

The migration to mobile 4G networks

Leveraging the all-IP network to improve efficiency, subscriber experience, and profitability



Mobile broadband requires operators to change the way they manage data services. The transition to a 4G IP network will give them the tools to manage traffic actively and achieve three goals:

- Increase network efficiency and capacity, lowering transport costs
- Offer service plans that are more flexible, fair, and personalized
- Maximize revenues from subscribers, applications and content providers, and vertical applications

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Introduction

Mobile broadband is a great success story. After several years of timid growth, mobile broadband adoption has exploded, driven by the concurrent availability of must-have devices like the iPhone and Droid, a myriad of applications that are intuitive to use, and attractive service pricing. The sudden growth in mobile broadband is happening at a time when mobile operators are fighting a slow but inexorable decline in voice revenues and see data revenues as their main hope for maintaining their profitability levels.

Yet for mobile operators mobile broadband is a relatively new service that presents many challenges. Despite its simplicity, the flat-fee model—with or without traffic caps—does not meet subscribers' demand for flexible and personalized data services. Network congestion, poor subscriber experience, and the inability to reach new market segments are among the problems that operators have started to encounter as mobile broadband becomes widely adopted in the consumer market.

On the other hand, operators have unparalleled, but largely under-utilized, access to real-time information about their subscribers and their network. They know where their subscribers are and what they are doing, what their preferences and plan settings are, which devices and application they use. They also have real-time information on traffic levels and traffic flow for each cell site, which allows them to decide whether and how to prioritize traffic. By using this information, operators can expand the potential of mobile broadband services, making them available to a wider range of subscribers and devices, while managing traffic growth, providing a reliable and fair service to subscribers, and protecting their profitability.

In this paper, we present a case for a more active management of mobile broadband services that leverages the IP network to pursue three goals:

- **More efficient use of network resources.** This is required in order to expand network capacity to meet

subscribers' demand in a cost effective way, which will enable operators to operate profitably.

- **More flexible, fair, and personalized service plans.** Mobile operators realize they have to move beyond flat-fee unlimited plans. To improve their subscribers' experience and differentiate their services from the competition, they can add features that allow them to move beyond capped plans.
- **Maximize revenues.** Flat-fee unlimited plans are not effective at segmenting the market and gaining revenues from added-value services, because for many potential subscribers the available plans are too expensive, or do not offer the features they want. A wider choice in service plans can address the demand from these subscribers, and raise data revenues. Furthermore, mobile broadband can create new revenue streams from advertisers and content and applications providers, and facilitate the development of new business models that make mobile data services more attractive, easier to use, and more effective. Mobile operators can also gain additional revenues from vertical applications, through partnerships with MVNOs, enterprises and public agencies.

Keeping up with traffic growth

Mobile operators provide voice services largely on a first-come, first-served basis, without trying to manage traffic actively. Subscribers can expect to place and receive as many calls as they want, as long as coverage and network resources are available—and usually they are. Every subscriber is treated the same and has equal access to the network. This is a successful model for voice, since the requirements for voice calls are the same and constant through time, making traffic management straightforward.

This model, however, does not work well for mobile data, with the exception of services like Short Messaging Service (SMS) text messages, which—like voice—have entirely predictable (and limited) requirements. For many operators, data traffic now accounts for a greater share than voice traffic. At Vodafone¹, data overtook voice in 2009, and now it accounts for 79% of overall traffic (Figure 1). Yet Vodafone’s mobile broadband revenues account for only 11% of service revenues, if we exclude messaging (Vodafone’s SMS and other data revenues are 24% of service revenues).

While voice services continue to provide higher profit margins than data, operators are under intense pressure to create sustainable profit margins for data services as well, because it is data traffic that is driving network expansion and upgrades, inflating both capex and opex.

The challenge of mobile broadband, however, goes well beyond capex and opex considerations. To meet increasing traffic demand, operators must increase capacity within the radio access network (RAN) by upgrading to more advanced air interfaces, installing new base stations, and turning to new backhaul techniques, such as Ethernet over fiber or microwave. However, the increase in RAN capacity brought by new technologies such as Evolved High-Speed Packet Access (HSPA+) and Long Term Evolution (LTE) (Figure 2) is not sufficient to support the expected growth in data traffic demand.

