



Mobile Broadband Network Solution

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Executive Summary

The potential benefits of Mobile Broadband are far more than just bandwidth. In the future, it will be possible for everyone to create, access, and share information and engage in social and gaming activities in a completely mobile networked world through any terminal, at any time, from any location.

Despite industry expectations, the evolution of Mobile Broadband is influenced by irregular development in four areas: services and applications, terminals, pricing, and networks. Along with the continuous convergence of the ICT industry, services and applications, terminals, and pricing have, over recent years, reached optimum conditions and achieved revolutionary breakthroughs.

Operator network development needs to become more robust. In Huawei's experience, the following three challenges are critical to the discussion of rapid development of Mobile Broadband networks:

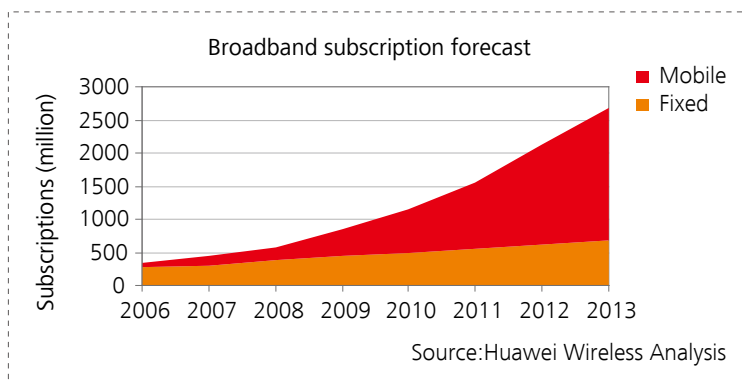
- A better user experience demands higher capacity and more optimized architecture.
- Increased bandwidth is not proportional to revenue growth.
- Given the impact of new business models, maintaining an advantageous position in the value chain has become increasingly difficult for almost every operator.

To this end, Huawei has introduced an overarching Mobile Broadband solution based on new architecture, new technology, and new styles of operation. By incorporating multiple technologies, such as SingleRAN, high speed cloud, continuous cloud, IPTime (IP Transport Infrastructure for Multiplay Experience), and IPN (Intelligent Packet Network), Huawei's Mobile Broadband solution helps an operator build a broadband network capable of providing a better experience and a higher-value service to users, while protecting the operator's investment across their broadband network. This solution helps the operator reinforce an advantageous position in the value chain by way of a fine granularity operation.



Future Trends and Key Success Factors

The number of mobile subscribers will increase from 3.5 billion in 2008 to more than 5 billion by 2013. By that time, everyone should be able to gain equal access to the network and freely use communication tools for multiple levels of correspondence. Lifestyles and approaches to work will change profoundly as our world becomes a truly networked society. At this point in its evolution, Mobile Broadband will have entered into a rapid development trajectory. Huawei predicts that by 2013, the number of Mobile Broadband subscribers will exceed 2 billion, including 1.6 billion new subscribers, accounting for 80% of new broadband subscribers.



However, before any of this can be achieved, we must examine four key areas in which inconsistent but extraordinary development influences the rapid evolution of Mobile Broadband:

i The Influence of New Technologies on Services and Applications

As Mobile Broadband evolves, terminal users expect a more personalized experience. Information technology, particularly the emergence of web-oriented architecture, Web 2.0, and the development of widgets, have helped greatly. These technologies have improved the resolution of lightweight business development needs for mobile terminals, overcome the drawbacks of a poor interactive experience between users and mobile terminals, and enabled traditional enterprise and numerous Internet applications on mobile terminals, such as *Google* and *eBay*, considerably enriching Mobile Broadband services. For true Internet openness, future services and service platforms must be reshaped into an open cooperative ecosystem to achieve a personalized, community oriented, and user-generated content (UGC) business model.

ii The Introduction of Large-screen and High-performance Intelligent Terminals

Breakthrough developments in large-screen and high-performance intelligent terminals, and the rapid diffusion of laptops and data cards, have laid a solid foundation for Mobile Broadband and mobile Internet development. The iPhone emerged as the biggest dark horse in the mobile phone field and iPhone and iPod touch-based *App Stores* have become the hottest digital content sales platform. In coming years, we can expect to see many new intelligent terminals emerge introducing increasingly intuitive platforms, enhanced man-machine interaction, and representing both revolutionary change and an opportunity for mobile terminal business within the industry chain.

