Evolution of the Mobile Network

As demand for mobile data applications grows dramatically, mobile operators are investing heavily in infrastructure upgrades to support network demand. Additionally, mobile networks are transitioning from being transport-centric, where the focus is on delivery of packets, to becoming service-centric, where intelligent end-to-end features deliver services efficiently, cost effectively, and with market differentiation. This shift in focus requires significant changes in the business and technology models that mobile operators are using to guide their expenditures and competitive strategies.

This white paper provides an overview of various technology, business, industry, and subscriber usage trends of the Mobile Internet and how they affect the evolution of mobile architectures and business strategy

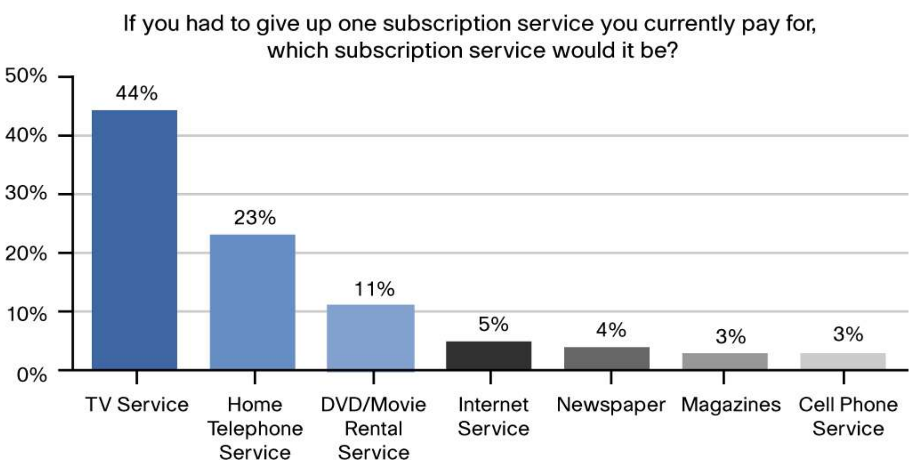
Overview

The evolution and growth of the Mobile Internet is fundamentally changing the way users access the Internet. End users are consuming content and services in new ways (such as over-the-top [OTT] and offnet), across new devices (such as smartphone, netbooks, e-readers, and tablet computers), and interacting with other users in ways that only mobile networks can provide.

Wired Magazine's September 2010 cover story, "The Web is Dead," cites a study by Morgan Stanley that forecasts, "the number of users accessing the Net from mobile devices will surpass the number who access it from PCs" within the next five years. The applications on the rise, accounting for more and more of the traffic on the Internet, include "peer-to-peer file transfers, email, company VPNs, the machine-to-machine (M2M) communications of APIs, Skype calls, online games, Xbox Live, iTunes, VoIP phones," and so on.

In a recent research report asking what subscription service a user would be willing to give up, respondents were subscribers are 15 times more likely to give up television service than cell phone service (see Figure 1), with only 3 percent saying they would be willing to give up cell-phone usage.

Figure 1. Most Expendable Subscription Services (Source: ChangeWave Research, 2009)



The mobile subscriber base is reaching a saturation point for voice. On the other hand, mobile data is growing exponentially. This trend is stimulated by the rise of high-bandwidth mobile applications and increasingly powerful smartphone devices that can access these new applications. As a result, mobile data traffic is growing dramatically.

The 2010 Cisco Visual Networking Index Mobile Data Forecast found that global mobile data traffic increased 160 percent between 2008 and 2009. The forecast predicts that global mobile data traffic will grow by a factor of 39 between 2009 and 2014, for a compound annual growth rate (CAGR) of 108 percent.

This growth in mobile data traffic, however, barely offsets decreased wireless voice revenue resulting from flat-rate, unlimited plans, according to earnings releases from leading mobile operators. Mobile operators have long enjoyed high operating margins due to the revenue-per-megabyte received from a largely voice-dominated traffic model. The shift to a data-dominant model is forecast to continue to deflate mobile operator margins quite significantly, with revenues dropping from US$0.43 per MB to approximately $0.02 per MB in 2014, according to a 2010 study by Bernstein Research. In a saturated, high-growth environment, mobile operators have only a handful of options to increase their operating margins:

- Achieve additional revenues from the current subscriber model
- Extend to a Business-to-Business-to-Consumer (B2B2C) model by creating new service models
- Decrease operational costs and complexity
- Extend services to reach multiple networks and screens

According to a 2010 study from ABI Research, capital expenditures (CapEx) represent 20 percent to 30 percent of the total cost of ownership for mobile operators, yet this crucial cost function directly affects 70 percent to 80 percent of the operational expenditures (OpEx). These numbers highlight the importance of operators understanding the technologies and trends affecting next-generation network architecture, so that they can make intelligent infrastructure investment decisions. In fact, due to this drastic effect on OpEx, an operator's investment in services and top-line revenue growth may not be enough to offset poor CapEx decisions.

Beyond Bandwidth Increases and Spectral Efficiency to Ubiquitous Mobility

Until now, mobile carriers have operated under the assumption that their crucial differentiator was the radio frequency network. Wireless network development has focused on offering services similar to those received through the landline but not restricted to a wired or wireless LAN. This model has led to an evolution of mobile networks starting with circuit-switched, low-bandwidth networks; these networks allowed subscribers to communicate through instant messaging (like Short Message Service [SMS]). Today, Third-Generation (3G) and Fourth-Generation (4G) mobile networks allow everything from Internet browsing to video viewing. The surge in mobile subscribers has followed the increase in bandwidth offered over the mobile network.

