily**
 - **See what the bandwidth is being used for**
 - **Graphical radar diagram of bandwidth usage by user**
- The application also offers the user a graphical network diagram.**

IP Stats – Line Vital Statistics

Invaluable statistical information for a snapshot of overall network performance



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These network performance statistics can be accessed with just one mouse click. . The Vitals measurement provide a statistical picture of the MAC layer and the various protocol stacks to show cumulative data and trends over time. You can use this statistics application to identify problems or assist in optimizing the configuration of the network.

IP Stats – Line Vital Statistics

Graphs current and maximum utilization in real time

- Export to CSV
- Provides current and maximum values, in tabular format, of the following parameters:

% Utilization	Runts
Total frames	Frames with bad FCS
Local collisions	Miss-aligned frames
Remote collisions	Multicast frames
Late collisions	Broadcast frames
Remote late collisions	



The Vital measurements provide a statistical picture of the overall network health.

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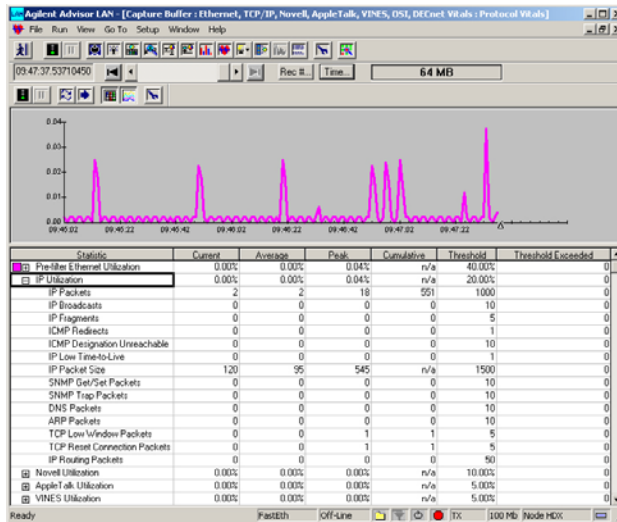
This protocol analyzer application graphs current and maximum link utilization in real time.

The results can be directly exported to CSV for viewing and analysis in any third party spreadsheet application.

The application provides current and maximum values in tabular format of the following parameters: (see slide)

IP Stats – Protocol Vital Statistics

Identify your network's health by protocol



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This slide shows a screenshot of the Protocol Vital Statistics application. This application provide network engineers with a view of overall network health based on protocol.

IP Stats – Protocol Vital Statistics

Protocol Vitals provide current, average, peak and cumulative values for a number of protocol specific parameters.

- User configurable thresholds
- TCP/IP Vitals:

IP Utilization	IP packets
IP Broadcasts	IP fragments
ICMP redirects	ICMP unreachable
IP low time to live	IP packet size
IP routing packets	SNMP trap
SNMP Get/Set packets	ARP packets
DNS Packets	TCP reset connection frames
TCP Low window frames	

The Vital measurements provide a statistical picture of the overall network health.



Protocol Vitals provide current, average, peak and cumulative values for a number of protocol specific parameters.

For efficient troubleshooting the application provides user configurable thresholds for to automatically detect intermittently occurring events.

The application also provides tabular statistics for all the variables shown on the slide.

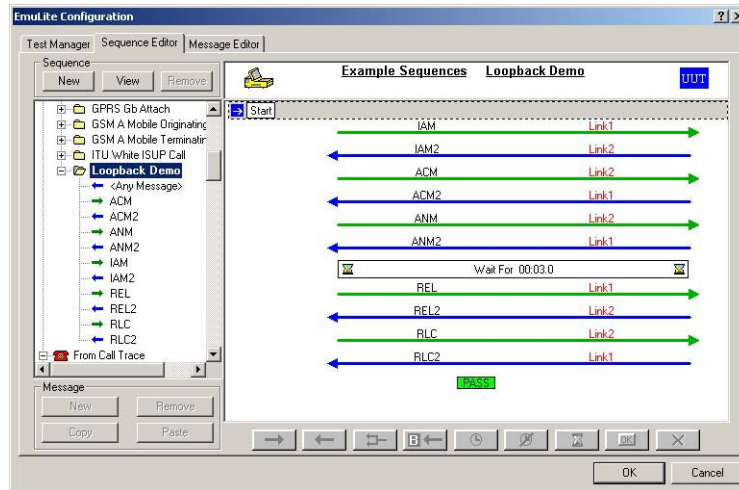
Data Measurement Requirements

1. **Call Trace**
2. **Statistics**
(Connection Stats, Utilization, Message Types Etc.)
- ➔ 3. **Emulation/Active Tests**
4. **Expert Analyzer, Commentators, Node Discovery and Mobile IP Filters**
5. **Decodes**



Graphical Emulation of IS-41 and A1 interfaces

Save valuable time using the industry's only fully graphical emulation tool



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Emulation is the ability to define and send signaling messages in a predefined sequence to a unit under test and respond to received messages.

