Simplifying the User Experience while Enabling the Profitable Evolution to All-IP Mobile Transport

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Growing Sophistication of Mobile Users

There's no question that mobile subscribers are becoming increasingly sophisticated. A look at the myriad available mobile devices, coupled with the growing list of features demanded by consumers and businesses alike, all point to the need for richer, more personalized services. Subscribers are looking for services which increase productivity, allow more leisure time and deliver performance comparable in quality to what they receive from wireline services, but with the convenience that mobility brings – anytime and anywhere.

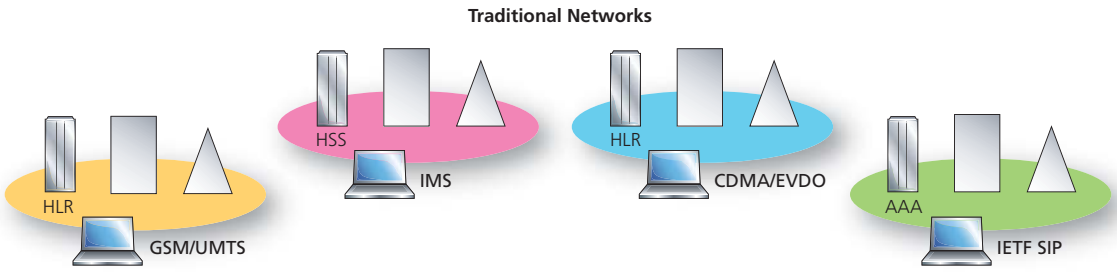
So what effect does this have on the network? In short, the network will require a well-integrated service infrastructure that tightly couples subscriber management with network resource allocation. In an IP Multimedia Subsystem (IMS) environment, IMS-enabled network transport elements can support dynamic resource allocation to supply the appropriate level of network resources and Quality of Service (QoS) required. This service-oriented infrastructure supports the end-to-end QoS, high-availability, scalability and security required by the new mobile broadband services.

Subscriber Management

A key element in facilitating network agility and strategically positioning a service operation to have the flexibility to shift business paradigms is to maintain simplification and control of subscriber data.

Many service providers today authenticate and authorize services by managing subscriber data through traditional methods (Figure 1). Mobile operators may use Home Location Registers (HLRs). Broadband and Internet service providers may use Authentication, Authorization and Accounting (AAA) servers, while IMS networks encapsulate subscriber data in a Home Subscriber Server (HSS).

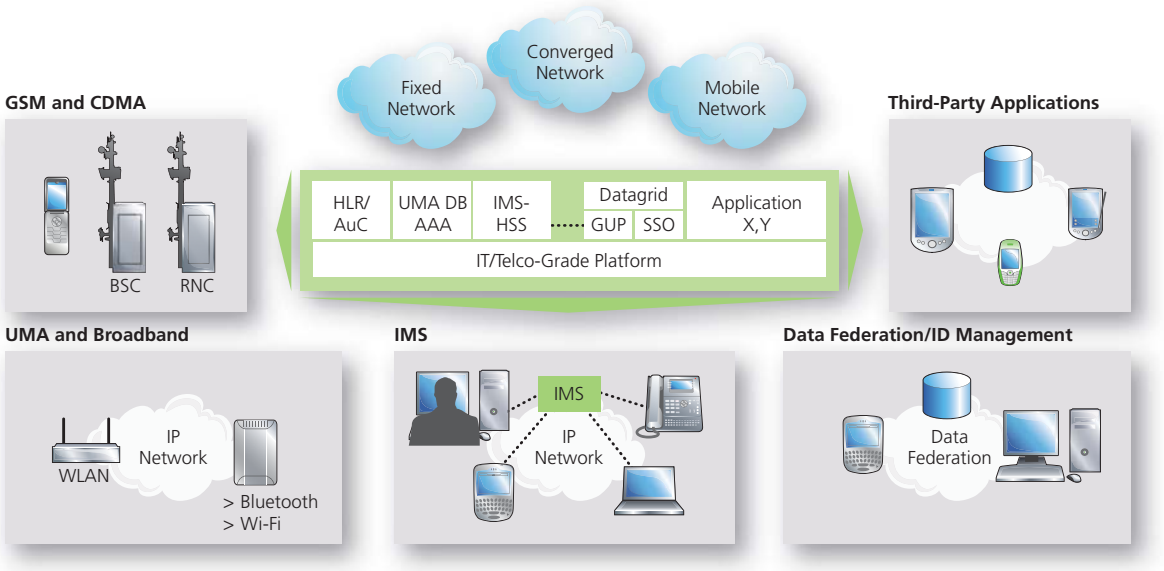
Figure 1: Traditional subscriber data management