The amount of bandwidth that can be offered over a mobile network, however, is a two-dimensional model only dictated by physics: the quantity of mobile spectrum available to a mobile operator multiplied by how efficiently that spectrum can be used. An auction process where mobile carriers spend billions of dollars to acquire right-to-use has largely dictated spectrum allocation. This auction model has underscored the finite availability of wireless spectrum and created a singular focus in the mobile industry: how to increase spectral efficiency.

The evolution of mobile networks has been affected as much by resource scarcity as by creating bandwidth for new services. Important points of market disruption have also influenced the evolution of the Mobile Internet, including the massive growth of mobile data applications and smartphone. These trends have made existing RF networks, backhaul, and other facets of the mobile network too expensive, forcing operators to find more efficient ways of delivering services.

Mobile radio technology has evolved from time-division multiplexing (TDM) and code-division multiplexing (CDM) to orthogonal frequency-division multiplexing (OFDM), which offers considerable improvements in spectral efficiency by allowing overlapping (or orthogonal) carriers. Four-G networks, such as Long Term Evolution (LTE) and WiMAX, use OFDM to provide spectral efficiency improvements, RF interference resiliency, and lower multipath distortion. OFDM itself has been adapted and enhanced through smart antenna technologies such as Multiple-Input Multiple-Output

(MiMo) and beam forming. To improve performance, both of these technologies use special multiplexing, taking advantage of multiple antennas at both the transmitter and receiver.

Additionally, three important factors that force mobile carriers to reconsider the way networks are designed and implemented:

- **The growth of the subscriber base:** Because the radio access network (RAN) is a shared medium, increasing the number of subscribers has the decreases the available bandwidth per subscriber.
- **The change in service mix:** The growth in data services and usage of smartphone changes the service model, oversubscription model, and data usage model for mobile devices. Mobile operators must reconsider how oversubscription in the airlink, backhaul, and mobile packet-core layers of the network will lead to evolutionary changes. More infrastructure, more bandwidth, and more capacity are necessary to support more traffic and more users.
- **Diminishing returns in spectral efficiency:** Because there is a theoretical limit to the efficiency of a RAN, continued growth of bandwidth becomes dependent on increased spectrum availability and not just technology improvements.

Thus, mobile carriers cannot continue to operate under the premise that delivering higher-speed services with unlimited consumption models is the only way to differentiate themselves competitively with subscribers. The return to tiered pricing models in advanced 3G and 4G networks instead of the unlimited usage plans that dominated the latter half of 3G subscriber growth is evidence of this awareness among operators.

The industry is instead shifting from a view of *wireless* as the major differentiator to service or device mobility as the main differentiator. All network infrastructure, protocols, and network designs account for *mobility* as the rule rather than the exception today. This trend represents a shift from an operator-centric, or network-centric, model to a subscriber-centric, or service-centric, model.

While subtle in nature, this shift has a significant effect on the design and implementation of networks and on the mobile vendor landscape. Table 1 highlights some of these subtle effects.

Table 1. Shift from Network-Centric to Service-Centric Mobile Networks

	Network-Centric	Service-Centric	Effect
RAN	RAN is of primary importance	RAN is a means of attaching a subscriber to the network, in much the same way that an Ethernet port connects a device to a fixed network, albeit significantly more complex.	This model leads to a shift from highly-integrated access and services to a decoupling of the radio from end-to-end service delivery.
RAN Deployment Model	Macro base stations are the predominant deployment model.	Macro-, pico-, and femto- base stations, and also unlicensed wireless technologies (such as Wi-Fi) and fixed technologies (such as 802.3 Ethernet), all play a vital role in delivering content to a subscriber.	This model leads to a requirement for session persistence and identity management across access technologies, while making access technology transitions transparent to the subscriber
IP Services Network	The IP network is seen as a necessity to facilitate the transport of subscriber data.	The IP network is considerably more important - helping with optimal service delivery, session continuity across access technologies, and technology convergence.	This model leads to a convergent IP services delivery network that delivers the same subscriber experience across all access technologies.
IP Services Deployment Model	The mobile gateway is responsible for all mobility functions, such as session persistence.	Many different elements— from the client, to the network, to the application and content—are responsible for mobility functions.	This model leads to an end-to-end deployment scenario for mobility, with clients, network elements, and applications all playing a vital role in the subscriber experience.

From the Network-Centric to the Service-Centric

A leading indicator of the shift from the network-centric model to the service-centric model has been the decreased importance and pricing of wireless Base Transceiver Stations (BTS). The next-generation mobile network is built on an interchangeable RAN model, where RAN equipment, vendors, and technology can be replaced with only configuration and software modifications within the transport and services delivery network. This creates a new level of flexibility and CapEx protection that mobile service providers have not experienced in the past.

The advent of Software-Defined Radio (SDR) has also changed the cost structure of the BTS significantly. In the SDR model, components that have historically been implemented in hardware, such as modulators and filters, are implemented in software. This significantly changes the economics of the RAN while also allowing a plug-and-play architecture for radio technologies. A single SDR unit can be front-ended with multiple RF technologies. Given the continued need to support legacy technologies while simultaneously investing in next-generation radio, SDR will play a crucial role in the architecture and design of mobile networks going forward.

Another indicator in the shift from network-centric to service-centric is the interest in using offload technologies as a way to augment both coverage and capacity. This points to a larger need to provide services across a wide array of access technologies, some of which may not be mobile at all.

