International Softswitch Consortium

Wireless Working Group

Softswitch Applications in Wireless Core Networks

An Overview

Major Contributors:

David Franklin, NMS Communications
Martine Lapierre, Alcatel SA
Rich Poole, AudioCodes, Inc.
Ravi Ravishankar, Tekelec
Sam Samoohi, UT StarCom
Qun Shi, UT StarCom

Editor:

Rich Poole
International Softswitch Consortium
Wireless Working Group Chair
rich.poole@audiocodes.com

Version: 1.1 - April 18, 2002

Softswitch Applications in Wireless Core Networks

Table of Contents

1. Introduction

Wireless networks are still an area of growth investments, whatever crisis the Telecom Operators may suffer. As a matter of fact, if the mobile penetration rate seems to stabilize in some countries like Western Europe, there are still a lot of countries globally that are experiencing significant growth of their mobile networks. Along with the subscriber growth potential globally, 3G cellular networks, with their focus on higher bandwidth to the mobile user, offer new services for the mobile user, like wireless access for laptop computers with the sending and receiving of emails with attachments, video-based services, and of course voice services.

3G networks are migrating to use packet-based transport within the 3G networks, voice is also migrating over to this packet network and the introduction of softswitch-based architecture, where the Mobile Switching Center (MSC) is disaggregated into a call control MSC Server (Softswitch) and switching Media Gateway(s), promises to offer many benefits to network operators worldwide.

This whitepaper has been created to document the use of softswitch architecture in wireless core networks. This paper is meant to provide a high level overview of the state of technologies within the different generations of wireless and the current state of the standards governing the wireless marketplace, as well as provide high level information concerning the use of softswitch architecture model within the wireless core network.

2. Background

The advent of Voice over Packet has brought about a major technological shift in the delivery of voice calls between users. In Voice over IP (VoIP), voice bearer traffic is sent in data packets over private or public IP networks instead of being circuit switched onto dedicated trunks in the Public Switched Telephone Network (PSTN) for the length of the call. In the cellular environment, voice bearer traffic has been circuit switched through Mobile Switching Centers (MSCs), as in legacy telephony.

The Third Generation (3G) cellular networks being planned are specifying a move from delivering voice over dedicated circuit switched trunks to delivering voice over a core packet network. Likewise, Universal Mobile Telecommunications System (UMTS) has defined a migration to a packetized core network where voice bearer traffic is delivered using packets over this new core network. The 3GPP standards specify several 'releases' of specifications to handle this migration from a circuit switched core network to an All-IP core network. Release 1999 (R99) has specified ATM for the Core Network (CN) and defines the Iu-cs (Circuit Switched) interface for the delivery of voice bearer traffic from the Radio Access Network (RAN), to the Core Network, through one or more media gateways and ultimately to the PSTN. Release 4 (R4), utilizing the same ATM Core Network, specifies a decoupling of switching and call control within the MSC into separate elements, namely the **Media Gateway**, which provides the switching portion of the legacy MSC, and the **Wireless Softswitch** (or MSC Server), which provides the call control portion of the legacy MSC. This architecture is analogous to the decoupling of Class 4 and Class 5 legacy circuit-switches into Media Gateways and Softswitches in the VoIP marketplace. Release 5 (R5) builds on the packet core network and specifies a move from an ATM core network to an All-IP core network for the deliver of voice, data and multimedia services.

While R99 specifications call for ATM-based monolithic MSCs for the core network, some vendors are beginning to offer MSC Servers and media gateways that are R99 compliant. Instead of deploying a legacy ATM-based circuit-switched MSC for R99 networks which will potentially be replaced by Media Gateways and MSC Servers in R4 networks, Service Providers can begin to choose to deploy an R99-compliant Media Gateway / wireless softswitch solution that provides the advantages of R4-based decoupled switching and control in a R99 compliant solution. Decoupling the switching from the call control allows Service Providers to distribute the AAL2 switching (provided by the media gateways) while centralizing the call control (provided by the wireless softswitch). Operators can deploy Media Gateways within networks where PSTN connections are required instead of centralized, as MSCs are today. Thus, the operators will benefit from reduced backhaul costs, as well as utilizing more efficient packet-based transport for voice bearer traffic. Deploying the MSC Server centrally reduces the Operational costs of operating and maintaining an MSC, a primary reason for centralized MSCs in legacy networks.

Deploying a R99-compliant Media Gateway and MSC Server solution, instead of a legacy R99-compliant MSC, should allow for a more cost effective use of Capital Expenditures and Operational Expenditures within the Wireless Service Provider's operations. Naturally, it will be Service Providers' decision to choose either to deploy R99 monolithic MSCs based on existing technologies or the new MSC Server / Media Gateway solution depending upon their own criteria (e.g. existing network, existing relationships with vendors, timeframe for migration to R4/R5, etc.).

Wireless Softswitches and Media Gateways can also be utilized in Second Generation (2G) cellular network, as well as provide interworking with Voice over Packet (VoP – either Voice over IP or Voice over ATM) networks by providing vocoding from cellular vocoders to VoIP vocoders (e.g. G.711, G.726, G.723.1, etc.). These applications will be further discussed in the next section.

3. Softswitch Applications in Wireless

This section provides an overview of softswitch applications within wireless networks and provides a high level overview of the 3G, 2G and the migration from 2G to 3G.

