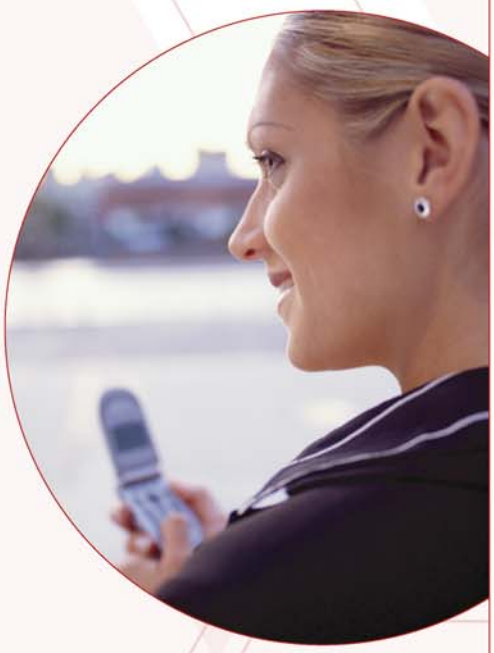

Agilent OSS
UMTS Network and Service Assurance White Paper

An introduction to UMTS and the implications on OSS

Agilent Technologies

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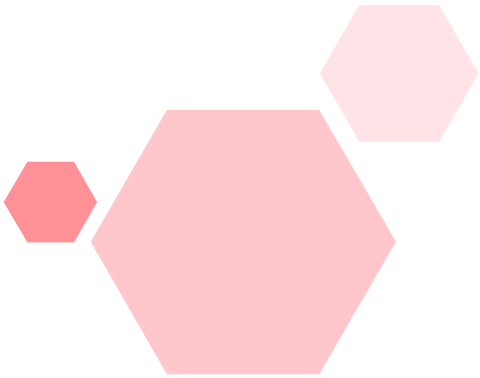

Is UMTS Still a Good Investment?

Wireless service providers (WSPs) have spent over 120 Billion Euros on UMTS licences. In addition, WSPs will need to invest in UMTS infrastructure and also the systems that enable the UMTS networks and services to operate efficiently.

So is UMTS still a good investment? The answer is clearly yes.

There are two main factors driving the launch of UMTS networks by WSPs.

The first factor is speed. The target data rates for UMTS are:

- 144 kbps—Satellite and rural outdoor
- 384 kbps—Urban outdoor
- 2048 kbps—Indoor and low range outdoor

The maximum theoretical speed of UMTS is far in advance of the data speeds offered by its predecessor technologies, as shown in Figure 1.