Examples of these offload technologies include:

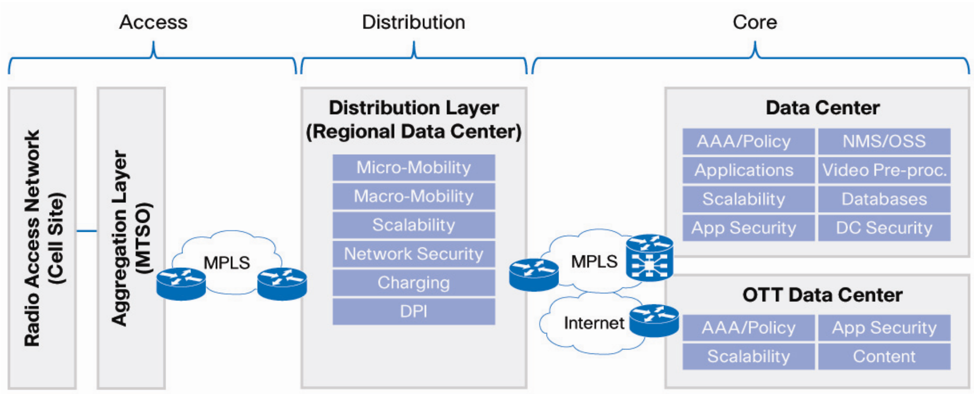
- **Licensed home access points** (for example, femtocells), have so far been deployed as coverage enhancements, with only limited success. With the advent of new pricing models allowing flat rate, all-you-can-eat voice and data, subscribers are unwilling to increase their wireless service spend on “home zone” plans and are reluctant to invest in a device that provides exactly what the carrier is expected to provide for free, coverage. Mobile service providers must consider business models that allow the delivery of captive services to single-mode devices within the home, over femtocells. This way, operators are able to reduce the up-front consumer costs of obtaining a femtocell through subsidization models based on RF and backhaul offload; however, this approach almost erases any recurring revenue models based on in-home coverage alone.
- **Unlicensed home access points** (for example, Wi-Fi), have mostly been an untapped market for mobile service providers; however, with the increased inclusion of Wi-Fi radios in mobile devices, the ability to increase subscriber relevance in an OTT business model extends the relevance of mobile services beyond the mobile network itself.
- **Licensed pico-access points** (for example, picocells), are becoming more common in mobile networks, because they can provide either coverage or capacity fillers in densely populated areas. Picocells will continue to grow in niche markets but remain challenging for mass deployments due to management and backhaul complexity. Today’s model of backhauling picocells relies on existing wireline providers (such as cable and DSL operators) to provide backhaul services, much like today’s macro cellular towers although on a smaller scale. The backhaul challenge, however, may be addressed through self-backhauling, or relay, picocells that rely on a wireless backhaul (using Wi-Fi, microwave, or 4G macro-cellular) to avoid recurring OpEx charges. These solutions, however, are experimental at this point and have unresolved line-of-sight problems in dense urban areas, as well as spectrum availability and consumption challenges.

New Hierarchy Among Network Layers

Similar to the economics in the fixed-access environment, the access portion of the mobile network will continue to evolve independently of the services delivery network, with continued downward pressure on price. All access technologies deliver two main functions: speed and distance. In the cellular world, speed directly equates to spectral efficiency, and distance equates directly to coverage (for example, within a building).

Wireless carriers have historically been well aligned to Cisco's hierarchical internetworking model, which divides the network into three layers, Figure 2.

Figure 2. Mobile Network Layers: Access, Distribution, and Core

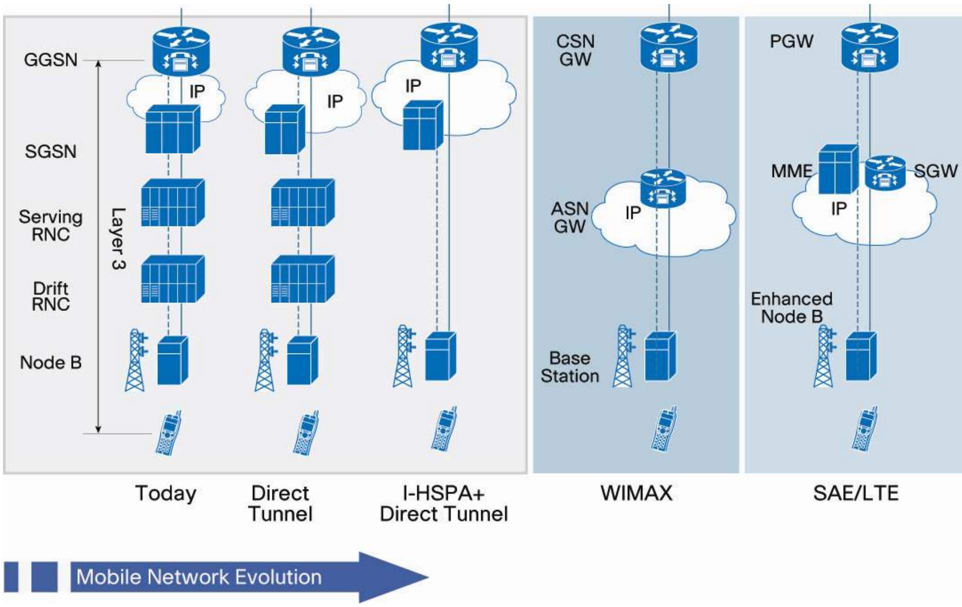


- **The Access Layer** provides connectivity. The elements selected for the access layer are typically those that are the most cost-effective.
- **The Distribution Layer** provides the network intelligence, including quality of service (QoS), filtering, and other network services. The elements selected for the distribution layer are typically those that provide the most features.
- **The Core Layer** provides high-speed forwarding functions. The elements selected for the core layer of the network are typically those that provide the most capacity.