This is a screenshot of Signaling Advisor's graphical emulation environment. The user can select from pre made sequences on the left, make his/her own custom sequences or paste a previously captured call trace in to the graphical emulation environment as a call trace sequence, to repeat and recreate network behavior.

Signaling Advisor's emulation capabilities include:

Automatic test creation – copy messages and their sequence from call trace

Graphical editor – quickly create messages, no more programming!

Intelligent protocol field based editor – correctly build complex signaling messages – not just in hex

Intelligent built in test manager - easily manage the execution of tests

Graphical analysis tool – instantly identify failed tests and why they failed

Easily verify network element responses

Test all non IP based CDMA RAN and core network interfaces.

Graphical Emulation

IS-41, ISUP and IS-634 interfaces

EmuLite Graphical emulation software

- Test all non IP based IS-41 and CDMA interfaces
- Automatic test creation (using captured call trace)
- Graphical message editor
- Graphical sequence editor
- Test manager
- Fully integrated with monitor functionality



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* Traditional emulation tools require complex programs to be written to perform even the simplest of tasks. There is no need for time consuming programming when using EmuLite!

* Take advantage of Agilent's cut and paste approach to emulation. EmuLite revolutionizes the way which emulation is performed through use of its key capabilities mentioned on this slide.

* Automatic Test Creation:

Users can generate test sequences automatically from previously captured data as opposed to entering all the data manually. A sequence of related messages captured using the call trace function can be copied directly to the EmuLite sequence editor. This sequence can the messages within it can then be modified, if required, to create a test ready for execution.

* Graphical Message Editor:

The EmuLite intelligent field based message editor allows message creation/modification using familiar protocol field names. When creating a message users are shown the valid selections from which they can choose, significantly reducing the possibility of error.

* Graphical Sequence Editor:

Tests are configured using "drag and drop" icons such as arrows, branches and timers. These automatically generate test scripts – a time-consuming and complicated task if programmed manually. More time can therefore be spent diagnosing signaling problems without the need for programming.

* Test Manager:

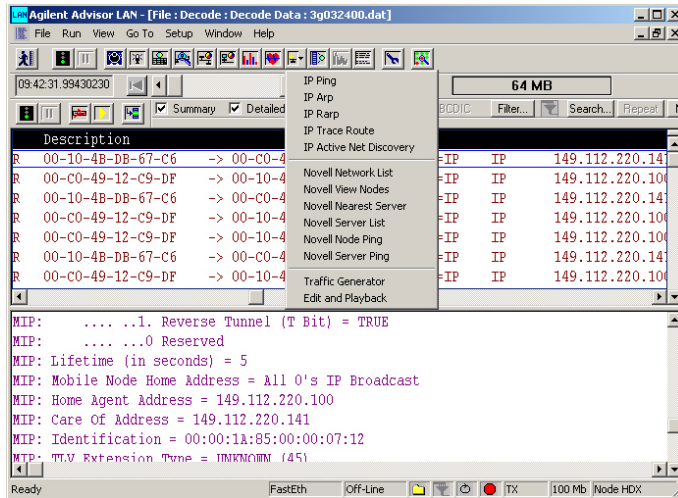
The Test Manager allows single or multiple tests to be selected and run sequentially. Results are stored in the test log and can be optionally logged to a .CSV file during execution. There is an EmuLite Status View that shows the progress of each test by displaying the messages and a pass/fail indication.

* Fully integrated with monitor:

EmuLite is fully integrated with the Signaling Advisor's monitoring tool. All analysis applications such as call trace, statistics and decodes are available for use. The flexibility of this software also knows existing monitoring only customers to upgrade easily to EmuLite.

IP Active Tests

Verify that network equipment is up and running, and responding correctly during installation



This is a screenshot with the menu of IP active tests dropped down. From this menu the network engineers can select the test they want to run for a particular purpose.

The next slides goes into more detail on what the IP active tests can be used for.