To offer services that are access/connectivity agnostic and available everywhere, service providers must ensure services are available to the same subscriber across multiple networks and domains. But using multiple data stores to support individual services across networks and domains creates independent databases. These databases are often independently managed, administered and uniquely provisioned. As a result, subscriber profile data records are often duplicated, fragmented or out-of-date and out-of-synch. In fact, it is estimated that up to 50 percent of existing access network records have some level of inaccuracy with as many as 50 percent of access network faults related to inaccurate data.[1]

Alcatel-Lucent, along with Bell Labs, developed the Alcatel-Lucent Subscriber Data Management (SDM) solution. This allows service providers to deploy a single, virtual repository of subscriber data on an off-the-shelf IT/Telco grade platform that is configurable for high availability, high reliability and geographical redundancy (Figure 2).

Figure 2: **Alcatel-Lucent approach to subscriber data management**



It also eliminates the risk of duplicate data and gives service providers the opportunity to reduce the operational costs of managing subscriber profile information. As a result, service providers can simplify the management and administration of subscriber profile data across multiple networks. Simplification comes from being able to provide a common subscriber profile combined with the needed HLR, HSS and AAA services. In addition, with its unique architecture, the Alcatel-Lucent SDM solution is able to support multiple fixed, broadband and wireless networks simultaneously, including:

- Code Division Multiple Access/Evolution Data Optimized (CDMA/EV-DO) and Global System for Mobile communications/General Packet Radio Service/Universal Mobile Telecommunications System (GSM/GPRS/UMTS)
- IMS/Broadband Networks
- Wi-Fi/Wireless Local Area Network (WLAN), Worldwide Interoperability for Microwave Access (WiMAX) and Unlicensed Mobile Access/Fixed Mobile Convergence (UMA/FMC)

1 'Dirty Data' secrets – exposed, *Total Telecom*, J.Mellis, 2006

In the short term, SDM reduces labor and network costs with network/data source rationalization. In the medium term, SDM improves profitability by reducing time-to-market for new services. Finally, in the long term, SDM provides a flexible "future proof" environment to adapt to the needs of the market, thereby increasing customer satisfaction.

Additionally, the solution delivers:

- A unified database that provides uniform data management for multiple applications across the network
- Data federation that offers a universal view of multiple data sources
- Flexible and efficient provisioning
- Scalability, density and capacity
- End-user single sign-on with identity management
- Reduced operating expenses through centralized management and reporting
- Revenue generation with the easy introduction of new services

Transport Evolution

The continuing rise in subscribers, currently three billion worldwide and expected to reach five billion in three to five years, and the availability of new technologies including High-speed Packet Access (HsxPA), EV-DO, WiMAX, and IMS, have the potential to bring huge amounts of data into the mobile transport network.

Meanwhile, operators are experiencing declines in Average Revenue Per User (ARPU) from commoditized voice services. They are tasked with lowering recurring costs in the mobile transport network and introducing new, personalized mobile broadband services to differentiate their offerings.

Current radio access network transport mechanisms based on legacy T1/E1 access mechanisms do not scale cost-effectively, limiting mobile broadband deployment and services. Therefore, mobile operators must transform to more scalable and cost-effective packet-based transport media such as Ethernet and IP. This can save operators money and allow them to expand more aggressively to support new services delivered via broadband radio interfaces such as HSxPA and EV-DO.