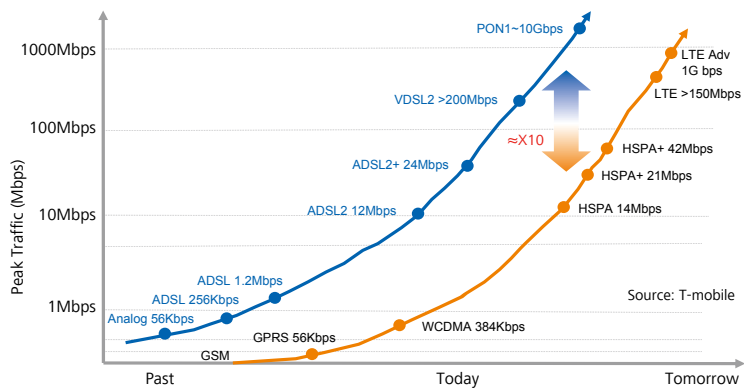
iii The Increase in Flexible Pricing Strategies

Flexible price and packaging strategies have been widely adopted by operators around the world as a result of their better understanding and clearer segmentation of end-users. To compete, operators are compelled to offer affordable packages. However, unlike Fixed Broadband, Mobile Broadband's network construction and transmission costs, coupled with spectrum resource restrictions, make monthly flat-rate pricing strategies with unlimited access, all but impossible. In addition to the traditional mode of charging end-users (forward charging), chargeback for service providers (including e-commerce transaction, advertisement, and rental fees) has become an important business model. Chargeback has evolved into a multi-sided business model.

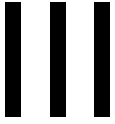


The Bottlenecks of Carrier Network Deployment

Technology platforms are in a state of flux. HSPA technology has been deployed on a massive global scale and is now approaching maturity. Some CDMA operators have switched to GSM, and Qualcomm has abandoned UMB in favor of LTE. Developments like these confirm a trend toward LTE and LTE Advanced for all mainstream network evolution. Theoretical downstream peak rates currently reach 150 Mb/s for LTE and 1 Gb/s for LTE Advanced. However, the majority of the world's networks remain incapable of smooth (software) migration to LTE, which is why bottlenecks to network evolution occur.



Pic 2: Fixed Broadband vs Mobile Broadband



Analysis of Key Network Challenges for Operators

Increasingly enriched services, exponentially and ineluctably expanding volumes of complex content, and billions of access demands create mounting challenges for computing capacity provided by telecommunications infrastructure.



Users Dictate Higher Capacity and Optimal Architecture

In 2009, Apple announced that App Store applications had been downloaded 800 million times on a cumulative basis. Entering the market in the footsteps of iPhone 3G, Google G1 provides an application environment that more closely resembles the real environment. Google G1, which transforms Google Maps into e-maps, is equipped with a brand new panoramic view and is capable of transmitting images in real-time. Clear evidence that only by providing a superior user experience can an operator expect to retain and acquire customer loyalty and added revenue streams.

In a world of social networking, terminal users are responsible for endless streams of content and ideas and have themselves become highly active network nodes. UGC, therefore, represents the collective wisdom of many users, including both individual and third-party developers, creating extensive services that have become the driving force for business creation. Driven by HD, 3D, and UGC, well over 1000 EBs (exabytes) of digital content will be generated each year. Correspondingly, telecommunications backbone network flow will accelerate by 50-80%. Access network flow will accelerate tens or hundreds of times faster, requiring ever higher network capacity from the operator.