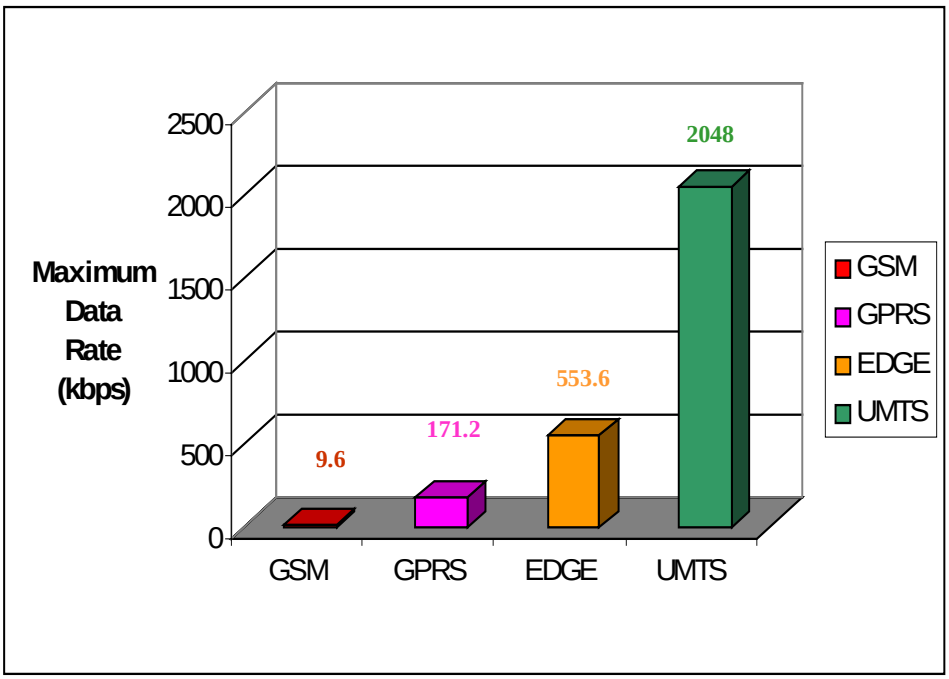

Figure 1 – Data Rates

These UMTS data rates will be required as the number of bandwidth-thirsty user applications increase. Also, for corporate users, the ability to download their email and calendar in seconds will ensure the UMTS data rates are utilized to the fullest.

The second factor is the lower cost in delivering voice. The cost of a WSP delivering voice via UMTS is greatly reduced from delivering voice via GSM. The capacity of a UMTS Node B is on average around eight times greater than that of a GSM BTS for a unit cost of 1-1.5 times that of a GSM BTS. These cost savings can be passed directly to the end subscriber or can be used to improve the Operating Margin of the WSP.

UMTS Overview

There are multiple "paths" to 3G as shown in Figure 2. In addition, TD-SCDMA is a 3G technology being considered mainly within the Chinese market.

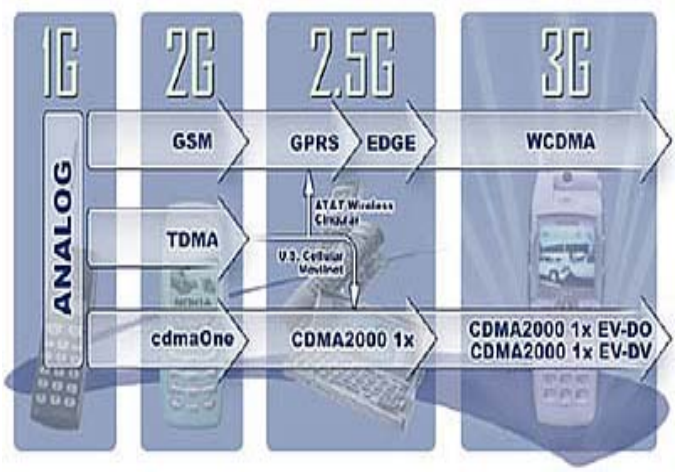

Figure 2 – Paths to 3G.

This white paper will focus on the UMTS path to 3G. UMTS is synonymous with W-CDMA and 3GSM.

The standards body for UMTS is the 3G Partnership Project (3GPP). There are currently four releases of UMTS defined by 3GPP.

Release 99
These specifications relate to the addition of the UMTS Radio Access Network (UTRAN), which is typically added to circuit-switched voice infrastructure and GPRS "Internet access".

Release 00 was abandoned in favor of Release 4 and Release 5, hence the inconsistency in the release numbering.

Release 4
These specifications relate to the migration of the circuit-switched voice network to an ATM or IP core network.

Release 5
These specifications relate to the addition of IP Multimedia Services (IMS), which effectively enable person-to-person multimedia sessions.

Release 6
These specifications imply no change to the overall network architecture. Release 6 will add more IMS capabilities, speech recognition, Wi-Fi/UMTS inter-working, radio optimization, etc.

Subsequent sections will provide more detail on Release 99 and Release 4 as these will be the releases utilized for the next few years by the majority of WSPs.

UMTS Release 99

Release 99 typically will be the first release deployed by a WSP in their migration to UMTS. R99 specifies the addition of the UMTS Radio Access Network (UTRAN), which is typically added to circuit-switched voice infrastructure and GPRS "Internet access".

Taking a few steps back, a GSM network would logically look like Figure 3.