However, migrating to a packet-based network does introduce challenges. To effectively and reliably meet new service demand, the network must provide:

- A scalable and efficient solution (both in terms of capital and operational expense) leveraging the lowered price points of carrier Ethernet
- The ability to adapt a range of legacy access protocols to a normalized Internet Protocol/Multi Protocol Label Switching (IP/MPLS) infrastructure
- The solution must retain the determinism, control and availability of current solutions
- Quality of service capabilities must be supported to both address aggregated flow capabilities and also be adaptable for more "per-subscriber" granular capabilities as the range of services supported in the mobile infrastructure broadens
- End-to-end synchronization solutions must be provided as appropriate to maintain call quality and traffic throughput.

Operators who fail to transition to cost-effective packet-based services will see exponential traffic growth without a corresponding increase in revenue. To address this gap, the mobile transport network must transform to support an order of magnitude more bandwidth at a fraction of the cost

per Mb/s operators pay today. The best way to do this is to transform networks by consolidating on a unified IP infrastructure, which offers efficiencies with:

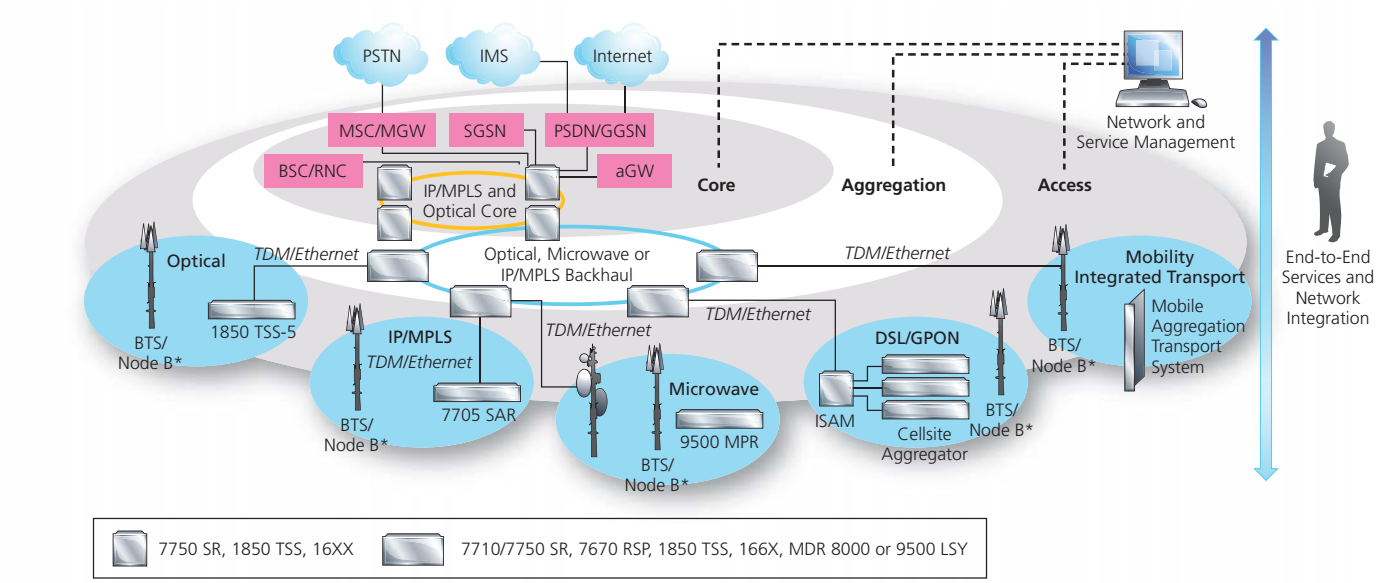
- Fewer network elements to purchase, manage and maintain
- Faster time-to-market for new services
- Streamlined operations
- Voice/data channels compression/aggregation and Ethernet economics
- Statistical gain across all traffic types sharing a common packet network

The best way to transform to all-IP is to utilize an all-inclusive solution that can be customized to the operator's needs while leveraging existing infrastructure to improve return on investment. This approach is supported by the Alcatel-Lucent Mobile Evolution Transport Architecture (META).

