ERICSSON

THE FUTURE OF WCDMA/HSPA

DELIVERING EXCEPTIONAL MBB USER EXPERIENCE EVERYWHERE

WCDMA/HSPA enables hundreds of millions of people to access mobile broadband (MBB) through their smartphones every day. Today, new, low-priced WCDMA/HSPA smartphones are entering the market, and they will enable MBB for new hundreds-of-millions-sized markets. WCDMA/HSPA has evolved into a highly effective MBB technology that will continue to serve both new and traditional markets for years to come, either as the main MBB technology or as an important complement to LTE.

ESSENTIAL TODAY AND TOMORROW

The number of mobile broadband (MBB) subscribers and the level of traffic continue to grow at an unprecedented pace. The key driver behind this growth is an accelerating shift from voice-centric phones and feature phones to increasingly affordable MBB-enabled smartphones.

In some markets, as many as 90 percent of all new handset sales are accounted for by MBB-enabled smartphones. While this figure varies across markets with different levels of maturity and consumer buying power, the global trend is clear (as illustrated in Figure 1). And it is being driven first and foremost by the falling price of highly capable WCDMA/HSPA smartphones.

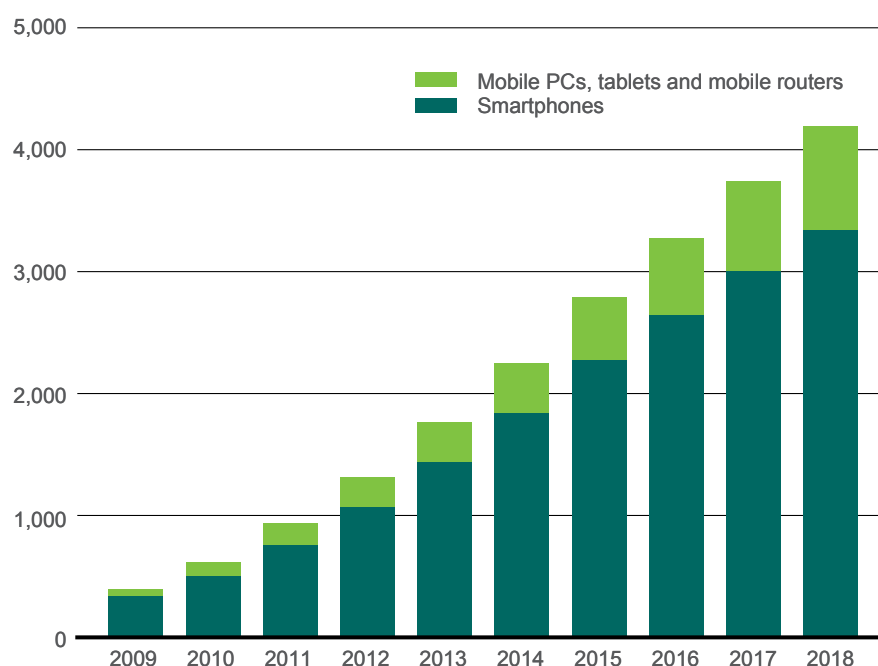**Subscriptions** (million)

Figure 1: The rise of smartphones, mobile PCs, mobile routers and tablet subscriptions with a cellular connection, 2009-2018 [1].

This transition to smartphones presents a significant new revenue opportunity for operators, as experience shows there is substantially higher average revenue per user (ARPU) from smartphone users compared with non-smartphone users.

WCDMA/HSPA networks will have an essential role to play in enabling operators to take advantage of this market opportunity, both today and for the foreseeable future. This is driven by mobile operators' need to satisfy four fundamental market requirements, wherever they are in the world and whatever the stage of market development. These market requirements are:
> Serving the growing volumes of affordable MBB-capable WCDMA/HSPA smartphones that are arriving on the market.
> Ensuring a "megabit experience" (better than 1Mbps download speed) for all MBB subscribers, and a "superior-" MBB experience (better than 2Mbps download speed, typically 10Mbps) for high-end-device users wherever they go.
> Delivering high-quality voice services everywhere.
> Meeting the roaming needs of all MBB subscribers around the world.

As with most consumer electronics technology, smartphones are subject to Moore's Law. In simple terms, smartphones are roughly doubling their performance (for example, processing power and data speeds), while halving in cost, every two years. We have reached a stage where the cost of WCDMA/HSPA chipsets is bringing highly capable smartphones into the price bracket previously occupied only by voice-centric and feature phones. At such sub-USD 100 prices, smartphones appear to have reached a tipping point and are entering a true mass-market phase.