3.1 3G Applications

Third generation (3G) mobile wireless systems are currently being standardized worldwide and anticipated to be deployed in 2003 – 2005 timeframe. The 3G systems can offer up to 2 Mbps data rates and therefore cover a wide range of multimedia services including voice, data and video. Two primary 3G standards are being developed, namely, the Third Generation Partnership Program's (3GPP) UMTS standard and one based on Third Generation Partnership Program 2's (3GPP2) CDMA2000 standard. UMTS primarily provides a migration path from 2G GSM-based networks and CDMA2000 primarily provides a migration path from 2G CDMA-based networks. The former is mainly targeted for European and Asia markets, while the latter is mainly targeted for the Americas and some Asia markets.

3.1.1 3GPP UMTS

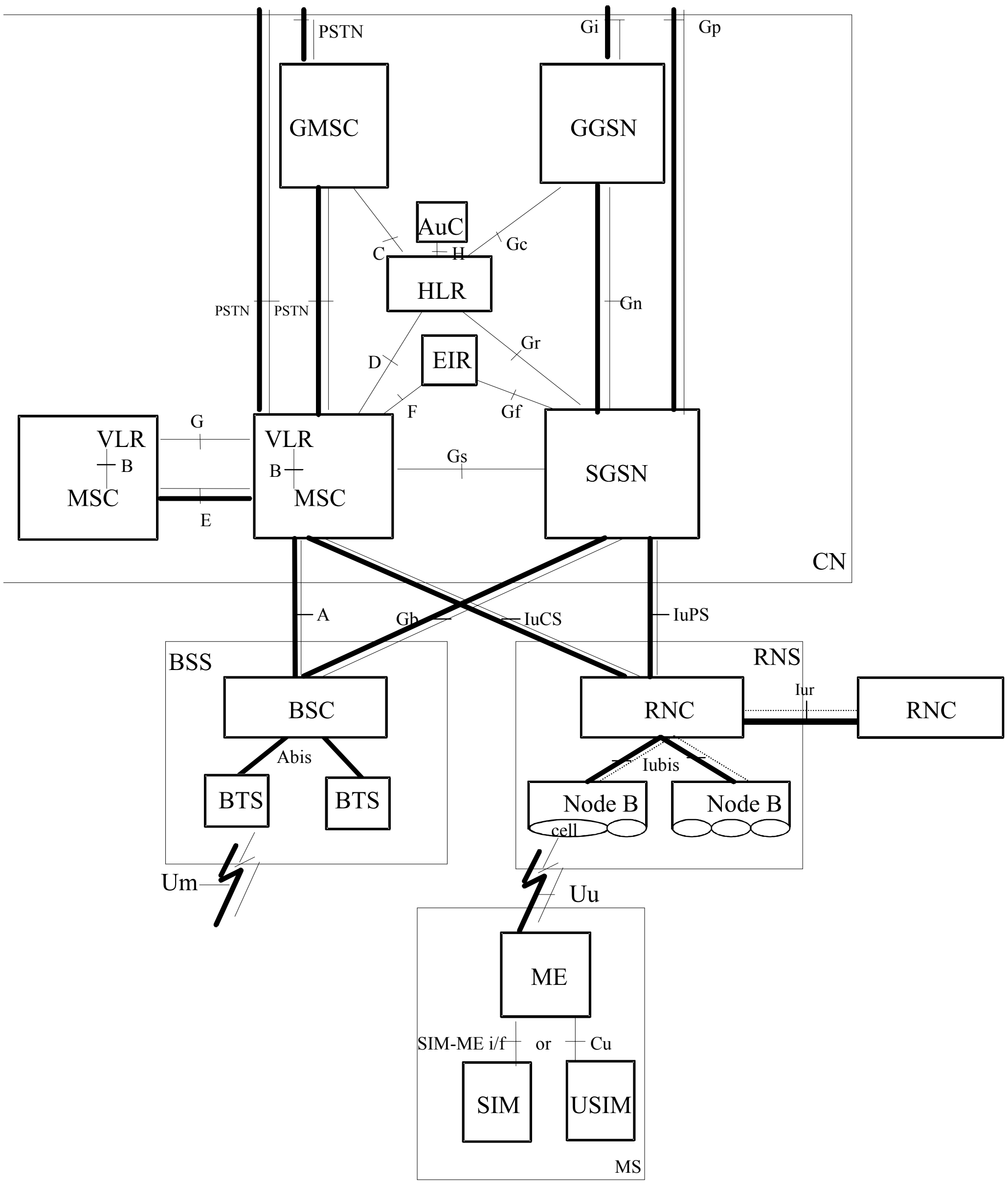
Third Generation Partnership Program (3GPP) UMTS releases (Release 1999, Release 4 and Release 5) are often referred to by their abbreviated names:

- **R99** specifications which were frozen in March 2000
- **R4** specifications which were frozen in March 2001 (both currently constitute the latest complete set of UMTS specifications)
- **R5** was scheduled for freeze in March 2002, but is experiencing some delays.

The 3GPP website (http://www.3gpp.org) provides a wealth of information, including specifications for all UMTS releases.

R99

Services provided by R99 are the same as those offered in 2G+ networks, although newer services can be implemented in a more timely fashion if a softswitch-based model is employed. With R99, a large range of new services is available, enabled by a higher data bandwidth available to end users, that cannot be offered in today's 2.5 G networks or are uneconomical to offer. Thanks to the broadband transmission available, users will be able to gain access to full wireless email versus the limited Short Message Service available on 2G networks. Along with this, voice traffic will continue to make up the large share of traffic within the network. For R99, MSCs must be upgraded to include ATM interfaces to support the connection to 3G RNCs, whether or not the MSC remains monolithic or is decomposed into a softswitch / media gateway model, as mentioned previously. Voice is transmitted from mobile phones utilize a new Adaptive Multi-Rate (AMR) vocoder, consisting of 8 different vocoder rates which can be used to optimize the performance of the cellular network. The transport of AMR voice packets in the core network is over ATM Adaptation Layer 2 (AAL2) to media gateways or MSCs, where it is transcoded into TDM to be sent over the Public Switched Telephone Network (PSTN).