"META is one of the industry's most comprehensive end-to-end frameworks for mobile transport evolution to all-IP," Patrick Donegan, senior analyst at Heavy Reading, writes. META builds upon Alcatel-Lucent's leadership in the IP transformation of fixed networks, based on its successfully deployed Triple Play service delivery infrastructure.

Leveraging the service-aware capabilities of MPLS and the economies of Ethernet, META provides the scalability, high availability, QoS and Operation Administration and Maintenance (OAM) capabilities that service providers require (see Figure 3). With end-to-end, seamless "Service Aware Management" across the fixed and mobile domains, META enables service providers to dramatically simplify network operation and reduce costs. This unique capability allows service providers to manage across base stations and transport infrastructure in a single view – dramatically simplifying the operations, end to and OAM and QoS across these disparate transport networks. META also supports long term evolutionary scenarios toward a "flattened" network architecture with the controller functions moving to the cell sites. In parallel with this, increasing use of end-to-end IP/MPLS networking will drive service scaling across the converged network.

Figure 3: **Mobile Evolution Transport Architecture (META)**



*Support of multigenerational wireless networks using any BTS/Node B (CDMA BTS, GSM/GPRS BTS, UMTS, WiMAX, EVDO/HSxPA, BSR Femto and Pico, LTE/UMB)

IMS Application Management

IMS provides a framework for operators to deliver high value-added services in a homogeneous way to their subscribers. Enabling a unified user session/service interaction, the IMS framework provides a highly improved and simplified end-user experience, while efficiently managing transport resources to provide a high QoS level for each service. It does this by leveraging:

- A centralized database that contains subscription-based user profiles
- An open architecture that allows a wide range of composite multimedia services (including legacy services as well as new innovative services)
- A way for improving the end-user experience by utilizing a single subscription, a single bill and a single customer support
- A dynamic session-based interaction between the service level and the transport level in order to ensure an adequate QoS for each media component

IMS is now a worldwide telecomm-unication framework accepted by both operators and manufacturers in main standards organizations concerned with mobile and fixed services (3GPP, 3GPP2, Telecoms and Internet Converged and Services for Advanced Networks [TISPAN]). In the first release of IMS, an initial set of popular services including Presence, Instant Messaging and Push Over Cellular were commonly proposed.

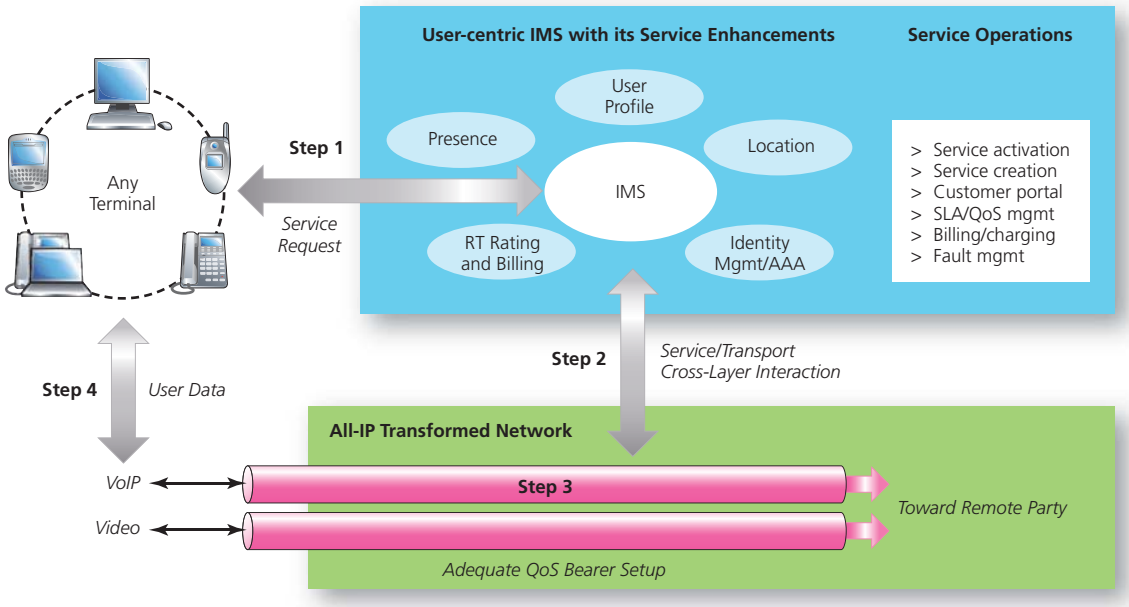
These services are classically identified as "non real-time" services and don't need stringent QoS from the underlying IP transport network to offer an acceptable user experience. Now in the maturation phase, more and more multimedia real-times services (Voice over Internet Protocol [VoIP] gaming, videoconference, Video on Demand, etc.) are emerging in the portfolios of the manufacturers.