Furthermore, traffic is not homogeneously distributed across the network and across time. Some cell sites, typically those located in dense urban areas or in transportation hubs, have much higher traffic loads. In Vodafone networks, for instance, utilization during the peak hour is 35%, and only 7% of cell sites run close to capacity. Similarly, network utilization varies through time and day of

the week. Data traffic tends to have a less peaked distribution than voice traffic, but usage varies considerably through the day and for different days of the week.

High traffic loads are becoming and will remain a major challenge to operators. Within an IP core, operators have access to many tools that that will enable them to use of network resources more efficiently and to manage the capacity stress points in their networks.

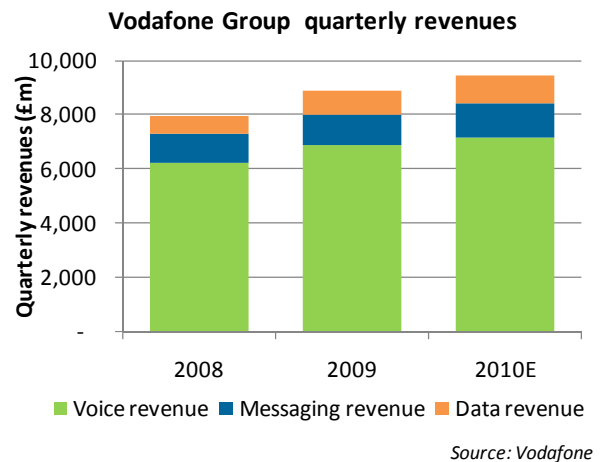
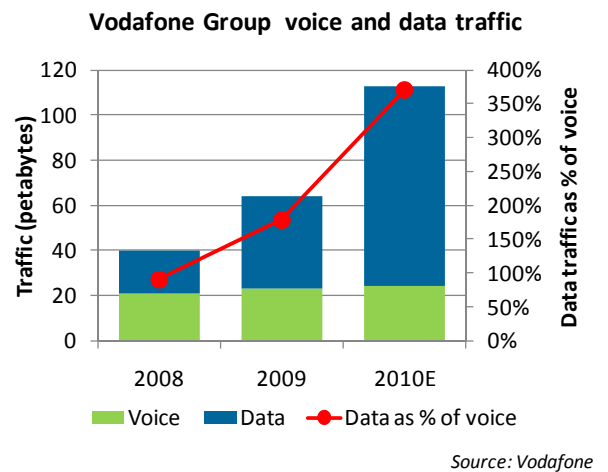


Figure 1. Vodafone Group voice and data traffic, and quarterly revenues

1. We refer to Vodafone Group’s data in several parts of this paper, because Vodafone publicly releases more detailed information than other operators. Vodafone’s data provide a consistent profile that is representative of cellular operators in developed markets. In developing markets, data traffic is generally lower, but it is increasingly approaching developed markets’ levels.

Can the RAN keep up with the increase in mobile data traffic?

Traffic change as a percentage of 2010 traffic and capacity change for wireless technologies over HSPA

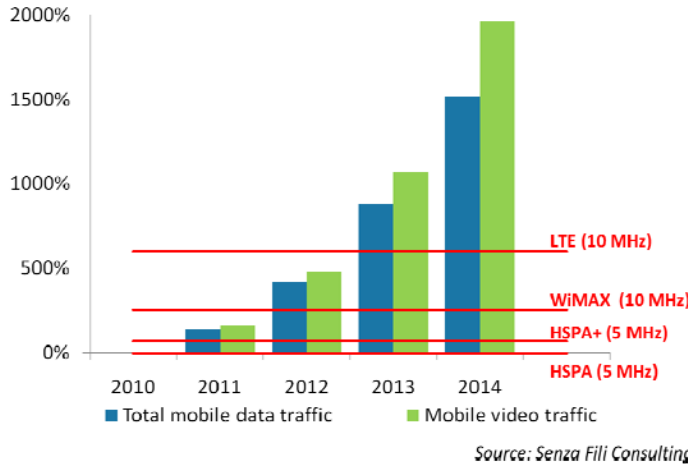


Figure 2. Increase in data and video traffic and RAN capacity over the next five years

WiMAX and LTE. HSPA+ provides a 67% increase in capacity over HSPA, using the same channel size. WiMAX increases the capacity 2.5 times and LTE 6 times. By 2014, however, data traffic will have increased 16 times over 2010 levels, and video traffic 20 times.