While future mobile next-generation networks will also align closely to this model of network layers, the most noticeable difference in the service-centric model is the expansion and decentralization of the distribution layer and the contraction of the access layer. This is caused by a number of trends in the mobile industry, including:

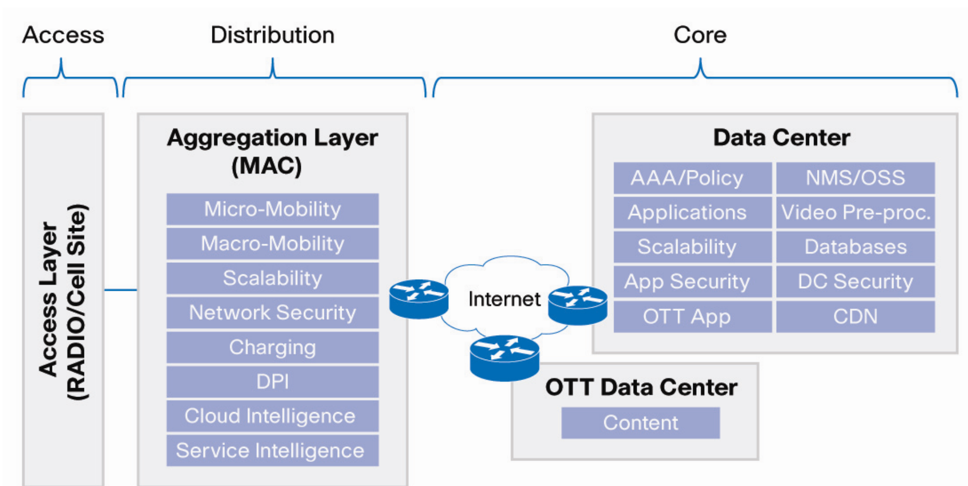
- **Standardization and openness of radio access interfaces:** Wireless control-channel interfaces, such as WiMAX R6 and LTE S1-C, are designed to be more interoperable than previous generations of base-station control functions.
- **Any-to-any radio-to-gateway models:** With flexible, dynamic establishment of the base-station control interface, the historical N:1 (N base stations paired to one base station controller) relationship between BTS and controller is adapting to support N:M (N base stations paired to M controllers, where M > 1) models. The WiMAX R6-Flex and 3GPP S1-Flex interfaces are examples of this any-to-any model.
- **Flattening of the control and bearer plane (see Figure 3):** Removal of the base-station controller and further trends towards simplification of both control plane and bearer plane within the mobile environment, result in fewer nodes playing a role in the delivery of mobile services.

Figure 3. Flattening of the Control and Bearer Planes



The net effect of this is a smaller access layer confined to the cell site, a distribution layer comprised of the mobile backhaul network, mobile gateways and network services, and a sprawling core layer that grows in tandem with the distribution of the gateways and services, Figure 4.

Figure 4. Today's Mobile Network Infrastructure



Sprawl of the Core Network

With the flattening of the mobile network architecture and removal of elements from the control plane, the radio controller has become part of the mobile gateway. Therefore, in addition to sheer bandwidth capacity, there are also control plane capacity, signaling, and latency considerations that must be addressed in the gateway. For example, if latency is not addressed, there is a high likelihood of increased handover failures or delayed connections. If the number of mobility events is increasing (for example, if users are accessing applications more as they move about), then the signaling plane of the mobile gateway quickly becomes overloaded if it must handle the capacity of a large number of cell sites.

The flattening of mobile networks has raised questions about how distributed a mobile gateway function should be within the network design and whether local breakout functions should be deployed to either offload mobile gateways or shorten data paths. Mobile data gateways have historically been centralized entities, because mobile data subscribers did not cause enough traffic to warrant distribution. Also, the mobile data call flow was best handled in a hierarchical model where the BTS fed the controller, and the controller fed the gateway.

In today's mobile network, bandwidth per-subscriber (and therefore per cell site) is increasing faster than the aggregated bandwidth available in the core dense wavelength-division multiplexing (DWDM) network. While this bandwidth growth per cell site has manifested itself in more scalable mobile gateways (scaling from 1 Gbps to 10 Gbps to 40+ Gbps), core networks are limited to 100 Gbps per link, as defined in the IEEE 802.3ba working group. In addition, in many instances, 100-Gbps transport connections are prohibitively expensive, because the technology is still in its infancy. This factor has forced mobile operators to continue to either distribute gateway locations or deploy mobile data offload solutions as bandwidth grows per cell site, allowing traffic to be immediately offloaded to the Internet.

While optimal deployment of the mobile gateway will remain at the Internet peering point, sheer bandwidth growth will continue to require more and more Internet peering points in order to provide better subscriber experience. Cost-effective availability of 100-Gbps circuits will largely help evolve mobile network architecture. If 100-Gbps technology is available prior to the next round of mobile gateway investment, more centralized architectures will dominate until these mobile aggregation locations scale beyond 100 Gbps. If 100-Gbps technology is unavailable prior to the next round of mobile gateway investment, distributed architectures will dominate, beginning at 10 Gbps or 40 Gbps, and eventually scaling up to 100 Gbps. Because the investment cycle differs among mobile operators, network architectures are likely to be disparate for this next round, with some operators investing in more centralized approaches and others investing in more distributed approaches.