R99 Network Diagram

Diagram courtesy of 3GPP

R4

In R4, Softswitches (MSC Servers) and media gateways are decoupled as compared to the previous monolithic MSC all-in-one structure. The MSC Server and media gateway can serve as a MSC replacement for R99 or even 2G MSCs, providing for a seamless evolution to R4 network elements. For mobile-to-mobile voice calls, as in the previous releases, the voice packets can be sent directly using either Tandem Free Operation (TFO) or Transcoder Free Operation (TrFO), thus decreasing latency and improving voice quality. In R4, media gateways can become ATM switches when TrFO is used. Voice transport in the core network is over ATM using AAL2. The softswitch (MSC Server) provides the same services as the 2G and 3G R99 MSC does except for voice bearer switching and processing. The media gateway provides the voice bearer switching from the packet core network to the circuit-switched legacy PSTN. The softswitch controls the media gateway via a standardized control interface using Media gateway control (Megaco) protocol.

Though the wireless Softswitch looks on the surface like a wireline Softswitch used for fixed Class 5 service, the software program of the wireless softswitch must be compliant with GSM and UMTS specifications and provide the necessary functionality to control the RAN and mobile users. This added complexity must also comply with standards-based protocols and procedures, such as CAMEL triggers, GSM MoU required features, Subscriber Information Management (SIM) procedures, communications with Home Location Registers (HLRs), communications with other MSCs' Visiting Location Registers (VLRs), etc. This added complexity makes the wireless Softswitch much more complicated than a wireline softswitch.

Release 4: Signaling & User Plane

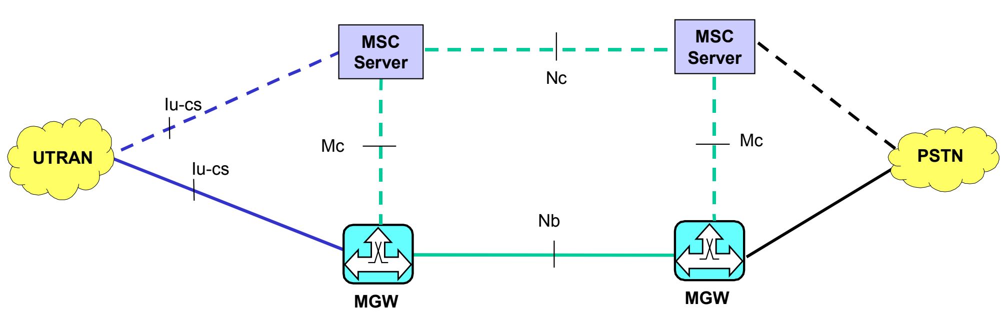


Diagram courtesy of 3GPP

R5

The core network migrates to all IP, with IPv6 recommended, and new IP multimedia services may be employed. End-to-end Quality of Service (QoS) is possible for packet-switched data. R5 specifications call for the MSC Server to be disaggregated into the Media Gateway Control Function (MGCF) and the Call State Control Function (CSCF), but it is still a softswitch though it now deals with multimedia call control which diverges quite a bit from voice call control. As an example, SIP is used between MGCF, CSCF and other Media Server SIP agents to provide call control signaling. As an example, the CSCF can be limited to simply passing SIP commands (e.g. SIP proxy) to another application server that would then run the call control for that particular session or call. R5 is not yet finalized in the Standards committees, but it is clear that it makes full use of new packet-based infrastructure, network elements and protocols. R5 may introduce a new Adaptive Multi-Rate – Wide Band (WB-AMR) vocoder for improved speech quality. AMR-WB has been approved by the ITU and is defined in the G.722.2 specification for both UMTS use and wireline.