To accommodate the forecasted traffic volume for 2014, mobile operators may have to deploy 250% more LTE base stations than they would need to accommodate current traffic volume. They would also have to allocate additional capex and opex to increase the backhaul and core network capacity. This is a very expensive strategy that puts high pressure on profitability, and that makes a compelling argument for active management of traffic in the core network to reduce the load on the RAN.

Figure 2 compares the increase in mobile broadband traffic to the increase in capacity brought by new air interfaces such as HSPA+, Worldwide Interoperability for Microwave Access (WiMAX), and LTE.

The vertical bars show the cumulative increase in traffic for overall mobile data and for video from 2011 to 2014 as a percentage of 2010 traffic, as forecasted by Cisco’s Visual Networking Index (VNI) Global Mobile Data Forecast.

The red horizontal lines show the increase in sector capacity that HSPA+, WiMAX, and LTE will provide over High-Speed Packet Access (HSPA). For WiMAX and LTE, we assumed that 10 MHz channels are used instead of the 5 MHz channels used by HSPA.

New wireless interfaces bring an increase in network capacity. However, this growth in capacity on its own is not sufficient to meet the growing traffic volume generated by subscribers, even assuming double channel bandwidth for

The inadequacy of the flat-fee model

What is the challenge of flat-fee, all-included plans? Subscribers understand them, and they feel free to do what they want without worrying about add-on charges. They are easy to manage for mobile operators. If spectrum were not

limited in availability and network capacity were not expensive to provide, flat-fee unlimited plans would be ideal. But resource constraints make them poorly suited for many data services. Even in the wireline broadband market, service providers are increasingly resorting to traffic caps and enforcing fair-use policies (FUPs) to protect their networks and services.

As mobile broadband becomes a widely adopted consumer service, flat-fee unlimited plans become untenable. Operators like AT&T in the US and O2 in the UK have started to acknowledge this and introduced capped flat-fee plans.

Most operators, however, act cautiously, as they anticipate subscribers’ resistance to alternative plan structures, especially in markets such as the US where flat-fee plans dominate both voice and data services.

The most commonly proposed remedy to flat-free unlimited plans is the introduction of traffic quotas, with varying degrees of flexibility to deal with over-quota traffic, and multiple mechanisms to enforce them, ranging from reminders, to traffic throttling, to service interruption. However, traffic caps alone are perceived as punitive if they are too strict.

Flat-fee unlimited plans lead to an exceedingly high overall traffic volume that is consistently generated by a small percentage of high-traffic users, who degrade the network performance for everybody. While flat-fee plans treat all subscribers equally, they fail to provide an equitable level of service for all.

However, subscribers are largely unaware of the unfairness of the flat-fee model—and highly reluctant to accept traffic caps—because they typically do not know how much data they use and how they use it. If they had such information and the ability to manage their online activities, subscribers would be able to customize their plans to their specific needs, and remain largely unaffected by traffic caps indiscriminately imposed on all.

Operators are likely to gain from a more transparent approach that gives subscribers more flexibility and control over their subscription plans. With more options, operators can segment the market more effectively, by offering attractively priced services to a wide range of subscribers, from the cash-strapped student willing to accept strict bandwidth caps during peak hours, to the demanding business user willing to pay more for a faster connection in downtown areas during peak hours.

A new approach to data traffic management

Operators can leverage the information they have on both network and subscribers in real time (Table 1) to manage traffic for each cell site sector, for each session, for each user, and for each type of traffic.