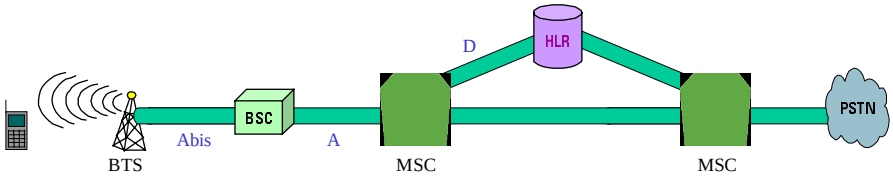

Figure 3 – GSM Network

It is interesting to note that in the early days of GSM, such a network was perceived as complex!

Addition of a GPRS overlay network would logically look like Figure 4.

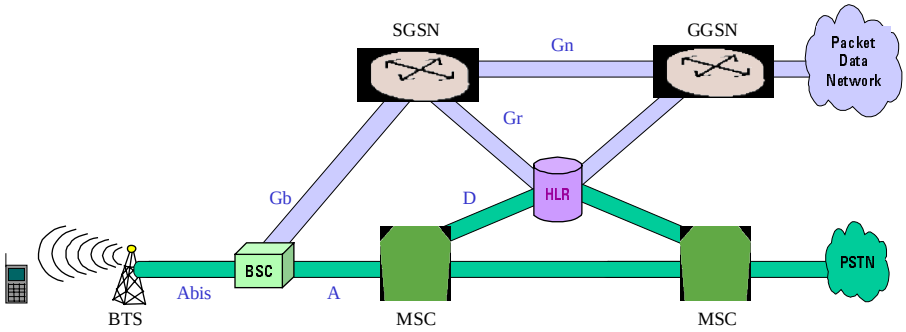

Figure 4 – GSM/GPRS Network

This overlay network effectively increased the bandwidth of the core network to allow high-speed data transfer with an "always-on" connection. The restricting factor for end-to-end high-speed data transfers became the Radio Access Network.

The addition of UMTS R99 effectively adds a new "front-end" high-speed network to the voice and data networks, removing the last major "speed bump". After the addition of UMTS R99 a wireless network would logically look like Figure 5.

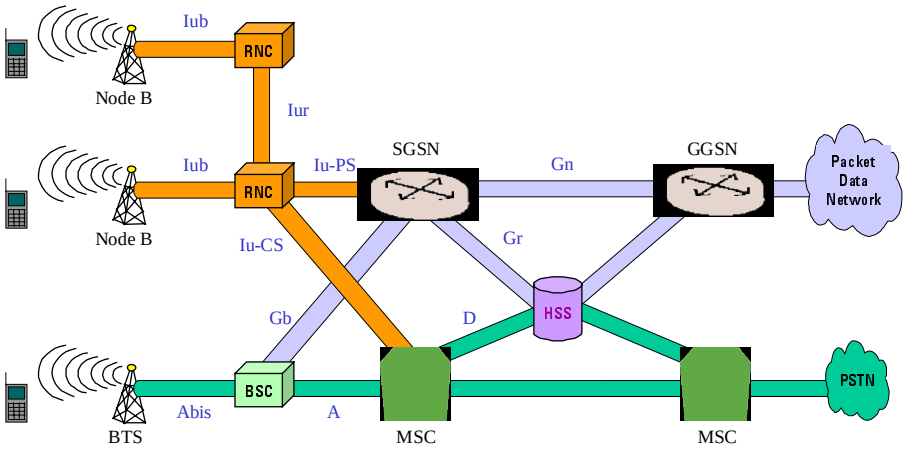

Figure 5 – UMTS Release 99 Network

The main reason why the UTRAN can offer a high-speed connection compared to the GSM/GPRS RAN is in the air interface mechanisms. In GSM/GPRS networks, modulation schemes known as Time Division Multiple Access (TDMA) and Frequency Division Multiple Access (FDMA) are used. In UMTS networks, the modulation scheme is known as Wide-band Code Division Multiple Access (WCDMA), which has two basic modes of operation: Frequency Division Duplex (FDD) and Time Division Duplex (TDD). These UMTS modulation schemes are inherently more efficient than their GSM/GPRS counterparts, which in turn enable faster connections.