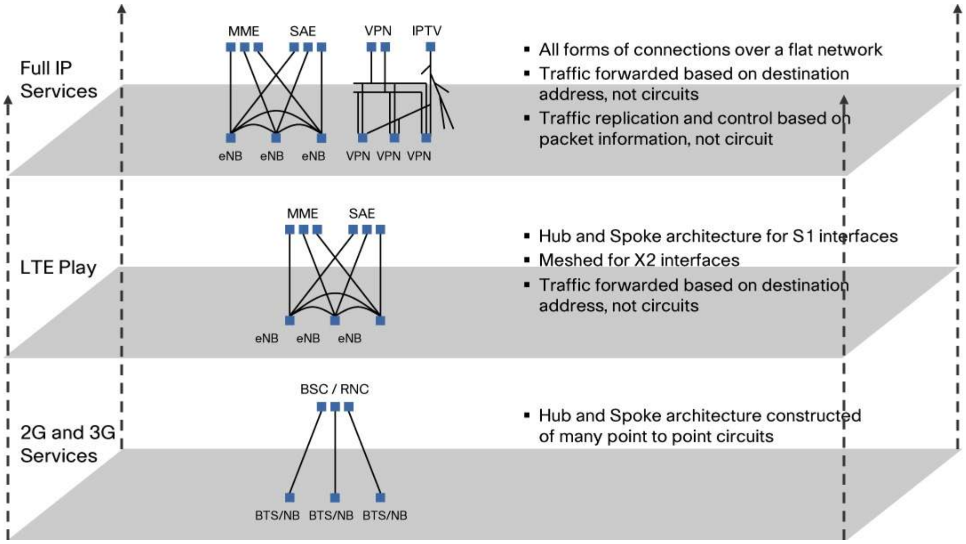
Challenge of the Backhaul Network

The backhaul network poses the most significant challenge for next-generation mobile networks. As backhaul networks shift from the access layer to the distribution layer, the features and functions of the elements deployed in the backhaul network must align with the distribution layer models; however, the size and scale of the backhaul network requires a pricing model that is lower cost, resembling that of the Access Layer.

There is growing debate as to whether the backhaul network should remain purely a transport network or whether the backhaul network should play a more central role in the delivery of services. This debate is evident in the move towards disparate, transport-centric and services-centric technologies. Technologies such as Multiprotocol Label Switching - Transport Profile (MPLS-TP), Provider Backbone Bridging Traffic Engineering (PBB-TE), and Virtual Private LAN Service (VPLS) are the leading protocols providing a transport-centric backhaul network, known as Packet Transport Networks (PTNs). IP and to a lesser extent, MPLS, are the leading protocols allowing a services-centric backhaul network.

As backhaul network architecture and design evolves from simple point-to-point architectures used for the connectivity of 2G and 3G base stations to radio network controllers to more complex point-to-multipoint and ring-based architectures, transport-centric approaches to these networks are becoming increasingly difficult to implement. In the LTE architecture, for example, tower-to-tower communications in both the signaling and bearer planes increase reachability requirements. The LTE X2 interface, for example, provides a logical mesh configuration between base stations, with as much as three to five percent of network traffic traversing this interface during handovers. Furthermore, enhancements in multicast distribution and advanced IP services are becoming standardized within the mobile standards organizations (MSOs). As these standards evolve, it is likely that IP services, such as multicast video and secured corporate access, will become an increasing part of the network traffic mix. Services-centric technologies are proving to be more flexible in delivering future requirements in the backhaul network. Figure 5 provides a comparison of the architectures mentioned above.

Figure 5. Backhaul Network Architecture



End-to-end tunnel approaches (in which interim nodes provide only next-hop path decisions) are unsustainable as next-hop decisions become less straightforward. This complexity stems from the likely increase in multicast traffic, tower-to-tower signaling and bearer flows, and mobile-to-mobile communication, all of which will require the backhaul network to be more intelligent. In addition, the continued need to support legacy RANs through pseudowires requires differentiated service capabilities in the backhaul network.

An additional requirement in the mobile backhaul network is the increased focus on end-to-end security. This has so far led to the deployment of IP Security (IPSec) tunnels originating from the base station to a centralized IPSec concentration device. Efficient transport and direct delivery of tower-to-tower control messages and mobile-to-mobile bearer messages is more complex as the number of adjacent cells increases, resulting in the exponential growth of direct IPSec associations between towers. Shared key methods (in which all towers with adjacent cells share a common encryption key and transport-mode IPSec is used) may be an important solution in delivering security while retaining simplicity.

As this evolution of the backhaul network continues, mobile service providers will eventually migrate to all-IP architectures in their backhaul domain. The timing and evolution path to the all-IP architecture will vary on a per-operator basis, depending on what CapEx they can sustain, individual operators' service requirements (that is, the need to support legacy radio infrastructure), and their depreciation cycles. Backhaul investment will likely follow three possible paths:

- Immediate investment in transport-centric solutions followed by a replacement cycle
- Immediate investment in a transport-centric solution that may evolve into a service-centric solution
- Immediate investment in a service-centric solution

Mobile Services Dilemma

Interestingly, a number of network services, including deep packet inspection (DPI) and firewalls in external nodes, have not mirrored mobile gateway scalability and are limited at between 10 Gbps and 20 Gbps, or roughly a quarter to half of the mobile gateway performance. This lack of scalability has added greater complexity to mobile networks. Large server farms of DPI and firewall nodes are deployed with both forward-path and reverse-path load-balancing solutions to provide the required scalability.