Net neutrality and other efforts to regulate operators’ handling of data traffic may impose limitations on the granularity or type of traffic prioritization allowed in different countries. Because within an IP network operators can manage traffic without targeting individual applications, service providers, or content providers, and following

Network intelligence
Network capacity for different wireless interfaces
Real-time per-sector, per-cell-site utilization levels
Distribution of traffic across network and wireless interfaces, with knowledge of capacity-stressed sites
Traffic optimization (e.g., video compression) achieved
Distribution of types of traffic flows (e.g., voice, video, data)
Subscriber intelligence
Historic and real-time traffic levels by type of application, time-of-day access, and wireless interface (e.g., cellular, home femtocell, Wi-Fi)
Billing profile, including service plan, traffic allowances, roaming preferences
Current location, roaming status and time
Device used
Preferences profile and policy, including priority for different applications, background applications and downloads allowed

Table 1. Network and subscriber intelligence

subscribers’ preferences, this type of traffic management should enable operators to comply with net neutrality or other regulation on traffic management, when—and if—it is introduced. Operators have access to tools that demonstrate that they do not unfairly block specific content or content providers. In the current net neutrality debate between industry and regulators, tools that provide a flexible and transparent approach to traffic management provide clarification of what operators want to achieve, and

may eventually facilitate the development of a policy that is acceptable to all parties.

As they transition to IP networks, operators have access to a wide range of powerful tools (Table 2) that enable them to manage traffic at different levels of granularity, depending on their preferences and requirements, using the real-time information on network traffic and individual subscriber activity that they have exclusive access to.

The operator’s IP network toolbox	
Network intelligence	
Deep packet inspection (DPI)	gives the operator a tool to protect the security of the network and to manage traffic associated with different applications as needed—for example, on the basis of subscriber preferences or network conditions.
Traffic prioritization, including quality of service (QoS) ,	allows the operator to manage bandwidth on a per-subscriber, per-session, and per-flow basis, and as a function of multiple criteria, such as real-time sector utilization, subscriber plan, billing-cycle usage, and application type. It also allows them to implement and enforce FUP.
Traffic compression and optimization	makes it possible to transmit the same content to subscribers using less bandwidth. Video compression is an effective way to reduce traffic load as a function of both the screen resolution of the device and real-time availability of network resources. Downloads that are not time-critical may be scheduled during off-peak hours to reduce their impact on the network.
Roaming, handovers, and off-loading	enable operators to optimize the distribution of traffic across different networks, on the basis of real-time base station or sector load, or subscriber location.
Customer intelligence	
Dynamic policy control	gives operators and subscribers alike great flexibility to define profiles, and manage network access. It allows operators to move beyond flat-fee plans, and provide personalized services.
Differentiated charging	uses policy and profile information to devise charging options that are relevant to individual subscribers, and that facilitate the monetization of mobile broadband services.
Location-based and time-based applications and content delivery	increase the relevance of content received by subscribers, thus improving the subscriber experience and potentially reducing the traffic transmitted (i.e., when searching subscribers receive relevant information on their first request, eliminating the need for further searches).
Device-based content and application support	allows operators to optimize traffic flows on the basis of the capabilities and requirements of subscribers’ devices. For instance, video compression levels may vary depending on the device screen size, with higher compression rates reserved for devices with smaller screens that do not benefit from high-resolution feeds.

Table 2. The operator's IP network toolbox

In the next sections, we will explore how these tools can help operators to increase the efficiency of the network, to provide more flexible, fair, and personalized services, and to maximize revenues from mobile broadband.

Improving network efficiency

Traffic management using tools such as those described in Table 2 improve network efficiency by reducing traffic volumes and smoothing the traffic load over time, and by decreasing the cost per bit for data traffic. Capex and opex savings in delivery costs can be achieved by reducing the RAN and backhaul capacity that would be needed to carry the non-managed traffic, and/or by postponing network upgrades and new cell deployment.

Compression and bandwidth optimization. Internet traffic is not optimized for mobile access or for specific device types. This is one area where operators can reduce transported traffic without causing a negative impact on the subscriber experience—and possibly improving it.

Video compression provides a good example. Knowledge of the subscriber device type (and, more specifically, screen size) can guide the operator to devise the appropriate level of video compression. Sending a high-definition stream to a smartphone is a wasteful use of network resources, because the limited screen size prevents the subscriber from enjoying the quality of the feed.

The operator may choose to ask the subscriber for permission to compress video downloads. The subscriber is likely to grant that permission, since compression will lead to faster downloads and will use less bandwidth, which is desirable if the subscriber's plan is subject to traffic caps or other limitations.