The new network elements introduced as part of UMTS R99 are:

- The Radio Network Controller (RNC)
- The Node B

Radio Network Controller

The RNC is responsible for control of the radio resources in its area. One RNC will control multiple Node Bs.

The RNC in UMTS networks provides functions equivalent to the Base Station Controller (BSC) functions in GSM/GPRS networks. The major difference is that RNCs have more intelligence built-in than their GSM/GPRS counterparts. For example, RNCs can autonomously manage handovers without involving MSCs and SGSNs. This was something not possible using standard BSCs in GSM/GPRS networks.

Node B

The Node B is responsible for air interface processing and some Radio Resource Management functions.

The Node B in UMTS networks provides functions equivalent to the Base Transceiver Station (BTS) in GSM/GPRS networks. Node Bs are typically physically co-located with existing GSM base transceiver station (BTS) to reduce the cost of UMTS implementation and minimize planning consent restrictions. This is likely to have a detrimental effect on

UMTS quality as the UMTS Node Bs are being placed in non-optimal locations. UMTS operates at higher frequencies than GSM/GPRS and therefore the signal range is less.

New Interfaces

The new interfaces added as part of R99 are:

- Iu-CS
  - This is the circuit-switched connection for carrying (typically) voice traffic and signaling between the UTRAN and the core voice network. The main signaling protocol used is RANAP.
  - The equivalent interface in GSM/GPRS networks is the A-interface.
- Iu-PS
  - This is the packet-switched connection for carrying (typically) data traffic and signaling between the UTRAN and the core data GPRS network. The main signaling protocol used is RANAP.
  - The equivalent interface in GSM/GPRS networks is the Gb interface.
- Iur
  - The primary purpose of Iur is to support inter-MSC mobility. When a mobile subscriber moves between areas served by different RNCs, the mobile subscriber's data is now transferred to the new RNC via Iur. The original RNC is known as the Serving RNC and the new RNC is known as the Drift RNC. The main signaling protocol used is RNSAP.
  - There is no equivalent interface in GSM/GPRS networks.
- Iub
  - This is the interface used by an RNC to control multiple Node B's. The main signaling protocol used is NBAP.
  - The equivalent interface in GSM/GPRS networks is the Abis interface. The Iub interface is in the main standardized and open, unlike the Abis interface in GSM/GPRS.
- Uu
  - This is the interface between the User Equipment and the network. That is, it is the UMTS air interface.
  - The equivalent interface in GSM/GPRS networks is the Um interface.

UMTS Release 4

Most WSPs will migrate to Release 4 via Release 99. Release 4 specifies the migration of the circuit switched voice network to an ATM or IP core network. Other functional areas are also covered by Release 4, such as broadcast services and network-assisted location services.

Figure 6 shows an overview of a Release 4 network.