As the life cycle of new technologies accelerates, new technologies quickly replace older versions, sometimes leap-frogging over them in the race to evolution. To merely maintain status quo, many operators have no alternative but to adopt new technologies; requiring significant investment, often reaping only meager benefits and even incurring considerable risk. Operators everywhere urgently need a Mobile Broadband solution to help them build a broadband network capable of smooth evolution and investment protection.



Revenue and Broadband do not Advance Together

Informa Telecoms & Media predicts global mobile data network traffic will grow by 1587% between 2008 and 2013, while revenue will grow by only 83% during the same period. Any increase in broadband will evidently not result in a proportionate increase in revenue. This imbalanced equation places many operators on the down-side of a dominant trend. To offset and correct the balance, operators have to adopt advanced technology capable of decreasing the cost per megabit.

According to Huawei's analysis of current networks, IP network traffic is in a state of uneven distribution. On the one hand, a few bandwidth-hungry services, mainly P2P, occupy 50-80% of the traffic, while a small proportion of users, between 5-20%, consume 70-80% of the bandwidth. Operators receive no additional revenue from the monopolization of available bandwidth by this minority group.



The Impact of New Business Models

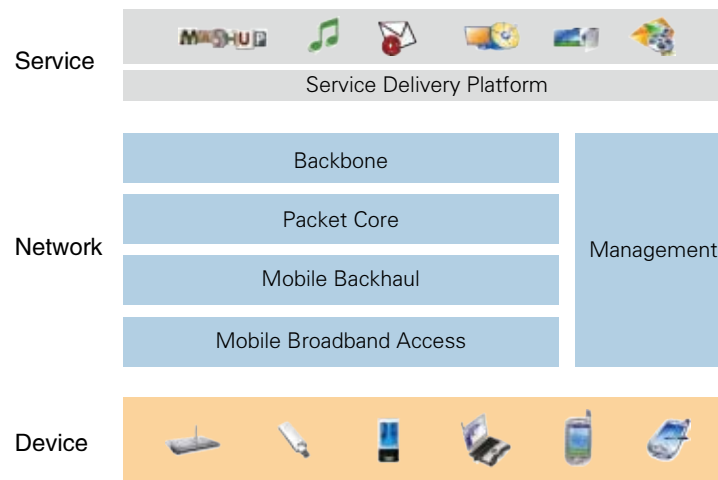
Use of mobile devices as data terminals has become increasingly commonplace. While initial use of data was for low-speed downloads of music ringtones and multi-media messages, today's higher speed 3G data channels now support speeds equal to earlier hard-wired PC connections. Tomorrow's 4G speeds will rival the fastest in-home speeds available to consumers today. As data speeds become higher and handsets smarter, mobile data connections will provide the primary means of accessing the Internet. These speeds can support streaming, real-time video services like movies-on-demand and complex data applications for full PC emulation. This brings about a collision between the business models of the traditional telecommunications industry, that is, pay for time or bits used, and the Internet, where much of the popular content is free, supported by advertising.

As a result, the focus has moved to services. Mobile video services, based on established Internet offerings like Hulu and YouTube, are becoming common. The provision of value-added applications and content for smart phones, highlighted by the success of Apple's iTunes store, has spawned a new wave of applications stores and caused operators to look in new directions. Rather than simply supplying a data pipe to these Internet services, today's telecommunications operators would like to become service providers to their subscribers; adding value, increasing ARPU, and building customer loyalty. In order to have the flexibility to offer new services and expand into new types of business models, operators must have an infrastructure capable of supporting new modes of operation.

IV

Success through a Comprehensive Mobile Broadband Solution

Overall Architecture for Mobile Broadband



Pic 3: Overall network diagram of Mobile Broadband

The network architecture consists of the service delivery platform, backbone network, packet core network, mobile broadband access network, and the network management system. The following describes the core solutions in the architecture of Huawei's intelligent Mobile Broadband network:

Mobile Broadband Access Solutions

Huawei's "Two Clouds" (high-speed cloud and continuous cloud)

Given the increase in site resource acquisition and operating costs, the explosive growth of mobile network traffic in the future, and the data service volume increase, Huawei believes that a merged mapping of a high-speed cloud and continuous cloud offer the best network design for providing DSL-level bandwidth to users in

any area and, in turn, helping operators offer a positive user experience by the most economical means possible.