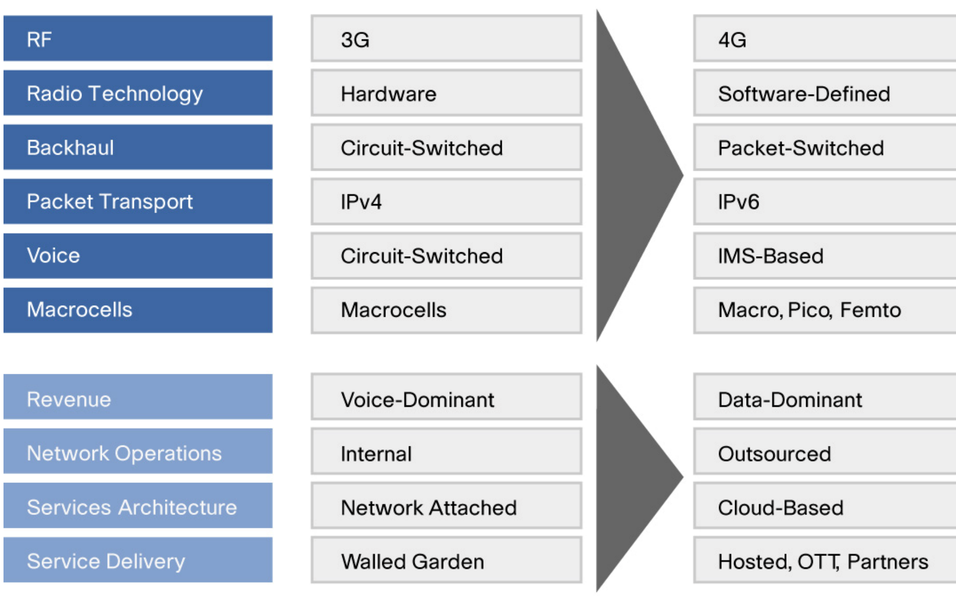
Firewalls and DPI entities are offered as two of many examples of the challenges facing operators in evolving the mobile services network layer. As mobile gateways scale towards 100 Gbps, service entities will continue the struggle to keep pace. In addition, scaling gateways and network service entities independently with load-balancing technologies, will continue to create significant complexity in the mobile network. This complexity increases with the introduction of new network services and increasing scale for existing services. For this reason, the mobile gateway will continue taking on more intelligent roles in the network architecture, in order to simplify operations.

In addition, an intelligent services overlay, providing both service authentication and service routing, will become integral to the delivery of mobile services. This service overlay will allow service deployment within the network infrastructure without significant changes to the network layer itself. New capabilities to advertise service availability - functioning in much the same way that the Border Gateway Protocol (BGP) advertises path availability and node reachability - will provide mobile service providers with the flexibility to deploy new services rapidly, then scale those services in response to subscriber demand.

IP as the Service Delivery Platform

With the increasing number of transitions occurring in mobile networks today, mobile operators are investing in technologies that allow for business continuity and subscriber transparency. IP itself needs to be considered as more than just a transport protocol but instead as a service delivery protocol that can unify network architectures and permit service availability during transition periods. These transitions are occurring in both technology and business models, Figure 6.

Figure 6. Technology and Business Model Transitions in the Mobile Network

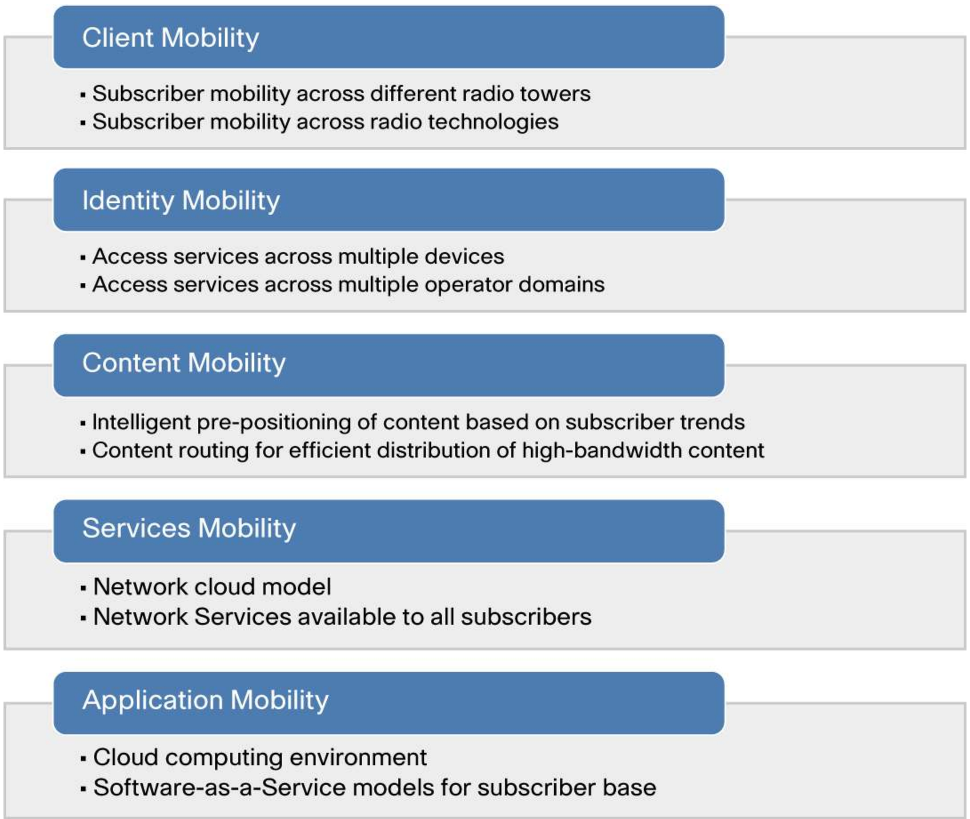


IP provides a common foundation for service delivery of 3G voice, 3G data, and 4G data services from the cellular tower through the mobile services edge, mobile packet core, and data center. Much as IP Multimedia Subsystem (IMS) investments provide an IP-based infrastructure for the delivery of real-time, Session Initiation Protocol (SIP)-based services, an end-to-end, IP-based network provides operators with a service delivery platform for to activate all future mobile data services and revenue streams.