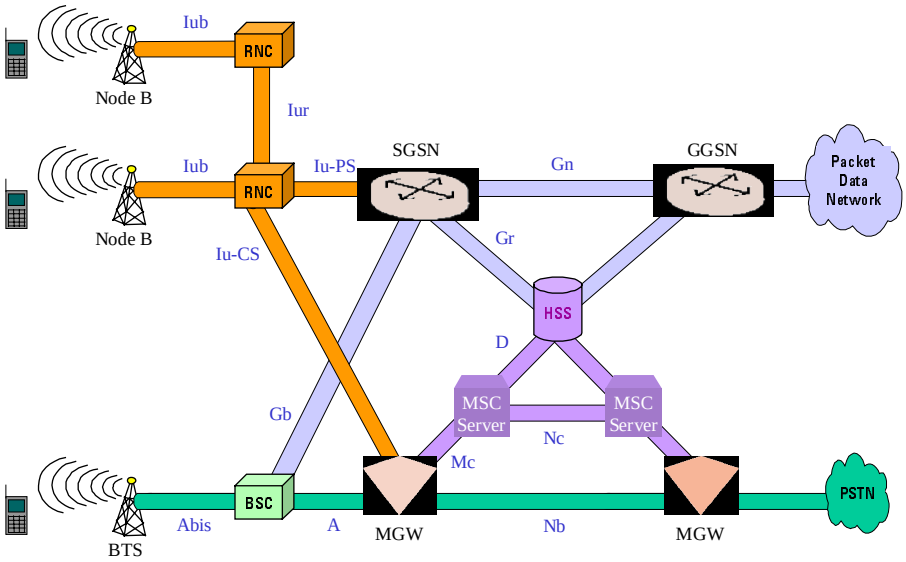

Figure 6 - UMTS Release 99 Network

Moving to a packet-switched core voice network will allow WSPs to gain from the inherent efficiencies of a Voice over Packet (VoP) network. In circuit-switched voice, a dedicated channel of fixed size (e.g. 64kbps) is assigned to carry the voice. In a normal voice call, this channel is under-utilized. In VoP, only the resources required are utilized.

In R4, the MSC functionality is split into two logical functions, which will typically be provided by physically separate network elements, namely:

- Media Gateway (MGW)
- MSC Server

The control functions of the MSC are now provided by the MSC Server.

The bearer switching functions of the MSC are now provided by the MGW.

Figure 7 shows this split of MSC functionality.

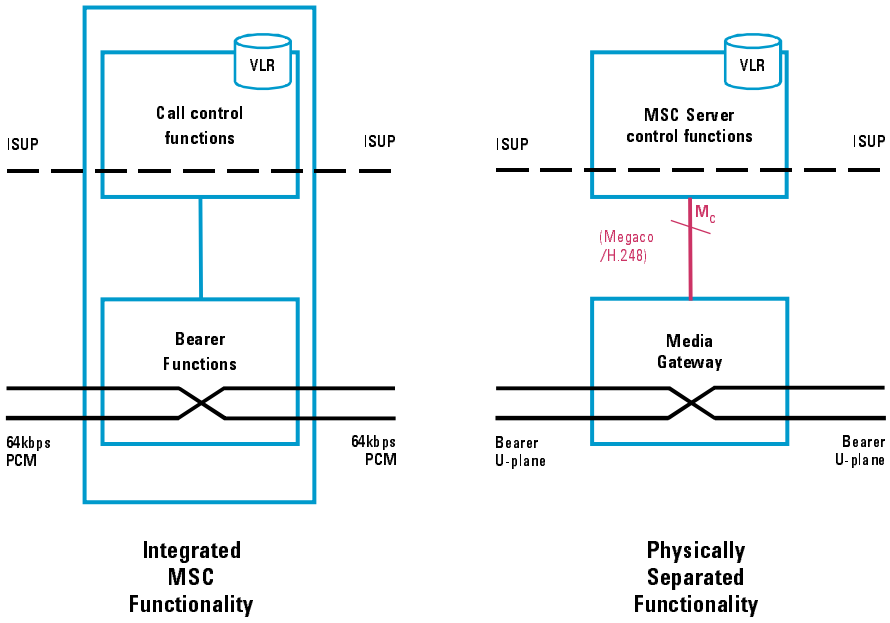

Figure 7 – Split of MSC Functionality in Release 4

UMTS Media Gateway

The MGW is responsible for switching the bearer, i.e. user, traffic. The MGW can also be utilized to convert bearer traffic between two different formats. For example, PCM circuit voice to VoP. The MGW will contain transcoders and echo canceling equipment.

UMTS MSC Server

In standard VoP terminology, this is known as a Media Gateway Controller. 3GPP have specified two instances of a Media Gateway Controller, namely the MSC Server and the Gateway MSC Server. The Gateway MSC Server is an MSC Server that controls the connections to other networks, e.g. the PSTN.

The MSC Server provides all the call control capabilities required by the MGW. The MSC Server is also responsible for Mobility Management. Typically, the MSC Server will also contain the Visitor Location Register (VLR) functionality.

A single MSC Server can control multiple Media Gateways. This provides major scalability benefits. That is, when extra capacity is needed, it may be possible to add only a new MGW and utilize an existing MSC Server.