In this topography, a high-speed cloud uses Pico micro base stations and Femto home base stations in hot spots and dense metropolitan areas to provide an average of 2-Mb/s or higher user bandwidth. In complementary fashion, a continuous cloud provides constant coverage to support a ubiquitous Mobile Broadband connection for mobile users. The continuous cloud employs macro base stations to provide 256-kb/s or higher bandwidth for users in other scenarios. The resulting resilient network architecture integrates intelligent network management concepts and forms an availability system capable of guaranteeing uninterrupted network coverage; coupled with the use of Mobile Broadband in any scenario to provide extensive broadband services.

Huawei's SingleRAN

In coming years, mobile voice subscribers and Mobile Broadband subscribers will grow simultaneously. Even in developed markets, where voice subscribers have reached a ceiling, Huawei expects multimode networks (GSM, Edge, UMTS, HSPA, and LTE) to coexist until at least 2019. Technology can be revolutionized, but networks must evolve over time. This is especially true for mobile networks. A fixed network is a dot network that can be replaced, dot by dot, but a mobile network is a surface network that cannot be completely replaced overnight and must smoothly evolve over time. In this case, what operators need is not a vertically stacked standard tower, but a horizontally converged network in which voice and data demand from users can be converged into one network element and evolved separately into LTE. The "one network" concept, pioneered and now widely deployed by Huawei, is called SingleRAN. Rapidly adopted by leading operators on several continents, this concept is leading an important trend in mobile network development. The key advantages of SingleRAN are:

- **One architecture**

SingleRAN involves a functionally powerful controller platform and base station platform on which all modes are unified. RF units can be modularized and standardized. RF modules on GSM, UMTS, LTE, and even other modes can be placed in the same base station. The unified base station platform ensures such modules can be randomly combined and they can share the same baseband unit. In the event of a change in market demand and a service increase or decrease, the operator can adjust RF module types as needed to change service capacity in a flexible way.

- **One evolution**

1. In multipath evolution, each path must be smooth. An operator always hopes to provide LTE services with minimum CAPEX. In multipath evolution, UMTS or HSPA must evolve to the LTE and GSM network without requiring any hardware modifications. In this case, UMTS or HSPA must also be capable of smooth evolution. When a Huawei 4th generation base station is upgraded from GSM and UMTS to LTE, 100% of the RF components can be reused.

2. A carrier operating multiple networks has to maintain smooth service across the board. A combination of multimode RF units allows for a smooth module-level evolution solution and Software Defined Radio (SDR) technology can enable smooth carrier-level micro transition all the way to LTE. Later, when the operator is ready to launch LTE there are abundant RF resources available, making it possible to also accommodate legacy GSM or UMTS services. According to fluctuating market demands, the operator can dynamically adjust carrier level resource dispatching and the LTE service capability allowing switchover to be smoothly achieved from this point forward.

(ii) The IPTime Mobile Bearer Solution provides a resilient bearer network

Traditionally, high mobile bearer network costs, poor availability, and limited bandwidth resources, as well as maintenance and fault location problems, have restricted Mobile Broadband development. Operators urgently need to build mobile bearer networks with full-scenario support capabilities, carrier-level capabilities, ease of maintenance, and scalability to meet Mobile Broadband demand and boost Mobile Broadband availability.

Huawei's IPTime mobile bearer solution, including the IP microwave RTN series, metro router CX series, and packet transmission equipment PTN series, has overcome Mobile Broadband bottlenecks and provides end-to-end IP mobile transmission.