While the rollout of 4G LTE radio networks is proceeding rapidly, especially in developed markets, coverage is still only a fraction of that provided by GSM/EDGE and WCDMA/HSPA – and, from a global perspective, will be for many years to come. Operators need to ensure that 4G subscribers' MBB experience does not "fall off a cliff" whenever they leave LTE coverage.

MBB subscribers will always want good-quality voice services. WCDMA/HSPA offers a well-proven and efficient voice solution that meets very good KPIs, including voice retainability and voice accessibility. It is also able to provide HD voice quality, which is already being deployed by several operators.

LTE is being deployed in more than 20 radio bands around the world (unlike WCDMA/HSPA, which has only four main bands worldwide). It will take time before one single LTE smartphone will be able to operate on every LTE network around the world. In addition, some markets are still years away from awarding LTE licenses. Nonetheless, operators need to ensure that high-value roaming subscribers can enjoy a consistent MBB experience.

While LTE is often viewed as the key solution for handling high-capacity situations, WCDMA/HSPA is equally capable of handling large numbers of smartphone users. What is more, this capability is being dramatically extended over the coming years, mainly through the implementation of software features.

Fundamentally, all operators – whether they are voice-centric GSM operators or MBB-centric operators who are deploying LTE – will benefit from having a strong WCDMA/HSPA network, as HSPA is the only technology that will be used in all smartphones for the foreseeable future.

Operators deploying LTE in the same frequency band in which they already offer HSPA will benefit from WCDMA/HSPA functionality that allows effective spectrum refarming.

THE HIGH-GROWTH MARKET

In the past couple of years, MBB has become firmly established as people have grown accustomed to having high-speed-internet access wherever they go. According to market analyst firm Wireless Intelligence [2], MBB technologies now account for about one-quarter of total global connections. WCDMA/HSPA makes up the vast majority of MBB connections and is the fastest-growing wireless technology so far.

Now MBB is entering its next phase of expansion as the availability and affordability of devices grows, especially in developing markets.

Ericsson's estimates show that there were 6.6 billion mobile subscriptions (excluding machine-to-machine subscriptions) at the end of 2012 [1]. Of these, about 1.5 billion were MBB subscriptions (including feature phones, smartphones, mobile PCs, tablets, mobile routers and dongles). According to Wireless Intelligence, mobile subscriptions in the developing world passed the 5 billion mark in the third quarter of 2012, and now comprise almost 80 percent of the world's total.

By the end of 2018, total mobile subscriptions are expected to grow to 9.3 billion, and about 6.5 billion of these will be for MBB, as shown in Figure 2.
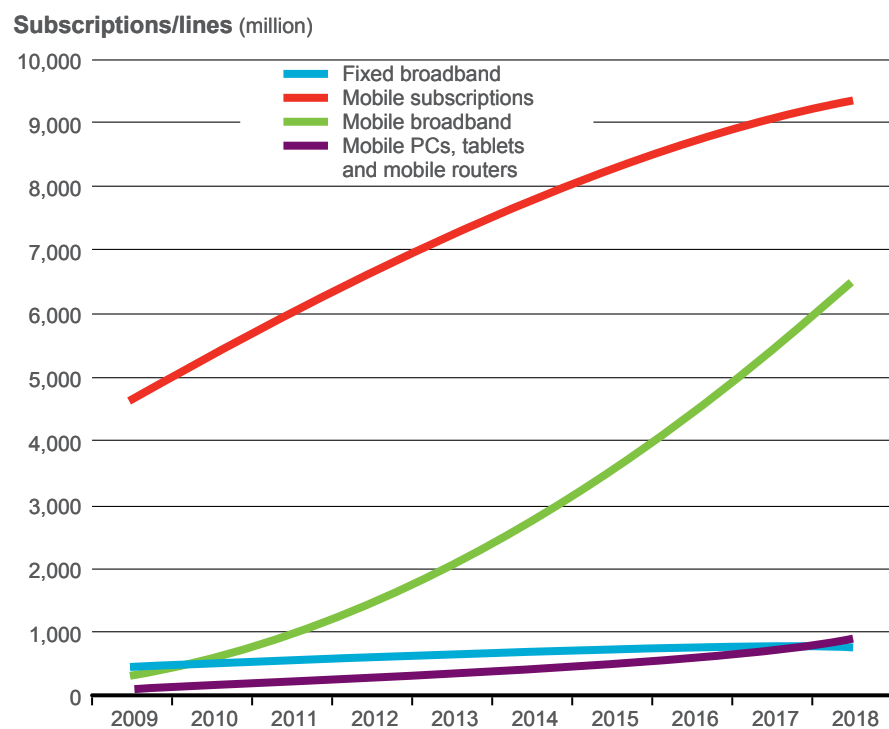
Subscriptions/lines (million)