New Interfaces

The new interfaces added as part of R4 are:

- Mc
  - The Mc interface is used by the MSC Server to control the Media Gateway(s). The protocol used on this interface is a derivation of the IETF H.248/MEGACO standard. The variations to the H.248/MEGACO standard are implemented using the H.248/MEGACO standard extension mechanism.
- Nc
  - The Nc interface is used to share signaling information between multiple MSC Servers involved in a session (e.g. a voice call). This in turn allows the relevant Media Gateways to be effectively controlled for the duration of the call. The call control protocol suggested for this interface is BICC (Bearer Independent Call Control). The actual bearer (i.e. Nb) transport used is transparent to the BICC signaling protocol, hence the term “Bearer Independent”.
- Nb
  - The Nb interface is used to transport data (e.g. voice packets) between Media Gateways. For example, one MGW may be connected to the UTRAN and another MGW is connected to the PSTN, with the voice packets being transferred between them using Nb.

OSS for UMTS

To ensure a successful migration to UMTS, WSPs must be able to rely on their management solutions evolving into the UMTS domain. One of the key management solutions for any network or service is the Operational Support System (OSS). It is the OSS that ensures the efficient operation of a network and associated services.

The OSS must evolve into UMTS so that the WSP has the same management solution for GSM, GPRS and UMTS. This will be key for UMTS as the data and voice traffic will flow between a WSPs GSM, GPRS and UMTS networks. For example, a voice call between a UMTS subscriber and a GSM subscriber within the same network will flow between the UMTS voice network and the GSM voice network. To allow rapid and efficient resolution of any issues with such voice calls, the WSP must be able to get a single view across these networks.

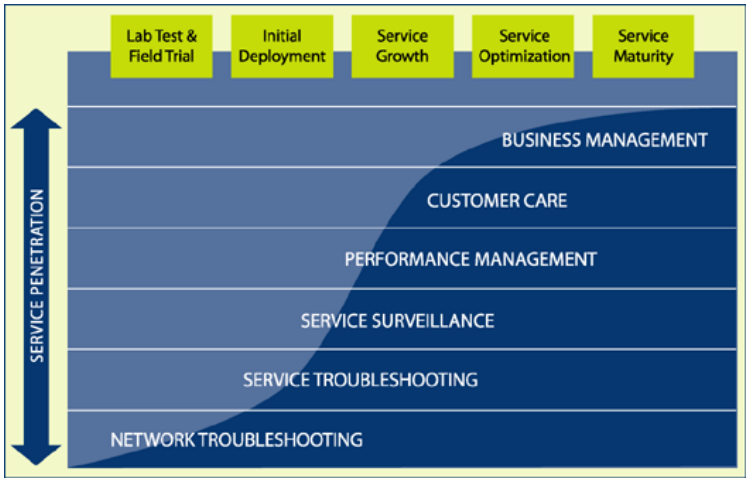

Figure 8 – Service Lifecycle

Figure 8 shows the key functions of the OSS which must evolve for UMTS. The OSS must be able to deliver these functions for UMTS from Day One. The reason is that the initial services available on UMTS will be the same services available today on GPRS and GSM. Therefore, mobile subscribers will expect these services to be as reliable and performant from Day One on UMTS as they have been so far on GPRS and GSM.

During initial UMTS network and service rollout the two main objectives of the WSP will be to ensure good RF coverage and to ensure the UMTS services work end-to-end. This is required to strengthen customer confidence and maximize service take-up.

The first of these objectives will be delivered via UMTS RF planning and optimization. One of the main management tools for this is Drive Test. The information from Drive Test is key in maximizing coverage, capacity and quality while minimizing cost.

The second of these objectives will be delivered via network and service troubleshooting. This involves making sure the network is providing the necessary resources to the mobile subscribers and that services are working end to end. The main data sources for this are:

- Active Test. These are probes placed around the country that check services are present and performing well. For example, for a new video streaming service the active test device can check that the Video Server is accessible, that the videos can be streamed from the Video Server to the handset and that the performance of the service is as expected. This can be done prior to service launch as well as at launch and during the growth phases.
- Non-intrusive Monitoring. These are probes placed on the network interfaces. By extracting the signaling and data from the network, the monitoring solution can build up a detailed end-to-end view of actual mobile subscriber activity. In the video-streaming example, if issues occur the monitoring solution can quickly pinpoint the root cause of the issue.