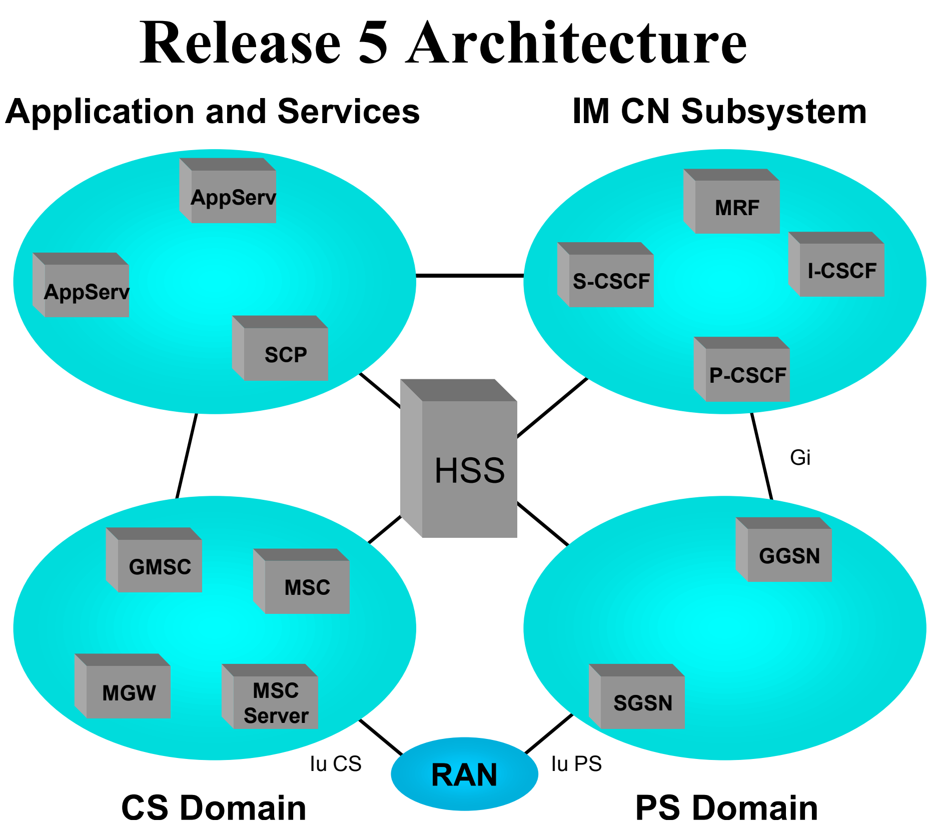


Diagram courtesy of 3GPP

R5 also introduces new network elements such as Home Subscriber Server (HSS) and innovative concepts such as Virtual Home Environment (VHE). HSS manages information about the mobile subscriber, similar to a 2G HLR, but expands it to include additional information such as location information which can be used to develop location-based services. The VHE is a concept that enables the portability of subscriber's personal services across network domains of multiple operators. The subscribers can create their own service environment by means Personalized Service creation Environment (PSE) and they are presented with the same personalized features, user interface and charging mechanisms as they roam across multiple networks.

Additionally, Application Servers are capable being added to the network, accessible via an open interface (OSA) based on Parlay / SIP-S protocols. The Application Servers receive information from the HSS and PSE, as well as the CSCF. These various interfaces are variants of SIP with specialized syntax to create new value in this active network.

Definition of OSS interfaces, provisioning, traffic management, Quality of Service (QoS), charging and observation of the various network elements and servers are currently left open, which could place to proprietary implementations that limit the ease to introduce an alternative network element quickly.

The ISC Wireless Working Group will continue to monitor the 3GPP activity for softswitch-based core network architecture.

3.1.2 3GPP2 CDMA2000

The Third Generation Partnership Project 2 (3GPP2) (www.3gpp2.org) is a collaborative third generation (3G) telecommunications standards-setting project comprising North American and Asian interests developing global specifications for ANSI/TIA/EIA-41. The 3GPP2 consist of the following Technical Specification Groups (TSG):

TSG-A (A-Interface System): responsible for the specifications of interfaces between the Radio Access Network (RAN) and Core Network.

TSG-C (cdma2000): responsible for the Radio Access part CDMA2000 specification.

TSG-N (ANSI-41/WIN): responsible for the specifications of the Core Network part of the system.

TSG-P (Wireless Packet Data Interworking): responsible for the specifications of the Internet and IP Multimedia Core Network part of the system

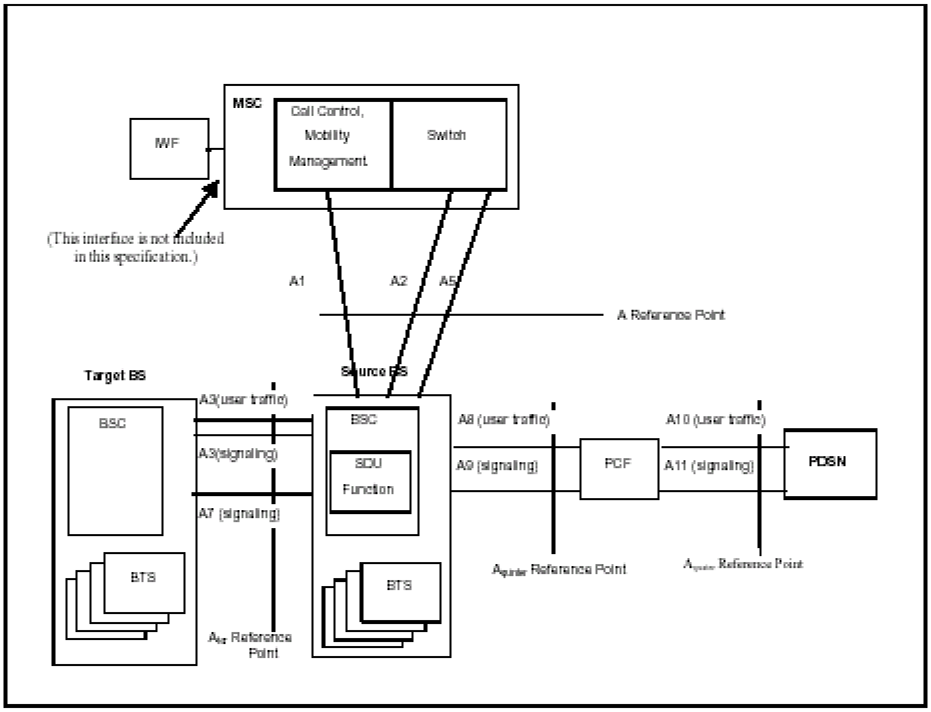
TSG-S (Services and Systems Aspects): responsible for the development of service capability requirements for the system.

All IP AdHoc, under TSG-S, was designated to define the high level requirements and network architectures required to support the future all-IP wireless Internet access. This TSG is no longer active and the work has been assigned to TSG-N.