Extending Mobility Above the Network Layer

With the world evolving towards more subscriber-centric and services-centric network delivery models, significant changes in the architecture, design, and deployment of networks are in progress. Mobility is no longer limited to the concept of a device changing point-of-attachment to a network, whether seamless or not. The future of network architecture and protocols, especially for mobile service providers, will not depend solely on the mobility of an end device. Mobility will extend from terminals to subscribers, content, and applications, driven by numerous factors ranging from subscriber experience to resource efficiency. Resource efficiency implies everything from server consolidation to transport cost reduction to power conservation.

Figure 7. New Models of Network Mobility

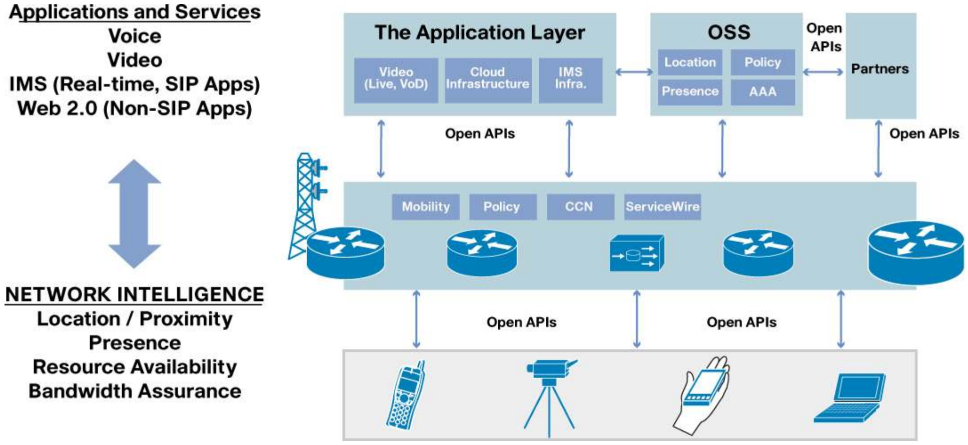


Trends in a wide range of infrastructure, most notably in the data center, clearly point to a future where:

- Investments in Content Delivery Networks (CDNs) highlight the movement of content to permit optimal transport and delivery over the IP network.
- Standardization of new or enhanced multi-path transport technologies, (such as, Multipath Transport Control Protocol [MP-TCP], Stream Control Transmission Protocol [SCTP], Mobility and Multihoming Protocol [MOBIKE], and Dual-Stack Mobile IP [DS-MIP]) allow a single device to communicate a single session over multiple physical interfaces.
- Investments in cloud technologies, such as VMWare VMotion, highlight the mobility of entire virtual machines from one physical server to another.
- Video transport technology evolving from streaming Real Time Streaming Protocol (RTSP) to adaptive bit rate, such as fragmented MP4, allows for switching the mobile video source midstream.
- Long-anticipated investment in SIP/IMS core infrastructure by mobile and cable providers allows application-layer mobility, so that a subscriber can move seamlessly between devices.

As mobility moves higher in the protocol stack, mobile operators will focus on the convergence, coordination, and correlation of mobility events across the entire protocol stack, helping with optimal service delivery at the network layer. This requires intelligence and service-awareness at the network layer that is far better than what exists today. This awareness can be achieved through open, extensible APIs into network infrastructure that allow service- and application-driven network policy decisions, Figure 8. Exposure of a common set of APIs into network infrastructure provides broader context upon which the service orchestration layer can base decisions.

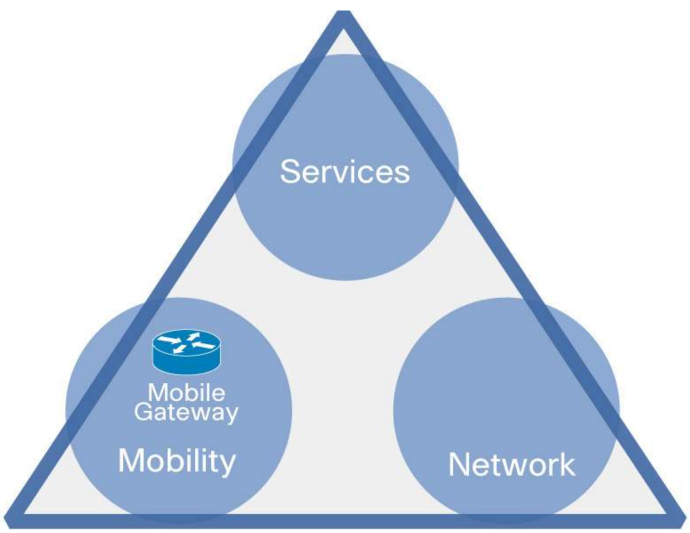
Figure 8. Intelligence Across the Mobile Network



Converging Control Planes

Today's mobile networks operate with two main control planes. One dictates the subscriber and service policies, such as authentication, identity, QoS, charging, available services, and so on. The other determines network and transport policies, including optimal routing, service reachability (at the IP layer), and so on. The first is specified in mobile working groups, including the Third-Generation Partnership Project (3GPP), 3GPP2, and the WiMAX Forum, using existing control plane protocols defined in the Internet Engineering Task Force (IETF), such as RADIUS and DIAMETER.