During the growth of new UMTS services, new WSP objectives will include assuring the uptime and performance of the UMTS services for all subscribers. This is required to maximize revenue from these services. This objective will be delivered via service surveillance and performance management. Once again the main data sources will be Active Test and Non-intrusive Monitoring.

Active Test will continually highlight the performance of the service from an end-to-end perspective. Non-intrusive Monitoring will measure the performance of the services across the customer base and will highlight any degradation.

Assurance of the UMTS services during the growth stage is critical. By offering a highly reliable, highly performant and valuable UMTS service to a large subscriber base, the WSP will guarantee the confidence of the users of that service. However, services that work efficiently during the launch phase may not work as well when the network or service is placed under heavy load during the growth phase. Having the right UMTS OSS can help ensure that any issues during service growth are quickly identified and resolved. Active Test can close the loop to ensure fixes have worked.

By having the right UMTS management tools, the effectiveness of these lifecycle phases can be maximized and the success of UMTS guaranteed.

Related Agilent Solutions

Agilent has supplied leading-edge measurement products and services to the communications industry for more than 60 years, across the complete lifecycles of many generations of technology.

Agilent has been at the forefront of UMTS measurement technology with instruments for R&D, manufacturing, network deployment and network optimization. Now we are applying our UMTS expertise to evolve and enhance the capabilities of our proven GSM and GPRS OSS solutions.

Agilent's solutions for UMTS network build out and trials include:

Protocol and Signaling Analyzers

With UMTS greatly increasing the complexity of mobile networks, it's no longer enough for a protocol tester to be able to pinpoint a signaling issue to solve a problem. Agilent's analyzers provide unrivalled measurement capabilities from the UTRAN to the core. They provide lower layer protocol analysis and higher level signaling analysis in an easy-to-use, flexible package.

Voice quality testers

Agilent's Voice Quality Analysis solutions perform passive or active voice quality analysis in circuit-switched and packet-switched networks to help ensure quality remains high.

Drive test tools

Agilent's attended and unattended drive-test systems give you the comprehensive phone and digital receiver measurements required to optimize your network and quickly solve RF problems.

Data service assurance

The Data Service Assurance active test and drill-down troubleshooting capabilities provide much-needed help in establishing service quality measurement base lines and resolving network and performance problems.

Consisting of drive test tools, data sequencing, active tests and analysis software this solution gives your RF and optimization engineers insight into the network's end-to-end quality of service—from the subscriber's perspective. RF, user application, and IP core measurements are integrated and results are presented through a single user interface for analysis and reporting.

Launching services

Once your UMTS network becomes stable, you need to test service performance to ensure successful take-up by early adopters. Agilent's Wireless QoS Manager provides real-time active testing of critical services—as seen from the end-user perspective.

Agilent's solutions for UMTS service launch and growth include:

Overall Service Management

To manage your entire service operations with maximum efficiency, Agilent's Wireless Service Manager aggregates and consolidates data from multiple sources—including UMTS and 2/2.5G components—into a single, intelligent dashboard view of current service quality, with drill down into detailed network and service views. This provides service status information to enable you to isolate and prioritize the resolution of those service problems that have the greatest impact on subscribers and ultimately on your business.

Service-specific Testing

As services achieve mass-market appeal and their take-up accelerates, active testing with Wireless QoS Manager lets you proactively validate service operation from different remote locations. This provides the key performance and quality indicators (KPIs/KQIs) to ensure that quality is maintained end-to-end.

Service Monitoring Solutions

For ongoing network and service troubleshooting, Agilent's solutions extract signaling and user-data messages from key UMTS, GPRS and GSM interfaces to feed call trace and protocol analysis applications, allowing you to rapidly diagnose and pinpoint faults.

For real-time surveillance, Agilent's QoS Analyzer features a rich set of key performance metrics relating to the network, services and customers. These metrics are used for real-time or historical analysis, trending, base-lining and SLA tracking. QoS Analyzer can integrate with the troubleshooting applications to provide detailed diagnostics on the affected service and the impact to customers.