The 3GPP2 specifications have been evolving from the initial CDMA 2000 air interface specification, which improved the existing voice and low speed data services to support voice and high-speed packet data. The 3G basic premise has been to provide high speed data, Internet access and multimedia services, that were lacking in the 2G and 2.5G wireless networks. Therefore, both 3G standards bodies (3GPP and 3GPP2) have been concentrating on providing the architecture for these applications.

The initial 3GPP2 specifications were based on the CDMA 2000 1X technology that provides voice services and up to 144 kbps packet data. In this phase, the 3GPP2 reference model introduced the RAN interface to the new Packet Data Service Node (PDSN) to provide high-speed packet data (Internet) services. The voice services continued to be supported by the circuit-switched MSC. A main focus of the standard was to adopt TIA-EIA-41 based services and address the inter-working issues.

As it can be seen in the following diagram, the 3GPP2 reference model continues to support the circuit-switch MSC architecture for voice services. (See 3GPP2-A.S0001-A version 2.0 June 2001). As mentioned above in the 3GPP introduction, the 2G and 3G MSC can be replaced today by a Softswitch architecture MSC (i.e. MSC server, media gateway and signaling gateway) with either circuit-switched or packet interconnect capabilities, depending upon availability of circuit or packet interfaces from the RAN. This allows service providers to gain the benefits of softswitch architecture in today's networks.



The next phase of the standard was the introduction of 1XEVolution-Data Only technology (1XEV-DO), which provides for a dedicated data only CDMA channel for higher data speed. Currently, the 3GPP2 standards are finalizing the 1XEV-DO specification for the data rates of up to 2.4 Mbps down link and 307 kbps uplink, using the same 1.24 MHZ channel as 1X, but dedicated purely for data only. Since the 1XEV-DO main focus was on the data services, the standards continue to support the circuit-switched (MSC) architecture for voice services.

The next phase of the 3GPP2 specifications plan is to support the 1X Evolution-Data and Voice, known as 1XEV-DV, which will provide support for both voice and data rates of up to 5Mbps using the same 1.24 MHZ channel bandwidth. Since this technology supports both voice and data services, the standard will address the all-IP core network requirements in this phase. The specification for the all-IP core will be defined by the TSG-N.

The preliminary work that was done by the all-IP adhoc-working group indicates that the architecture for the IP core network will follow the 3GPP R5 IP network model. The 3GPP R5 IP core network builds upon the MSC Server (MGCF & CSCF), media gateway and signaling gateway model, as well as the new application or feature servers (via open service access).

The softswitch architecture can easily support the CS Core IP architecture with additional interfaces to the Home Location Register (HLR) and Visiting Location Register (VLR).

The ISC Wireless Working Group will continue to monitor the TSG-N activity for IP core network architecture.

3.2 2G Applications

This section describes uses of softswitch applications within 2G wireless networks.

3.2.1 Packet Backhaul for IMT and remote PSTN termination

Today, most MSCs are interconnected using mesh network architecture. Each MSC is connected to several other MSCs using TDM-based Inter Machine Trunks (IMT). The IMT trunks on the MSCs serve three types of connections:

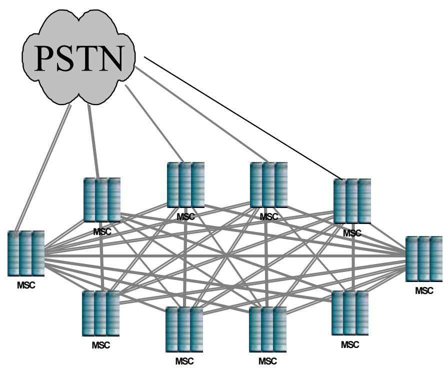
- For inter-MSC hand-off as subscribers with active calls move from one MSC serving area to another MSC serving area.
- For calls originating & terminating between MSCs.
- For calls originated & terminated between the mobile networks & PSTN. These trunks connect MSCs to a PSTN Class 4 or Class 5 switch.

For the most part, in today's networks, MSCs are interconnected using a mesh interconnection architecture. Each MSC is connected to a large number of other MSCs using IMT trunks to handle inter-MSC calls. Though this approach is manageable in a small network, it becomes extremely complex to manage as the network expands and grows. Another disadvantage of mesh network is the large transport cost associated with the large number of meshed trunks required between MSCs.

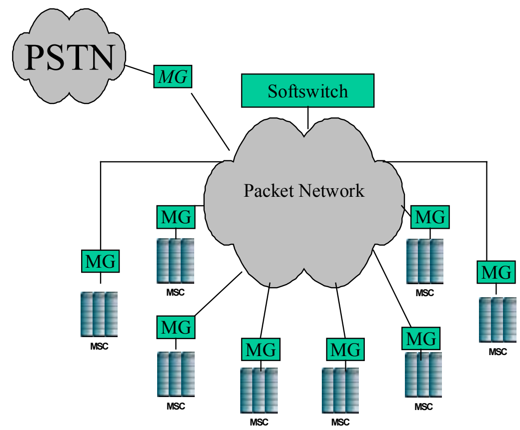
An immediate opportunity for the operators to reduce cost & network complexity is to introduce a Softswitch-based packet Tandem Switching capability within their network. Instead of routing the calls using circuit-based IMT trunks, the calls are routed over an IP network within the core of the network. This approach must be minimally intrusive to the current network architecture for it to be attractive. This is accomplished by deploying packet tandems comprised of a centralized softswitch controlling an overlay of distributed media gateways. IMT trunks from each MSC are terminated on a media gateway typically collocated with each MSC. The trunks from PSTN are also terminated on these media gateways. The media gateways perform the packet conversion of voice and routing the voice call to the destination MSC under the control of softswitch. This architecture has minimal impact on the MSCs as they continue to route calls over TDM circuit. The benefits of this approach are that it reduces the long haul transport cost by eliminating point-to-point TDM trunks between MSCs and simplifies the network architecture. As the network continues to grow and new

MSCs are added, IMT trunks are added to the packet core network thereby not requiring the setup of circuit-based trunks to all other MSCs.