Subscribers may be granted higher traffic allowances (or unlimited traffic) when connected at specific times or

locations, or when using wireless interfaces such as Wi-Fi. In this scenario, subscribers may choose to schedule regular background processes (e.g., incremental backups, software updates, downloads of TV shows or magazine issues) during low-traffic times (e.g., at night) or when they are at home (e.g., if the subscriber has a femtocell or Wi-Fi, and does not use the macro cellular network). Flexible traffic allowances enable subscribers to use their service plans more extensively, but lower the risk of network congestion by off-loading traffic where and when needed.

Dynamic traffic prioritization and traffic-peak smoothing based on real-time resource availability. Using real-time information on traffic load for individual sectors, operators can identify the network pressure points where congestion is most likely, and then proactively apply more aggressive traffic management at these locations. When prioritization is not sufficient, operators may have to resort to throttle or block some traffic flows or users.

Traffic offload and management of multiple wireless interfaces. At some locations, operators may provide their subscribers access to multiple wireless interfaces, which may include non-cellular technologies such as Wi-Fi. They may dynamically allocate some device form-factors or individual devices to a specific network, based on a combination of factors, which may include current traffic load, network resources, device type, subscriber plan features, and subscriber preferences. Subscribers may still have the option to override the operator's automatic choice of network type, but in most cases they will prefer a background network selection that will give them the best connection available that is supported by their plan.

Flexible, fair, personalized services

When moving to an IP network, mobile operators can give subscribers the option to choose features on the basis of their own requirements, preferences, and willingness to pay. With this approach operators can meet more effectively the demands of different market segments by offering plans at the right price points that provide the level of service required.

Subscriber profiles. At the core of personalized services lies the ability of subscribers to easily access information about their plan features and usage history, to define their profile, and to set preferences that will determine their access to the services. For instance, subscribers may want their devices to switch automatically to Wi-Fi when it is available, as long as they can connect to a trusted access point. Or they may want to block all data access when they are roaming to avoid roaming fees.

As policy control is enacted in real time, subscribers can set multiple profiles that can be activated depending on their location (e.g., if they are at home), the time of day (e.g., nights and weekends), the wireless interface in use (e.g., Wi-Fi), and the application used (i.e., assigning VoIP traffic priority over P2P traffic).

In absence of traffic quotas or other access rules (e.g., free access from home femtocells), all subscribers equally compete for the same network resources, and have no incentive to set up such profiles, because they do not directly benefit from them.

Default profiles may be set by the operator to allow subscribers to facilitate the customization process, or to skip it entirely. Even with default profiles, the operator can still steer subscribers toward behaviors that optimize their experience while protecting the network. By introducing appropriate incentives and tradeoffs, operators can find the right balance to motivate subscribers to set up profiles that optimize their experience.

Usage information. Access to usage information is crucial for subscribers to understand what their traffic requirements are, what the service plans are, which options are best suited to them, and how to set their profiles.

Operators increasingly leverage FUPs to protect the network against abusive use. While only a small percentage of subscribers violate FUPs, all subscribers are subjected to them. Transparency about what FUPs entail and how they are enforced make subscribers more comfortable, but subscribers also need to have access to sufficient usage information to ensure that they comply with them.

If a traffic quota is included in a service plan, access to real-time information on the remaining traffic available during the billing cycle enables the subscribers to decide whether to buy additional access time or bandwidth allowance, or to ration the mobile data access to avoid reaching the quota before the end of the billing cycle.

Roaming management. A separate profile can set the services available to the subscriber when roaming. Instead of either completely deactivating roaming, or facing a huge bill when returning from a trip abroad, subscribers may, for instance, decide to limit roaming traffic to email headers and text messaging. This spares operators from lengthy disputes with bill-shocked subscribers, yet preserves operators' ability to earn roaming revenues.

Tiered services. Cellular networks today do not implement QoS and do not extensively prioritize traffic. With the introduction of traffic prioritization that IP network will facilitate, they will be able to offer tiered services, giving network access priority to subscribers who typically choose more expensive plans.