- **Any Media Access:** Meeting access demand in complex scenarios and supporting flexible transmission for deep coverage of mobile networks
- **Any Media Clock:** Providing GPS precision packet clock capability and enhancing QoS
- **Any Media Management:** Enabling rapid release and reliability of mobile services, while boosting mobile bearer network efficiency and allowing for future orientation.
- **LTE-Oriented:** Large bandwidth, fast switchover, and lower latency, as well as over 350-km/h high-speed mobility, effectively reducing broadband service interruption time.

(iii) Mobile Broadband needs a smarter core network

Deployments of Mobile Broadband networks have resulted in vastly different behaviors by subscribers, particularly with respect to the use of the data network. For instance, the 3G "dongles" for laptops and smart phones with integrated Internet connections have resulted in mobile data usage 10 to 15 times prior volume. To stimulate demand, many operators have moved to flat-rate plans with large monthly allocations of data capability. If operators simply expand capacity to keep up with demand, particularly demand including everything from streaming video to P2P downloads, they will never be able to achieve profitable operations.

To assist operators in solving this problem and help meet the demands of their subscribers, Huawei has created the Intelligent Packet Network (IPN), an enhanced mobile packet core allowing operators to successfully monitor and manage Mobile Broadband networks while providing opportunities to profit from the creation of new services.

- **Visible network:** IPN uses deep packet inspection technology to assess traffic volume through the packet core network and report information related to service types and bandwidth usage according to individual operator definitions. Operators can carry out sophisticated analysis based on this information and lay the foundation for optimizing network control.
- **Manageable network:** IPN bandwidth management capabilities can be controlled by different parameters, such as service type, time, location, user type, and many other dimensions. Operators can manage low, value-added services to save bandwidth resources and ensure the quality of profitable services.
- **Profitable network:** Being able to understand the way subscribers are using a network and being able to precisely manage that network to support different qualities of service allows the operator to look at new types of offerings that will provide enhanced subscriber experiences and also generate incremental revenue. Priority downloads for "watch it now" streaming video, high-quality multimedia conferences, and even services like ad insertion, are all possible based on the intelligence provided by Huawei's IPN.

(iv) IPTime Backbone Solution

Huawei has rich experience in the IP and optical fields. In the IP field, Huawei was the first to commercially deploy a 2+4 Cluster Router and router supporting 40 G/port, 400 G/slot, 10 T/node, and ISHE (In-Service Hardware Expansion). In the optical field, Huawei provides the 5.12-Tb OTN platform, the most comprehensive 40G solutions, and implemented a 100 G/2000 KM prototype in the lab in 2008.

Based on Huawei's deep understanding of IP and optical fields, Huawei introduced a flat backbone solution with synergized IP and optical:

- **Optimized expansion for efficient improvement**
- **Visualized management for troubleshooting**
- **Synergized protection between IP and optical for enhanced reliability of the network.**

ii

Technologies for Mobile Broadband

For multiple reasons, operators must seek the earliest possible unique vantage points in their respective markets. MBB technologies answer many of these needs.

(i) HSPA+ accelerates the pace of Mobile Broadband

HSPA has become established as the Mobile Broadband access method most commonly used today. It relies on the traditional UMTS network and uses new technology to increase transmission rates. Looking ahead, the industry continues to examine the potential of higher transmission rates. This is enhanced HSPA, also known as HSPA+.

Benefiting from parent HSPA technology, HSPA+ inherits the advantages of established wireless resource management, mobility management, and industry chain maturity. In addition, HSPA+ concentrates attention on technological improvement in the areas of L2 enhancement, MIMO, high-order modulation, and fast access. As a result, HSPA+ affords greatly increased system throughput. Single-cell throughput, with the combined use of 64QAM and 2x2 MIMO, has now reached 42 Mb/s downstream and, by using upstream 16QAM high-order modulation, throughput has reached 11 Mb/s upstream. Service setup time has also been shortened while improving the user experience. With upstream, intermittent sending and downstream, intermittent receiving, and user equipment battery life has been extended with call duration increasing significantly. 3GPP R8 and its future iterations will introduce multicarrier HSPA and the combination of multicarrier HSPA and MIMO. These technologies will further enhance user experiences during peak periods.