Figure 2: Fixed and mobile subscription growth 2009-2018 [1].

ENTER THE AFFORDABLE SMARTPHONE

At the center of this more than fourfold predicted increase in MBB subscriptions is the rising tide of affordable smartphones and, to a lesser extent, tablets.

According to the market analyst firm Strategy Analytics [3,4], 217 million smartphones were sold in the fourth quarter of 2012 – some 40 percent more than in the same quarter of 2011 overall. Within this figure, sales of Android smartphones grew close to 90 percent year-on-year. And there is a similar story for tablets: fourth-quarter 2012 sales were 45 million; 67 percent higher year-on-year overall and 85 percent higher year-on-year for Android devices.

The overall growth trend is set to continue. Total smartphone subscriptions are set to rise from 1.1 billion at the end of 2012 to about 3.3 billion in 2018.

One of the most significant factors behind this rapid growth in smartphone adoption will be their significantly lower average selling price, driven by the availability of lower-cost chipsets, especially from Asian manufacturers.

We are already starting to see a number of sub-USD 100 WCDMA/HSPA smartphones with 14.4Mbps, dual-band, dual-core processor capabilities. There is also strong growth in the mid-range smartphone market (USD 100-200), thanks to the arrival of much lower-cost chipsets for 42Mbps, quad-core, HD (1280x720) devices.

According to market research firm Strategy Analytics [5], unit sales of entry- and mid-range smartphones are set to grow at a compound annual rate of 45 percent between 2011 and 2016, while unit sales of premium and high-end smartphones will grow by a compound rate of just 1.8 percent, as illustrated in Figure 3.
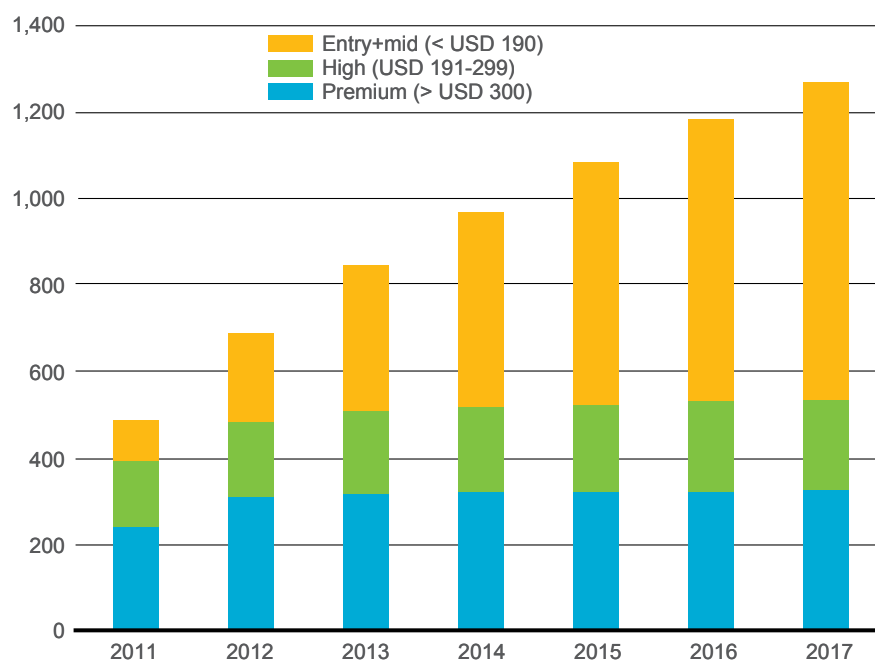
Smartphones by wholesale tier (million)

Figure 3: Global smartphone sales forecast by wholesale price tier. Smartphones below USD 190 are the biggest contributor to volume increases (source: Strategy Analytics) [5].