Business customers use roaming services to transact business on the move. The Agilent Roaming Management System provides you with a real-time picture of service quality as

experienced by roamers in your network or as experienced by your customers when they roam internationally.

To resolve customer service calls with greater efficiency, Agilent's Session Analyzer gathers together signaling information (such as connection, mobility, and user authentication), and service data relating to a specific call. The information is summarized in an easy-to-use format, enabling less skilled users to perform basic troubleshooting, or to route calls to the appropriate team.

Acronym Guide

3GPP	3G Partnership Project
ATM	Asynchronous Transfer Mode
BSC	Base Station Controller
BTS	Base Transceiver System
GSM	Global System for Mobile Communications
GPRS	General Packet Radio Service
IMS	IP Multimedia Services
IP	Internet Protocol
MGW	Media Gateway
MSC	Mobile Switching Center
OSS	Operational Support System
PSTN	Public Switched Telephone Network
RF	Radio Frequency
RNC	Radio Network Controller
SGSN	Serving GPRS Support Node
UMTS	Universal Mobile Telecommunications System
UTRAN	UMTS Terrestrial Radio Access Network
VoP	Voice over Packet
WSP	Wireless Service Provider

Biography

Kevin O'Donnell is a Product Manager, based in the UK, focusing on the Agilent OSS Wireless portfolio. Kevin has over 13 years experience in the Wireless OSS Business with a variety of roles in R&D and Marketing. Most recently, Kevin has been involved in the evolution of the Agilent OSS portfolio to the UMTS domain.

Kevin joined Agilent/HP in 1994 and was initially focused on working with Wireless Service Providers in identifying the customer needs in evolving the acceSS7 non-intrusive monitoring solution to the GSM market.

Kevin began his career at AT&T Network Systems designing and developing SMS code for the 5ESS switch.

Kevin holds a 1st Class BSc in Computer Science & Electrical Engineering from Strathclyde University.

About Agilent

Agilent Technologies is a leading provider of components, test, measurement, monitoring and management solutions for the communications industry. Agilent enables designers, manufacturers and service providers to accelerate the delivery of next-generation devices, networks and services. Agilent's broad set of solutions and services includes optical, wireless, Internet and broadband technologies that span the entire communications life cycle.

Agilent OSS solutions gather information from the network via probes, gateways, agents and test devices for network, service, customer and revenue assurance. With a real-time, proactive, end-to-end view of network and service health, performance and quality, service providers can deliver comprehensive service management to ensure customer satisfaction. Agilent OSS solutions have delivered extensive ROI to over 200 service providers worldwide, through operational efficiencies, improved quality of service and increased revenue

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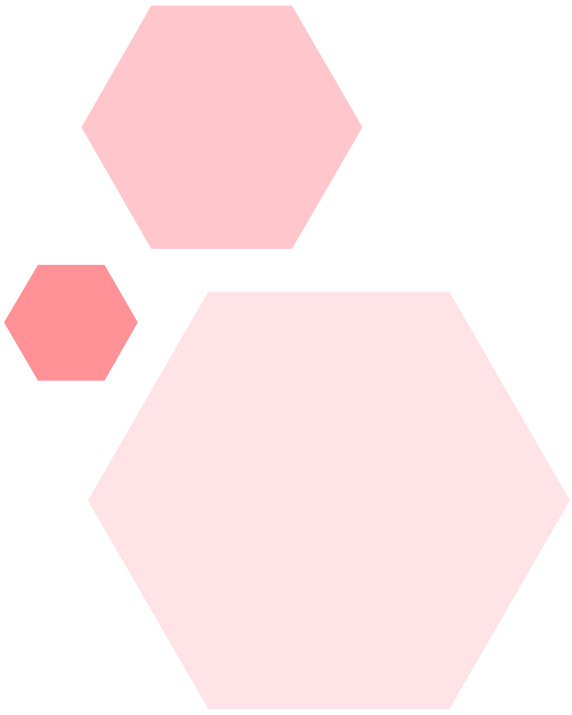

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