Tiered plans may also include different bandwidth allowances. For instance, a high-priority plan may be designed for users of email-centric devices like the BlackBerry, and may include a relatively low bandwidth allowance. Another high-end plan may combine high priority with a high bandwidth quota. For students, the operator may instead offer an unlimited plan with very low

priority, with connections available only at cell sites that are not running at capacity.

It is a delicate balancing act to provide compelling base plans and to complement them with appealing options, making subscribers feel empowered rather than overwhelmed by the selection. But this is exactly where operators can differentiate their offering from the competition's, positioning themselves as experienced providers who understand what is most valuable to their subscribers, can provide it in a flexible way, and price it equitably.

Maximizing service revenues

The increased control over traffic management in IP networks generates multiple opportunities to expand the range of revenue-generating services, to open new market segments, and to develop new business models.

Revenues from subscribers

Personalized services give subscribers the option to select features or additional allowances that they are willing to pay for in addition to their monthly plan's fees. These fee-based services will generate additional revenues, as long as operators create informative and easy-to-use account management interfaces, and identify add-on services that are compelling and appropriately priced.

Flexible charging. Subscribers resent many of the current constraints on service plans. The plans force them either to pay for something they do not want, or to get a service that does not meet their needs. Flexible charging allows operators to offer a wider choice of options that, without overwhelming the subscriber, can provide a valuable extension to the base plan. Examples of flexible charging include:

- **Time-based and location-based charging** may offer different traffic allowances, possibly including unlimited access at certain times or locations, and/or higher access fees for connection during peak times or at high-traffic locations.
- **Quota exception options** may be presented to subscribers when they reach their quota but want to purchase additional mobile broadband access for the remainder of the billing cycle.
- **Prioritized access options** may be offered to subscribers who have specific requirements for a limited time. For instance, a subscriber who needs to join a videoconference call while traveling may be able to pay for high-priority access for the duration of the call to ensure a high-quality video connection, and then revert to the standard plan.
- **Fee-based services.** Knowledge of subscriber preferences, usage history, location, and device give the operator an opportunity to propose to the subscriber specific fee-based services that may be of interest, using an opt-in model that allows subscribers to control the type and amount of solicitations received.
- **Ad-supported free access.** Operators may also decide to offer free access in partnership with advertisers, but they may want to limit the availability of the service to times and locations when traffic is below capacity to prevent congestion. They can use their knowledge of network resource availability and subscriber location and preferences to decide which subscribers are eligible for the free access offer.

Family and multi-device plans. Data plans are most commonly targeted at a single device, even if the device is part of a family plan. Because individual subscribers are likely to use more than one device to connect to the mobile internet, and because multiple devices within a family plan contract may be used for mobile broadband, operators may want to introduce multi-device, multiple-user plans, similar to voice family plans. They may include a shared data allowance but individual profiles, specific profiles for

parental control, and the same flexible charging options that are available to individual plans.

Prepaid access. In most countries, prepaid access is dominant for voice service, and it may become equally popular for mobile broadband access, as it enables subscribers to avoid lengthy contracts and to pay for access on an as-needed basis. This approach is likely to attract subscribers who do not currently have a data plan either because they cannot afford it or because they only occasionally need it.

By leveraging real-time information on network traffic load, subscriber location, and time of day, however, operators can move beyond plain prepaid access, and offer many of the options enabled by flexible charging to prepaid subscribers as well. Prepaid subscribers are, on average, more price-sensitive but also more flexible in their usage patterns. Lower-cost access to the network during off-peak hours or at low-traffic locations may prove very attractive to subscribers, without adding significant capacity pressure on the network.

Revenue sharing with advertisers, application developers, and content providers

Most operators have wisely moved beyond captive portals toward supporting third-party applications developers and content providers. With this open model operators face the risk of being excluded from gaining a fair share of the associated revenues by becoming merely a utility bit-pipe to their subscribers.

At the same time, control over the network gives mobile operators exclusive access to valuable historic and real-time subscriber information, and to knowledge about network resource availability. This information is highly valuable to advertisers, application developers and content providers.

Information sharing. Knowledge about subscriber preferences and usage patterns, devices used, and location is highly valuable to advertisers and application and content providers; they can use it to target the communications to subscribers more effectively. For instance, subscribers may

request notifications about the availability of per-pay video feeds for footballs games, but only for their home team, when they are away from home, during non-working hours.