Figure 9. Mobile Service Enablement with Independent Control Planes



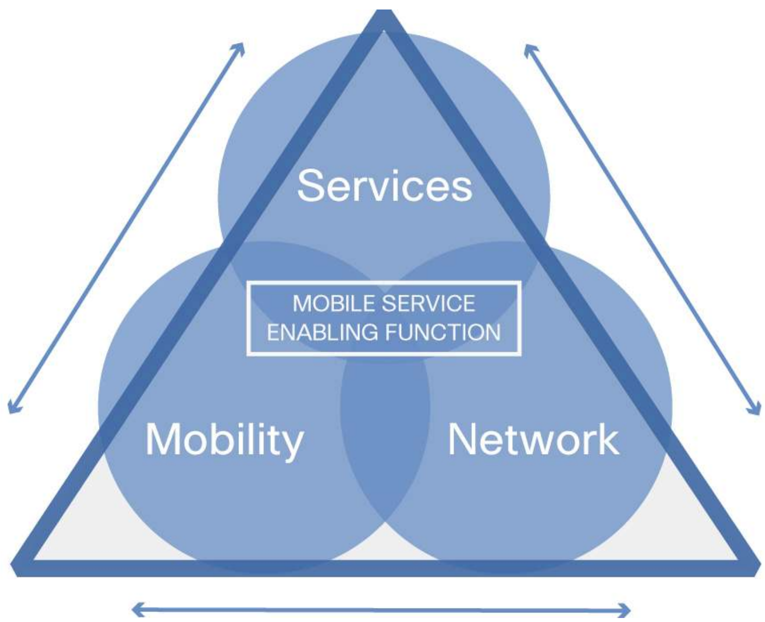
Multiple control planes create numerous policy decision points in the network architecture and force numerous devices within the packet flow to be aware of the subscriber profile. In addition, the dual-control plane model results in more complex network architectures, requiring numerous points of subscriber-aware or session-aware security control (such as the mobile gateway), load-balancing, and policy-based routing to force traffic into a specific network-layer policy.

Future mobile networks will integrate these control planes, allowing the mobile gateway to function as the gatekeeper to the network's resources, Figure 10. The mobile gateway will not only be aware of **who** the subscriber is and **what policies** should be applied to the subscriber, but will also be aware of **where a service or application is**, **when to allow service access**, **and how to forward subscriber traffic to the relevant service or application**

in the most efficient manner. This will extend not only to services hosted and managed by the mobile service provider but also to those provided through partnerships and others running OTT.

This function also provides initial policy decisions across the routing and services layer. For example, as mobile data offload solutions residing between the radio and gateway become more popular, the network will provide the policy rules for local breakout of the data traffic and a consistent control channel to the intermediary routers. This consistent control channel can help provide advanced functions such as DPI (through sampling), lawful intercept, handovers, and so on.

Figure 10. Mobile Service Enablement Through Control Plane Consolidation



New Operations Model

As mobile service providers continue to strive for differentiation, we also see a decoupling of functions specific to network operations and those specific to providing service. More and more, build-operate-transfer (BOT) models and network outsourcing agreements are taking shape, allowing mobile service providers to focus on core differentiation while choosing the outsource the optimization of network operations. A 2010 Heavy Reading study forecasts a 400-percent increase in mobile network outsourcing between 2009 and 2013. This outsourcing and managed services strategy, mostly reliant on network equipment vendors, is transforming the business of managed service providers.

Those mobile operators that trend towards the left of Table 2 below and attempt to focus on their brand are investing heavily in areas such as billing and charging, policy (for example, Authentication/Authorization/Accounting [AAA], Identity management, Policy and Charging Rules Function [PCRF]), portals, service development or partnerships, and customer support. Those operators that trend towards the right focus on OpEx reduction, including reduction of interoperability points, simplified deployment models, and operational best practices. Over time, mobile operators that trend towards the right will function more as wholesale networks or utilities, and focus more on pricing differentiation. Alternately, those operators that trend towards the left will operate under a strong brand with a greater focus on service differentiation.

Table 2. Areas of Strategic Focus Among Mobile Operators

Service Provider Business Functions	Network Operator Business Functions
Billing and charging	Operation of network infrastructure
Policy (QoS, authentication, and so on)	Test, certify, deploy vendor technology
Regulatory compliance (for example, CALEA)	Interoperability Testing (IOT)
Applications	Design and operation of services (for example, voice, video, IMS)
Service plan bundling and differentiation	
Customer support	

Conclusion

Next-generation mobile networks are retooling to prepare for the explosive, ongoing growth of the Mobile Internet. Mobile networks must be capable of delivering vertical services and long-tail content that does not consume a lot of bandwidth at any given point in time. Instead, it must continue to generate subscriber interest and high-demand applications over a common infrastructure, independent of the airlink technology or vendor. To provide these services, mobile networks must continue to evolve from transport-centric networks designed to deliver packets to intelligent, feature-rich networks designed to deliver services. For this evolution to occur, service providers must move from designing access networks and addressing specific service requirements to investing in capabilities that support a service-centric model. This model requires dramatic shifts in both business and technical frameworks.

For More Information

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