IP Active Tests

Advanced Traffic Generation and Packet Editing Functionality to Test the Network:

- Test network equipment before deployment
- Customize data to be transmitted
- Edit and play back captured network traffic
- ARP and PING



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Stimulus response testing and other active tests are available for Ethernet.

This allows network engineers to verify that network equipment is up and running (responding) before deployment

Users can also capture LAN traffic and play it back on the Network, or edit the traffic and then play it back over the network. The application provides intelligent packet and capture buffer packet editing for full seven layer customization of data to be transmitted over the 10/100 Ethernet network.

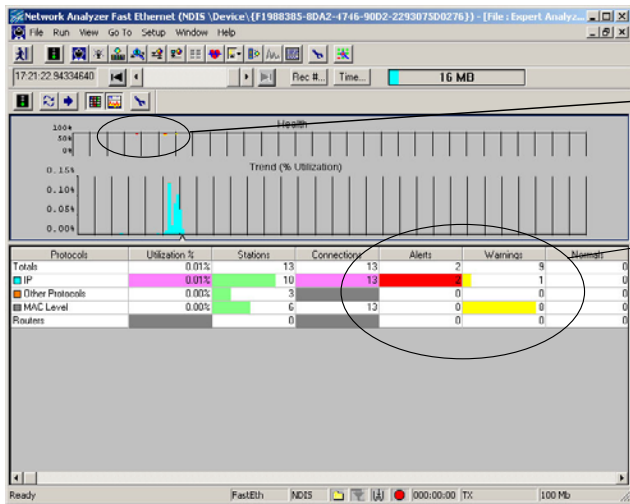
Data Measurement Requirements

1. **Call Trace**
2. **Statistics**
(Connection Stats, Utilization, Message Types Etc.)
3. **Emulation/Active Tests**
- ➔ 4. **Expert Analyzer, Commentators, Node Discovery and Mobile IP Filters**
5. **Decodes**



IP Expert Analyzer

Rapidly identify key issues and view the overall health of your 10/100 IP cdma2000 backbone



Network health degradation shown graphically.

Alert and warning counters shown in tabular format.

This case:

1. Duplicate IP address alerts
2. Excessive IP retransmission warnings

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This is a screenshot of the 10/100 Ethernet software. This application gives the network engineer an overview of the overall health of the network. This is one of the most powerful features of the protocol analyzer 10/100 Ethernet software, and a key application for baselining activities on the 10/100Mbps cdma2000 backbone.

The next slides goes into more detail of what the Expert Analyzer offers.

IP Expert Analyzer

Rapidly identify key issues on your network using the cornerstone application for any 10/100 IP test tool

- Quickly identify key issues (warnings and alarms)
- Overall network health
- Drill down capability
- Help and suggestions for resolving problems
- Statistics for nodes and connections
- Set thresholds
- Analyze long term trends (Baselining)



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The Expert Analyzer enables an instantaneous view of the key issues and overall network health of the network. Utilization and significant events are shown graphically by protocol, and further information can be obtained by drilling down on items of interest. The drill down capability takes the user straight into the IP Commentator application linking the commentators to the items the user chooses to drill into. The Commentator will be discussed in depth in the next two slides.

This application provides a graphical overview of the health of your Ethernet network.

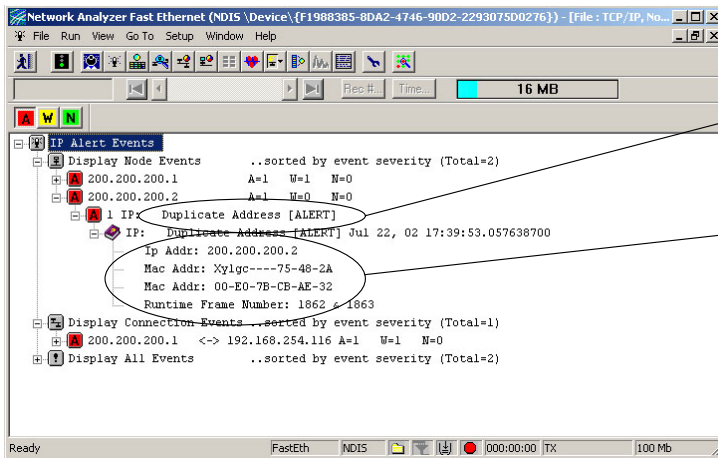
The application can be used in real-time analysis as well as post capture analysis.