(ii) LTE/SAE leads the way for Mobile Broadband development

The next step in communications technology evolution has been to seize multiple initiatives and utilize globally unified technology standards. Many operators address technology convergence, according to maximization of their unique specific business interests and those of their precisely defined user segments and markets. Considered as a global whole, this convergence technology is LTE/SAE, the industry's first technology standard intended to cover Europe, America, and Asia. This standard has been recognized, planned, and deployed by mainstream operators. It is universally accepted that LTE/SAE is the preferred choice for next generation Mobile Broadband technology. The deployment of the world's first LTE/SAE commercial network in December 2008 subsequently achieved landmark status in the early history of LTE/SAE commercialization. The network, deployed by Huawei for TeliaSonera in Oslo, Norway, is an example of the positive contributions made by Huawei to LTE development. Huawei commenced LTE research and development in 2004 and by 2Q09 had contributed 15% of all LTE patents. Huawei has continuously participated in LTE standardization and organization activities. Huawei also fills an important role in NGMN and has made extensive contributions to research on SON, system architecture, and network performance.

(iii) Femto provides a Home Convergence Network

With Huawei's help, the Singapore-based telecom operator, StarHub, launched the world's first 3G-based femtocell service, Home Zone, at the end of 2008. By installing a portable wireless access device indoors (femtocell base station provided), StarHub users now enjoy superior 3G services and indoor broadband services with a download rate of up to 7.2 Mb/s. Broadband services include Mobile Broadband access such as IPTV, entertainment downloads, cyber surfing, and remote video conferencing. The femtocell is a home and SMB-oriented client product that can be easily and quickly installed by individual end users. 3G and 2G communications are enabled only by moving ADSL or LAN from the computer to the femtocell. The operator can change the market landscape through differentiated competition by leveraging the opportunity to offer femtocell services.

Given the increase in diversity of in home user equipment, including mobile phones, fixed phones, notebook computers, and television sets, users' demand for unified access, unified billing, UE interconnectivity, and multiservice play, has become extremely strong. Femtocells provide an effective solution for fixed-mobile convergence platforms. By installing a femtocell at home, users can achieve superior signal coverage for the entire home and can receive economical convergence services with more extensive content. In the home, the user can access it via the Internet and outside the home, users can switch to the mobile network. This reduces mobile charges. Use of a femtocell means one number and one bill for each family and enables interconnection between multiple mobile devices. In the short term, because of its innate Internet access and mobile features, femtocells will offer operators an effective way of bundling the sale of broadband access service and mobile phone services with the promise of enhanced end-user experiences.

Femtocell services, especially indoor, high-speed data and outstanding voice, have equal relevance for small and medium enterprises, adding considerable revenue potential and subscriber allure for operators.



Precision Control Enables Fine Granularity Operation

The ability to exercise Precision Control, allows Mobile Broadband operators to leverage existing network resources and segment customer demand based on network characteristics to provide differentiated and competitive data services, optimize network utilization, and improve profitability.

(i) Precision Control of Services

The identification and management of services utilizing large amounts of bandwidth is becoming a key requirement for Mobile Broadband operators. Many P2P protocols use dynamic ports and private/proprietary protocols to evade detection and even use encryption and disguise themselves as normal web protocols, making it very difficult for the traditional firewall and ACL to protect and monitor P2P traffic.

An intelligent packet core network should be able to identify protocol tag words, application layer messages, and service modes; determine the use of P2P/VoIP technology and behavior; and use the relevant service policy to manage and control this traffic. These same capabilities can also be used to optimize P2P/VoIP services to offer new services to users while preventing such applications from causing an impact on the network and other services.