Operators need to develop solutions to protect subscriber privacy that are transparent, easy to manage, and effective, but leveraging this information can become very profitable in new partnership and revenue-sharing models with advertisers, and applications developers and content providers.

Dynamic pricing. At the same time, operators can develop dynamic pricing with their partners based on the availability of network resources. Streaming a five-minute video during peak hours may have to be priced higher than a twenty-minute video during low-traffic times. For the five-minute video, the content partner may decide to charge higher fees or postpone the video download offer. Alternatively, the download may be associated with a service plan that the subscriber has with the content provider; in this case, the type of plan may determine whether the download is delayed or not.

New revenue streams from vertical applications and embedded consumer devices

The ability to prioritize traffic at different levels (subscriber device and traffic flow, session, and traffic type) as a function of network load makes it more attractive for mobile operators to open their network to vertical applications, such as mobile health care, smart grid applications, or fleet and asset management, as well as to consumer electronic devices such as the iPad, the Kindle, game consoles, or cars with embedded devices.

Adoption of vertical applications and embedded consumer electronic devices has started to grow at rates that far outstrip those for the traditional cellular market of individual subscribers. These markets represent huge opportunities for mobile operators, but to date operators' ability to serve them has been limited by their inability to support QoS and robust prioritization of traffic, and by their inflexibility in managing services with tight service-specific requirements.

The transition to an IP network gives operators the tools they need to support these services at the levels required by their customers, and to do so cost effectively.

Traffic prioritization. In vertical market segments such as mobile health care or utilities, operators can offer service level agreements (SLAs) and prioritized access to the network. For low-priority applications, the operator may propose low-priority network access to the content

provider, as this will result in a more affordable service for the customer. Some remote metering applications, for instance, require only periodic transmission data, which can be accommodated as best-efforts traffic.

Separate data management. Depending on requirements and volume of these new services, operators may decide to manage them within the mobile core elements already in place, or they may deploy separate solutions.

Conclusions

Mobile broadband access represents the biggest revenue growth opportunity for mobile operators, but the explosion in data traffic is straining cellular networks that lack the capacity to cope with high traffic loads. To capitalize on this opportunity, operators need to develop a new approach to mobile broadband services that requires a more active management of data traffic.

The transition to 4G IP networks gives mobile operators multiple tools for controlling data traffic, such as QoS and traffic prioritization, DPI, dynamic policy control, flexible charging, and advanced location-based services. With these tools, operators can leverage the network and subscriber intelligence that they have exclusive access to. They can develop sophisticated yet simple-to-use and attractive new service offerings for their subscribers, access new revenue streams through partnerships with advertisers, application developers and content providers, and enter the market for vertical services and service to embedded consumer devices.

Managing mobile broadband services within 4G IP networks	
Improving network efficiency, lowering transmission opex and capex	<ul style="list-style-type: none"> ▪ Compression and bandwidth optimization ▪ Traffic prioritization and traffic-peak smoothing based on real-time resource availability ▪ Traffic offload and management of multiple wireless interfaces
Offering flexible, fair, personalized services	<ul style="list-style-type: none"> ▪ Subscriber profiles ▪ Usage information ▪ Roaming management ▪ Tiered services
Maximizing service revenues	<ul style="list-style-type: none"> ▪ Revenues from subscribers <ul style="list-style-type: none"> – Flexible charging (time-based and location-based charging, quota exception and prioritized access options, fee-based services, ad-supported free access) – Family, multi-device plans – Prepaid access ▪ Revenue sharing with advertisers, application developers, and content providers <ul style="list-style-type: none"> – Information sharing – Dynamic pricing ▪ New revenue streams from vertical applications and embedded consumer devices <ul style="list-style-type: none"> – Traffic prioritization – Separate data management

About Senza Fili



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We provide a bridge between technologies and services, helping our clients assess established and emerging technologies, leverage these technologies to support new or existing services, and build solid, profitable business models. Independent advice, a strong quantitative orientation, and an international perspective are the hallmarks of our work. For additional information, visit www.senzafiliconsulting.com or contact us at info@senzafiliconsulting.com or +1 425 657 4991.

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