The expert analyzer application is also an application made for baselining the Ethernet backbone. Specify when the protocol analyzer capture and saves traffic and proactively baseline your backbone network. This data can be exported to the protocol analyzer's reporting software for automatic creation of powerful management level reports of the network's performance. Armed with these reports you can quickly and easily identify network trends and plan for future network requirements.

The graphical user interface of the Expert analyzer is fully user customizable.

IP Commentators

A groundbreaking approach to problem identification



See the root cause of your IP problem with one click

Immediately identify the source address and associated hardware addresses as well as the captured frame numbers where the problem occurs



This is a screenshot of the 10/100 Ethernet software's Protocol Commentators application. This is the cornerstone troubleshooting application in the protocol analyzer software. This application quickly identifies warnings and alarms on the 10/100 Ethernet backbone and instantly lets the network engineer know what the alarm or warning was, the user will also instantly get help with an explanation of the problem at hand as well as suggestions for remedies that will fix the network and get it back to a normal state.

Protocol Commentator is the hearth of the Expert Analyzer application. The application performs real-time analysis of frame sequences to detect protocol events.

IP Commentators

Problem identification and help is just one click away!

- Real time detection of protocol events
- Identify “trouble” IP addresses quickly
- Drill down to decode view
- Help and remedy recommendation



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Protocol Commentators perform real-time analysis of frame sequences to detect protocol events. The logged events are linked to the corresponding capture frames, which allows for drilldown capability taking the network engineer straight to the root cause of the problem. This makes it easy for the network engineer to view the details of the event.

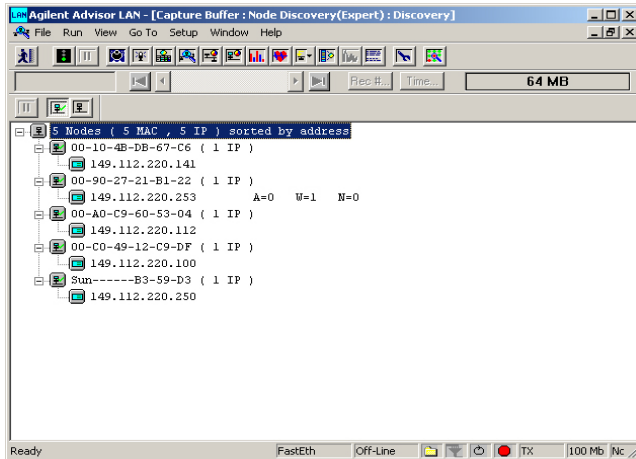
Three levels of events are shown: Alert events show serious problems, warning events show configuration or performance problems, and normal events show information on network transactions.

This allows the network engineer to identify trouble IP addresses quickly and allows sustained QoS for the end user.

One click on events will make the application drill right into the decode view to see the corresponding frames. The commentator application also describes the problem for any alarms and warnings. Drilling into the description of the problem and the application drills into the online help available for the problem at hand and gives the network engineer recommendations for how to remedy the problem.

IP Node Discovery

Get visibility into which nodes are active on your network and who is using bandwidth.



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This is a screen shot of the 10/100 Ethernet software's Node Discovery application. This application identifies which network nodes are active on your network and who is using available bandwidth.

The next slide goes into a more detailed discussion of what this application has to offer.

IP Node Discovery

See who is using bandwidth on your 10/100 backbone...

- Maintains an up to date list of all network nodes
- Shows MAC , IP addresses and node names
- Drill down functionality
- User definable graphical user interface



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See who is using bandwidth on the network.

The Node discovery feature allows the Advisor to detect new nodes that have been connected to the network and adds it to it's internal node list. The node list contains the following information:

MAC (Medium Access Control) addresses

Network Addresses (IP, IPX, AppleTalk, DECnet, OSI CLNP)

Node Names (DNS (Domain Name Service) name and addresses)

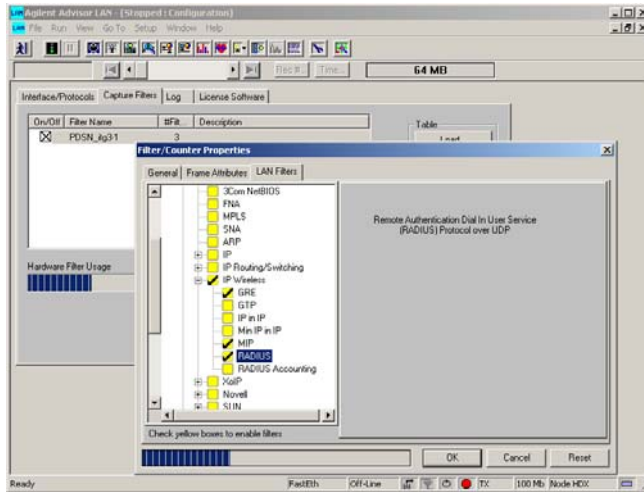
This allows the network engineer to keep an accurate picture on which nodes are active on the network and what IP addresses that are in use at any given time. Counts for alerts, warnings and normal events are also listed.