This increase in entry and mid-range smartphones will power demand for MBB coverage, capacity and throughput, especially in developing markets, where mobile devices will provide many people's first taste of high-speed internet connectivity.

So, which networks will this growing band of MBB subscribers be using?

WCDMA/HSPA SCALE BEATS LTE PACE

In the second half of 2012, there was extremely rapid growth in LTE connections, mainly driven by smartphone uptake in Japan, South Korea and the US. LTE subscriptions are expected to grow from just under 100 million at the end of 2012 to about 1.6 billion by the end of 2018.

However, over the same period, WCDMA/HSPA subscriptions are predicted to grow from just over 1 billion to 4.4 billion, as shown in Figure 4 [1].

In other words, there are likely to be almost three times as many WCDMA/HSPA subscriptions as LTE subscriptions in 2018. (It is also worth noting that GSM/EDGE subscriptions have continued to grow in number, and are only expected to start declining during 2013).
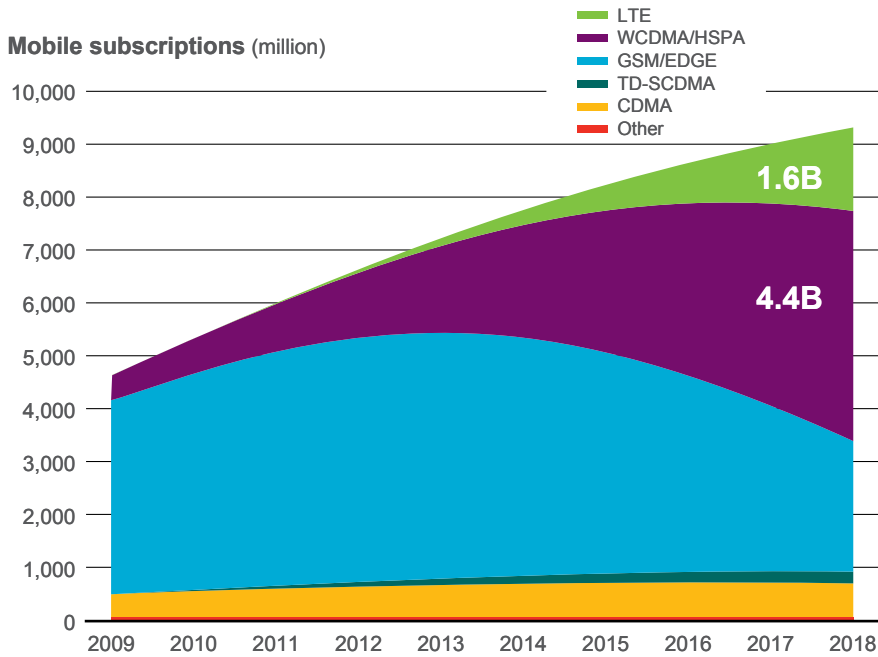
Mobile subscriptions (million)

Legend:
- LTE
- WCDMA/HSPA
- GSM/EDGE
- TD-SCDMA
- CDMA
- Other

Chart with y-axis from 0 to 10,000 and x-axis years 2009–2018.

1.6B (LTE)

4.4B (WCDMA/HSPA)

Figure 4: Mobile subscription growth by technology [1].

In addition, Ericsson's predictions forecast that global population coverage for WCDMA/HSPA will increase from 50 percent in 2012 to more than 85 percent in 2017.

Furthermore, people are expected to be using their MBB devices a lot more than today: they will consume roughly four times as much data across all device types by 2018, as shown in Figure 5. For example, the average monthly data usage for a smartphone is expected to rise from 450MB in 2012 to nearly 2GB in 2018 [1].

	2012	2018
(mobile PC)	3 GB	11.0 GB
(tablet)	0.65 GB	2.7 GB
(smartphone)	0.45 GB	1.9 GB

Figure 5: How average monthly mobile-data usage will grow for mobile PCs, tablets and smartphones [1].

Whichever way we look at the numbers relating to MBB, it is clear that it is a high-growth market that offers great potential for revenue growth in developed and developing markets. What is also clear is that WCDMA/HSPA is going to be the MBB "workhorse" for some years to come.

Whether or not mobile operators have access to LTE spectrum, they will need to ensure the availability and good performance of WCDMA/HSPA networks in order to serve the rapidly growing numbers of non-LTE smartphones and other devices. Even if they are rolling out LTE, operators need to ensure their WCDMA/HSPA networks provide a comparable quality experience when users move outside LTE coverage.