(ii) Precision Control of User Policy

The rapid growth of mobile data usage will eventually translate into insufficient bandwidth. In this scenario, it will become impossible for operators to obtain an adequate return on their investment. It will become essential for operators to conduct in-depth segmentation of user demand, and this will provide an opportunity to offer differentiated services. This is key for operators to increase the value of their Mobile Broadband offering and be able to simultaneously offer new business models.

Building an intelligent packet core network capable of generating and managing user-level policy is a prerequisite for an operator to achieve precision control. With user-level policy generation and control, the operator can implement different billing modes for different users, such as monthly fixed traffic, bundled service, and content billing. The operator can also allow users to change their service packages online, helping the operator boost market share and revenue.

(iii) Precision Control of New Business Models

Advertising is one of the most important business models of Internet services. With the spread of Mobile Broadband, advertising will become an important new source of revenue. For mobile users, advertising can more precisely and effectively target customers.

With the capabilities of an intelligent packet core network, mobile operators can precisely market mobile advertising. The intelligent packet core network can also extract information on user preferences, interests, and habits left by users in the service utilization process. Through Intelligent system analysis, it can derive the precise target audience for advertisement and meet advertiser demands for precision. In addition, advertisement splicing and WAP PUSH can be used to bring beneficial, trustworthy, and valuable advertisement information to mobile users.

(iv) Precision Control of the Value Chain

In coming years, the new value-added mobile industry chain may no longer be dominated by operators alone. The addition of intelligent terminals and SP/CP has extended the industry chain. Intelligent terminals and SP/CP occupy an increasingly important position in the industry chain.

To maintain control over the industry chain and retain or boost their right of discourse, operators must forge mutually beneficial relationships between all members in the industry chain. This is essential, especially at a time when users have changed from passive service consumers into active service creators, creating a new profit-sharing model.

An operator may use the intelligent packet core network to identify and count SP/CP content and traffic. The operator can set up a reasonable revenue-sharing model and carry out the transition from a traditional collection model to a direct billing model. By providing a more convenient and user-friendly application interface (API), the operator can reduce service creation and risks, stimulate the content provider and user enthusiasm, and encourage a virtually endless stream of innovative wireless services.

V

Conclusions and Recommendations

Huawei's Mobile Broadband solution is founded on our innovative network solutions, leading next-generation communications technologies, and intelligent core network knowledge.

A smart network architecture can be established by deploying Huawei's "Two Clouds", SingleRAN, and IPTIME solutions to help the carriers provide a cost-effective user experience while benefiting from future-proof investment protection.

Huawei's leading next-generation mobile communications technologies, such as HSPA+, LTE/SAE, and Femtocell, substantially enhance the utilization of air interfaces and reduce the cost per bit while improving the user experience. With Huawei's IPN solution, P2P traffic can be effectively identified and managed, helping to mitigate the disconnection between traffic increases and revenue growth.

More importantly, the IPN solution enables a personalized operating strategy and varied revenue sharing model according to the content and traffic of different SP/CPs. While overseeing the solution, the business intelligence function can accurately identify the audience for targeted mobile advertisement, which not only creates new revenue streams for the carriers, but also reinforces their position in the mobile broadband industry, contributing value to the entire ecosystem, users, SP/CP, mobile ad agencies, and many others.

VI

Glossary

BOSS	Business and Operation Support System
CAPEX	Capital Expenditure
CDMA	Code Division Multiple Access
CN	Core Network
GSM	Global System for Mobile communications
HSPA	High-Speed Packet Access
IEC	International Engineering Consortium
IPN	Intelligent Packet Network
IPTime	IP Transport Infrastructure for Multiplay Evolution
LTE	Long-Term Evolution
MBB	Mobile Broadband
P2P	Point to Point
RAN	Radio Access Network
SAE	System Architecture Evolution
SDR	Software Defined Radio
SP	Service Provider
UGC	User Generate Content
UMB	Ultra Mobile Broadband
VoIP	Voice over IP
WCDMA	Wideband Code Division Multiple Access
WoA	Web-Oriented Architecture

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