From node discovery the SW allows the user to drill down directly into the commentator where the alert and warning events can be seen. The user can also drill right into the decode view or the connection stats from node discovery. ARPs and Pings can be configured and launched directly from the Node discovery application.

The view of the Node Discovery application is fully user customizable.

Extensive IP Hardware and Display Filters

Enjoy the capability of capturing any subset of data on your network when everything is too much



Having the option of filtering out irrelevant data is crucial in rapid network analysis and troubleshooting

Ideal for Engineers who know what they are looking for



This is a screenshot of filter configuration in the Ethernet Software.

Having the option of filtering out irrelevant data is crucial in rapid network analysis and troubleshooting. Information overload can frustrate the most experienced network engineer. This application is ideal for engineers who know what they are looking for.

Extensive IP Hardware and Display Filters

Capture and view only relevant data

- TCP/UDP Port Filters
- Station Filters
- IP Filters
- Mobile IP Filters
 - GRE
 - GTP
 - MIP
 - RADIUS



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A variety of A10 and A11 Mobile IP filters are available in the Agilent Advisor LAN 10/100 Ethernet Software.

Including filters for GRE, GTP, IP in IP, Mobile IP, Radius and Radius accounting.

An extensive selection of other Ethernet filters are also available including filtering on UDP and TCP streams by port number.

Same filters available for Hardware and Display filtering.

The filtering capability can also be used to set up filters by frame attributes such as:

Bad FCS,

Collisions,

Jabbers (long frames)

Dribbles,

Or on the data portion of the packet. When filtering by data, up to 64 bytes may be specified in the data field following MAC source and destination addresses as filter criteria (or network layer for IP network filters).

Data Measurement Requirements

1. Call Trace
2. Statistics
(Connection Stats, Utilization, Message Types Etc.)
3. Emulation/Active Tests
4. Expert Analyzer, Commentators, Node Discovery
and Mobile IP Filters
- ➔ 5. Decodes

Protocol Decodes

Get visibility into your entire network with one test solution!

Agilent Mobile Solutions feature decodes for:

- IS-41
- A1
- A3 (Signaling Part)
- A7 (Signaling Part)
- A9
- A10
- A11
- IOS up to 4.2



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Agilent Advisor and Signaling Advisor offers a complete picture of the cdma2000 Network testing, with decoding capability of the following:

- IS-41
- A1
- A3 (Signaling Part)(Launch in October)
- A7 (Signaling Part)(Launch in October)
- A9
- A10
- A11
- IOS up to v4.2

Most network problems can be solved with Expert Analyzer without viewing the details of each frame. However, when you need them, there are more than 450 protocol decodes available to help interpret the protocols as they appear on the network

Get more and better visibility of how your network is operating with your protocol analyzer

Protocol Decodes

When you need to see all the details...

- 100% line rate capture
- Choose between Summary, Detailed and Hex views
- Offers fully detailed troubleshooting and analysis
- Complete picture of cdma2000 decodes



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100% capture and decode capability is crucial when looking for error conditions in a CDMA network. If you miss only one message in thousands you can potentially miss that crucial message communicating a network failure. 100% line rate capture and decode capability on all interfaces is extremely important, 99% capture is not satisfactory for a serious service provider.

Agilent's protocol analyzer offers 100% capture on any interface in the cdma2000 network. The Signaling Advisor is also the industry leading test tool in cdma2000 protocol decodes and offer an extremely user friendly and highly customizable user interface.

Agenda

- Introduction
- New challenges and advantages with cdma2000
- The cdma2000 network
- Installation and maintenance solutions

 •**Conclusions**

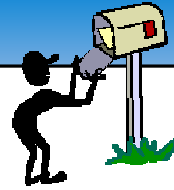


Conclusions

We would like to recommend for operators and vendors not to focus on high promised data rates. As SK Telecom and CDG emphasize, the issue is not high data rates, but profitable data rates.

Over the short to mid term data rates may well be in the range of 30 to 50kbps, allowing coverage of larger areas. To become profitable early in the transition to 3G will be key in implementing a successful business model.

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