QoS Challenges of Real-Time Multimedia

But providing multimedia real-time service in an IP network is a challenge in terms of QoS. People will not accept these new services if the quality, as perceived by the end users, is not good enough. Voice or video quality does not have to be sacrificed because of parallel web browsing or chat sessions. A massive use of VoIP, gaming or Video on Demand (VoD) means that more and more stringent real-time constraints will have to be supported in the network.

The Network Transformation to an all-IP network enables some QoS control throughout the network. A major strength of IMS is its incorporation of the mechanisms required for the session layer to control and enforce QoS in the underlying IP transport layer, as shown in Figure 4.

Figure 4: Service – Transport interaction for QoS establishment



In Step 1 of the figure, a service request is sent from the terminal to an IMS application. This service request is based on the Internet Engineering Task Force Session Initiation Protocol and contains information on the different media components and their associated QoS that will be used in the session for the service.

Step 2 allows the IMS session core to send the QoS related information to the IP transport layer (in fact to the IP Access Gateway node that handles the IP bearer from itself) to the terminal. By using the QoS information received in Step 2, the IP Access Gateway ensures the QoS control on the data path (verifying that the user has established the adequate IP bearer resource on the user/IP gateway segment). That is the purpose of Step 3. The access networks are evolving to improve the efficiency of this model and to enhance the user experience: In future Long-term Evolution/System Architecture Evolution (LTE/SAE[2]) and 3G UMTS/2.5G GPRS networks, the network will establish the bearer, in order to ensure the correct bearer with its adequate level of QoS.

When this bearer establishment phase is performed for all the media components of the invoked service, the terminal can send user traffic (VoIP, video, gaming…) by using the correct bearer. The terminal is assured that the transport resources are efficiently used and the end-user experience is improved since the network controls the correct level of QoS.

Conclusion

Traffic levels (driven particularly by data applications) continue to rise and stress the network. Operators, experiencing declines in ARPU from commoditized voice services, are tasked with lowering recurring costs in the mobile transport network and introducing new, personalized mobile broadband services to differentiate their offerings. In order to succeed, they need to leverage the cost efficiency of a scaleable Ethernet architecture without relinquishing the resiliency, determinism and operational control they have established, which assist them in attracting and retaining their subscriber bases.

2 LTE/SAE: Long Term Evolution/System Architecture Evolution (3GPP Release 8).

To meet the increasing end-user demand for mobile broadband services, while at the same time mitigating against competitive pressures and streamlining network operations to reduce costs, mobile service providers must act now to take a more holistic approach to network transformation.

The transformation to all-IP must be an all-inclusive solution that can be customized to the operator's needs while leveraging existing infrastructure. A service-oriented infrastructure, enabled by an IMS, service-aware transport infrastructure and subscriber management, will provide the end-to-end QoS, high availability, scalability and security required to meet subscriber demand for new mobile broadband services.

Using this approach, META enables operators to transform their networks from Time-division Multiplexing (TDM) to all-IP, yielding significant operating expenditure reductions, improving average revenue per user and delivering a bigger return on investment. Through the creation of a multi-service IP infrastructure, fixed-mobile convergence is simplified, providing a platform in which anytime, anywhere communications are supported cost-efficiently to provide competitive advantage. ❄

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