The figure below compares the mesh architecture with a packet-based architecture:



MSC Mesh architecture



Softswitch based Packet Tandem

3.2.2 Routing Gateway-MSC with Packet IMT Network

Building on the Packet Backhaul solution, the Media Gateways would also receive incoming PSTN calls, along with the IMT traffic. When a call arrives at the Media Gateway from the PSTN, the Gateway-MSC Server, using GSM-MAP or ANSI-41 SS7 messages to interrogate the Home Location Register (HLR) subscriber database server, determines the mobile’s location. The call is then forwarded to the Visiting MSC, often bypassing the Home MSC, thereby freeing up capacity on the Home MSC to handle additional revenue generating calls. The Routing Gateway-MSC does not introduce new billing records because incoming calls are always forwarded to and recorded by an existing MSC. This is an extension of a Class 4 VoIP Routing Tandem application where the Routing Tandem is mobile network-aware and can interrogate the mobile HLR to determine the proper routing of the incoming call to the Serving MSC. For both the Packet IMT Network and the Routing Gateway-MSC applications, the softswitch can control the media gateways using either MGCP or Megaco control protocols.

This solution presents many benefits for the System Provider, including the experience gained in the deployment of voice over packet networks while lowering operational costs. With the routing of calls destined to other MSCs being handled by the Routing Gateway-MSC, valuable legacy MSC resources are freed-up to handle additional revenue generating calls.

3.3 Migration from 2G to 3G

Second generation (2G) wireless networks are widely deployed today. The two dominate 2G systems in today's markets are Global System for Mobile communications (GSM) and IS-136 and IS-95 Code Division Multiple Access (CDMA). The 2G systems are, however, limited by data rates (i.e., 9.6 kbps) and were primarily designed to provide voice services.

The 2.5G system, e.g., GSM phase 2+, can provide enhanced data services ranging from 28.8 kbps to about 100 kbps, such as high-speed circuit-switched data (HSCSD) and General Packet Radio Data (GPRS). While 2.5G systems can provide some new services such as Internet access and web browsing, they are still limited in data rate and cannot offer more advanced services like multimedia video streaming, real-time imaging transfer, or video conferencing.

To evolve from 2G circuit-switched voice networks to 3G packet-switched multimedia networks, it is desirable to have graceful migration path from existing circuit-switched networks to the new packet-enabled network architecture with the following purposes in mind:

- extending the service provider's service offering to include high-speed multimedia services
- leveraging the Packet infrastructure for establishing the basis for the mobile core network
- leveraging the common core network for interworking between the 2G and 3G services and for extending subscriber reach to other external networks and enhancing operator service-delivery opportuniies.

The initial phase of the network migration may begin with the deployment of a packet-overlay data network, such as GSM's GPRS network, for enabling packet data services in 2G systems. For example, the GPRS overlay network is the IP or IP over ATM packet data network for providing data and Internet based services. In the GPRS network, the Serving GPRS Service Node (SGSN) and Gateway GPRS Service Node in the GPRS overlay network, are analogous to the MSC and Gateway-MSC (GMSC) of the circuit-switched GSM voice network and play the important role of interfacing with the Radio Access Network (RAN) and external IP-based packet network. This initial phase makes the first step to the ATM networks required in UMTS R99. It provides data capability but with the use of an overlay network, so that the operator must maintain a circuit-switched voice network along with a packet-enabled data network. This core network will provide interoperability between RANs and connectivity to external voice and data networks and support the new application services that Service Providers will offer. It will also provide the flexibility for fast deployment of new service offerings.

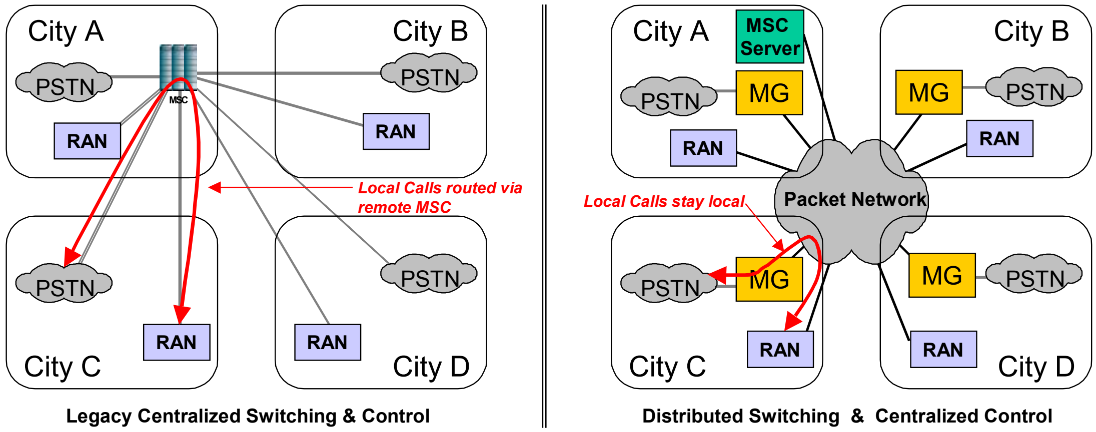
As mentioned previously, a step towards the converged 3G voice and data packet network architecture, Service Providers can opt to packetize their 2G voice MSC InterMachine Trunks (IMTs) and utilize a Packet-based Gateway-MSC application to reduce operational costs of operating large cellular networks. In this case, instead of operating leased circuit-switched trunks between each of the MSCs in a mesh configuration, the Service Provider can install Media Gateways at each MSC location where the voice is packetized and sent over the core data network.

This core network can then evolve to include both voice and data applications using the softswitch-based distributed architecture which includes MSC Server / Softswitch for call control and Media Gateways for bearer path delivery. The 3GPP committees have specified this architecture as the new 3G UMTS core network architecture and calls for this type of architecture to be initially deployed in Release 4, but this architecture can be deployed earlier in Release 99 compliant networks to take advantage of the many benefits of softswitched-based core networks. The softswitch-based core network builds upon interworking gateways (media gateway, signaling gateway, etc.), packet voice call-control and signaling (MSC server and GMSC server), and the new multimedia application or feature servers (via open service access) that will generate new revenue streams for the operator.

4. Features and Benefits of Softswitch Architecture in Wireless Networks

4.1 Distributed Switching

Legacy circuit-switched networks utilize centrally located MSCs to provide the needed switching of voice calls between the Radio Access Network (RAN) and the PSTN. Due to the significant cost of operation and staffing of operational personnel to operate a MSC, Service Providers have deployed large centrally located MSCs at the expense of backhauling the voice circuits from RAN located in each city and likewise backhauling of the voice circuits to local PSTN connections within each city. It should be noted that most local calls stay local, that is when a mobile subscriber makes a call, they usually call someone within their own city or local area. Since most calls stay local, this calls for double the circuits from the local RAN to the MSC and from the MSC to the local PSTN. This is shown on the left side of the following diagram.



As show on the right side of the above diagram, using the softswitch-based architecture of centralized MSC Server/Softswitch with Media Gateways, call control and voice processing / switching are separated allowing for Media Gateways to be placed where they can provide the most value and the complex call control can still be centrally located. By deploying distributed switching, Service Providers can significantly reduce the backhaul charges that they would have to pay because the bearer voice stays local for local calls and does not require to be shipped back to the central location only to be shipped back again to the local area for completion to the local PSTN.

Another key benefit of using the softswitch-based distributed architecture is to share the core network between voice traffic and GPRS data. The Service Provider now has one network to maintain instead of 2 networks as they do in 2.5G networks.

4.2 Deploy services off Softswitch

Wireless operators are deploying standards-based services using mobile Intelligent Network (IN). The GSM standard for the mobile IN is Customized Application for Mobile Enhanced Logic (CAMEL). Similarly, the U.S. CDMA & TDMA markets are standardizing on Wireless Intelligent Network (WIN). Though many services, such as prepaid, today are deployed using proprietary extensions to the IN protocol, extending these services to roaming partners requires the implementation of standards-based CAMEL & WIN services.

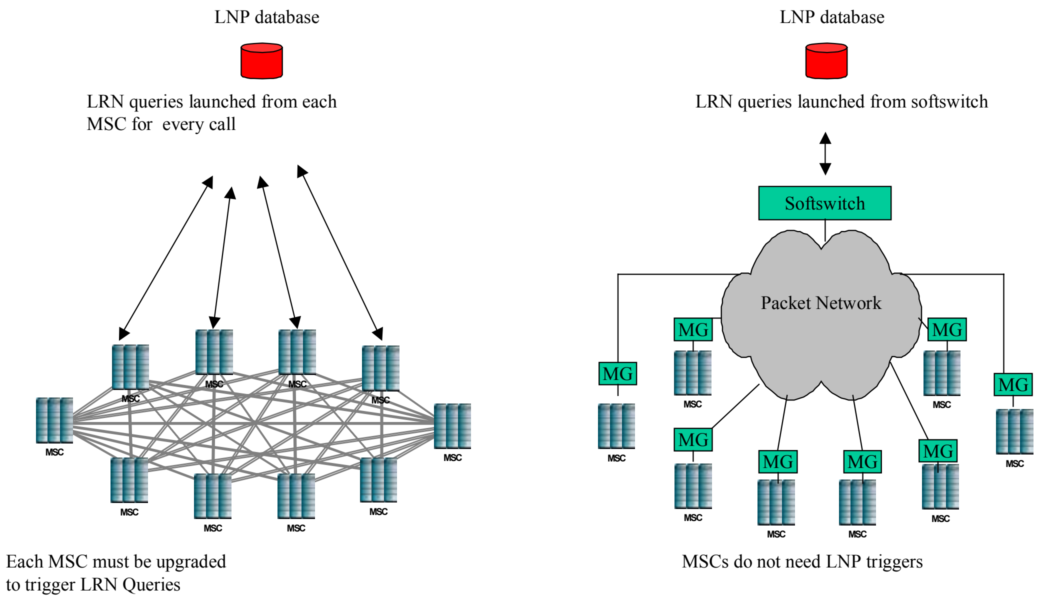
Both CAMEL and WIN architectures utilize a centralized intelligent network node known as the Service Control Point (SCP). A MSC that has been upgraded to provide support for CAMEL and WIN, at certain points in a call, passes control of the call to the SCP. The SCPs then execute the service logic. As new services are deployed, operators must upgrade all their MSCs and arm them with these triggers. The disadvantages of this approach are:

- Provisioning Cost – Upgrading each MSCs and provisioning the service can be expensive and time consuming.
- MSC real-time processing cost – These triggers may take up 5 to 20% of the MSC processing capacity. This means that the operator will be able to pack 5 – 20% fewer wireless subscribers per MSC compared with MSCs, which do not have to process these triggers. This is a huge cost to the operator.
- Software cost - There is a capital expense associated with software upgrades on the MSCs
- Market Timing of Service Delivery – Software development on traditional circuit switched MSCs is longer.

A better and more economical solution is to offload these triggers onto a Softswitch. As Mobile originated/terminated calls are routed through the softswitch, the softswitch launches the queries to SCPs based on the provisioned triggers. This allows centralizing the provisioning of service triggers at the softswitch and unburdens the MSC from processing these triggers.

A good example is Wireless Number Portability (WNP). WNP, mandated by the FCC in the U.S., allows subscribers to change the operator they use for service but still retain the same PSTN directory number. As the PSTN directory number no longer indicates the physical home network switch, every call must be intercepted at the MSC, and a WNP query is launched to the SCP to obtain a Location Routing Number (LRN) and ultimately the call is routed to the destination indicated by the Location Routing Number. As queries are launched on every call, the processing burden on the MSC could be significant.

The following figure compares the architecture of doing the LNP triggers on an MSC versus doing it on a softswitch.



Other examples of IN Services, which can be launched from a Softswitch, are Number Pooling, Prepaid Roaming, Toll Free service, Location based Services etc. Number Pooling, which allows multiple operators to share a block of NPA-NXX also, requires processing very similar to LNP. Number Pooling is mandated by several state regulators. Most of the prepaid platforms deployed today use proprietary IN solution. CAMEL & WIN based solutions allow seamless roaming prepaid across partner networks. CAMEL Phase 2 and Phase 3 define the prepaid & prepaid roaming capabilities where as WIN Package 2 defines the prepaid solution for the roaming networks.

4.3 Deploy Services using IP-based Service Platforms via Softswitch

The International Softswitch Consortium's Applications Working Group has developed an Applications Framework, in which Softswitches can use SIP or LDAP to access services from IP-based Application Servers. These IP-enabled Service Platforms operate in a similar fashion as SCP's, but they are available at a much lower cost and offer more flexibility. Once the databases are moved to a more modern platform, they can be queried by the Softswitch using SIP or LDAP. More information on this Application Framework is available from the Application Working Group.

5. Conclusion

While early softswitch development focused on applications for wireline networks, it is evident that the technology also offers tremendous benefits for wireless operators as well. As 3G is just beginning to roll out and 2G continues to grow, there are softswitch applications that can be deployed in both 2G and 3G networks that will enable operators to create more economical and efficient networks and deploy advanced revenue-generating features. As a forerunner of the future of softswitches in the wireless environment, there are wireless softswitches deployed today in UMTS trial networks, as well as in 2G networks.

6. Glossary

2G	Second Generation
3G	Third Generation
3GPP	3rd Generation Partnership Project (UMTS)
3GPP2	3rd Generation Partnership Project 2 (CDMA2000)
AAL2	ATM Adaptation Layer 2
AMR	Adaptive Multi-Rate
AMR-WB	Adaptive Multi-Rate – Wide Band
ATM	Asynchronous Transfer Mode
CAMEL	Customized Application for Mobile Enhanced Logic
CDMA	Code Division Multiple Access
CN	Core Network
CSCF	Call State Control Function
GGSN	Gateway GPRS Service Node
GMSC	Gateway MSC
GSM	Global System for Mobility
HLR	Home Location Register
HSS	Home Subscriber Server
IETF	Internet Engineering Task Force
IN	Intelligent Network
IMT	InterMachine Trunk
IP	Internet Protocol
LNP	Local Number Portability
LRN	Location Routing Number
MEGACO	MEdia GAteway COntrol protocol
MGCF	Media Gateway Control Function
MoU	Memorandum of Understanding
MSC	Mobile Switching Center
PBX	Private Branch exchange
PDSN	Packet Data Service Node
PSE	Personal Service creation Environment
PSTN	Public Switched Telephone Network
QoS	Quality of Service
RAN	Radio Access Network
SGSN	Serving GPRS Service Node
SIM	Subscriber Information Management
SIP	Session Initialization Protocol
SS7	Signaling System 7
TDM	Time Division Multiplex
TFO	Tandem Free Operation
TrFO	Transcoder Free Operation
TSG	Technical Specification Group
UMTS	Universal Mobile Telecommunications System
VLR	Visiting Location Register
VoIP	Voice over IP
WIN	Wireless Intelligent Network
WNP	Wireless Number Portability

7. References

- 3GPP UMTS Specifications: www.3gpp.org/3G_Specs/3G_Specs.htm
- 3GPP2 CDMA2000: www.3gpp2.org
- ATM Forum: www.atmforum.com
- CDG (CDMA Development Group): www.cdg.org
- CTIA (Cellular Telecommunications & Internet Association) - U.S.: www.wow-com.com
- ETSI (European Telecommunications Standards Institute): www.etsi.org
- FCC (Federal Communications Commission): www.fcc.gov/wtb/
- GSM Association: www.gsmworld.com
- IETF (Internet Engineering Task Force): www.ietf.org
- IETF Megaco Charter: www.ietf.org/html.charters/megaco-charter.html
- IETF SigTran Charter: www.ietf.org/html.charters/sigtran-charter.html
- ITU-T Recommendations by Series: www7.itu.int/publibase/itut_rec/ITUTbySeries.asp
- NTIA (National Telecommunications & Information Administration) - U.S. 3G Wireless: www.ntia.doc.gov/ntiahome/threeg/
- PCIA (Personal Communications Industry Association: www.pcia.com
- Softswitch Consortium: www.softswitch.org