As demand grows, MBB services are putting immense pressure on limited radio spectrum, and operators will need to find new ways of using this spectrum ever more efficiently across 2G, 3G and 4G technologies.

So, how can operators ensure they have the WCDMA/HSPA coverage, capacity, performance and business models they need to meet the rapid increases in MBB uptake, usage and expectations?

DELIVERING MORE

Whether operators are expanding their WCDMA/HSPA coverage into new areas, or upgrading WCDMA/HSPA coverage and capacity as a complement to LTE rollout, the key challenges are the same:

> Delivering cost-efficient WCDMA/HSPA coverage.
> Efficiently handling very high numbers of smartphones, characterized by a mix of voice and very bursty data traffic.
> Ensuring a consistent user experience with the focus on KPIs, such as call retainability and accessibility, as well as high uplink and downlink throughput and short latency. Such KPIs will, to a large extent, define the perception of the operator among smartphone users.
> Constantly monitoring the smartphone population and taking action to shape it, for example, by using subsidies to encourage users to replace their old network-inefficient smartphones with newer models that enhance both network efficiency and user experience.

Unlike any other radio technology, WCDMA/HSPA is both a proven voice solution and also a very capable MBB solution that can deliver very high peak rates in the uplink and downlink, as well as high cell-edge throughput. Cell-edge throughput has a dominant influence over the WCDMA/HSPA system's smartphone capacity.

WCDMA has already gone through a lengthy process of evolution, and has come a long way from its first "Release 99" incarnation more than a decade ago. WCDMA/HSPA already exceeds the requirement to deliver a megabit experience for users everywhere, thanks to:

> Support for up to 42Mbps in the downlink and 5.8Mbps in the uplink.
> Superior radio performance with a comprehensive base station portfolio for optimized coverage and capacity.
> Excellent in-service performance built on scalable and future-proof 3G platforms.
> A clear evolution path to HSPA Evolution, which will provide speeds of more than 84Mbps in the downlink and more than 12Mbps in the uplink.

Behind these headline features, there are numerous improvements being developed and applied to WCDMA/HSPA that will further boost its ability to deliver a better user experience through improved smartphone capacity and higher uplink and downlink bitrates.

ADDED CAPACITY FOR SMARTPHONES

Many newer smartphones on the market support features that enable a substantial rise in overall smartphone capacity (number of users per cell).

For instance, multicarrier technology enables the WCDMA/HSPA system to use multiple 5MHz carriers for one user in both the uplink and downlink. From 3GPP Release 10 onwards, WCDMA/HSPA supports multicarrier operation on up to four carriers in the downlink (which can be spread across one or two frequency bands) and up to two carriers in the uplink.

Multicarrier technology provides both substantial capacity gains, as well as throughput and peak rate gains in the cell. The first step in WCDMA/HSPA multicarrier development (2x5MHz downlink) is available in smartphones today. Multicarrier in the uplink is expected to arrive in smartphones toward the end of 2013.

Another function that boosts capacity is the 3GPP-specified Fast Dormancy Release 8. This enables a smartphone to move to an energy-efficient state (Universal Terrestrial Radio Access Network (UTRAN) Registration Area Forward Access Channel (URA_FACH)) as soon as it has no data to send, dramatically decreasing the time the smartphone is in the most resource-intensive state (Cell Dedicated Channel (Cell_DCH)).

The WCDMA/HSPA radio uplink is non-orthogonal by nature, meaning that all users in a cell interfere with each other on the radio interface. The most efficient way to counter this interference is to eliminate unnecessary, or excessive, network "chatter," such as control signaling. This is the purpose of a feature called Continuous Packet Connectivity (CPC), which has the effect of dramatically improving uplink capacity by limiting interference.

Many commercially available smartphones already use Fast Dormancy and growing numbers are appearing with CPC.

In addition, advances in base station signal processing provide a clearer received uplink signal, which reduces the cell's total interference while sustaining uplink quality. Four-way (instead of two-way) receive diversity further amplifies the positive effects of advanced uplink receivers.

WCDMA/HSPA enables users that are sending and receiving only small bursts of data (as is typical with smartphones most of the time) to handle that data in a semi-active state called

CELL_Forward Access Channel (CELL_FACH). To enable even more efficient CELL_FACH operation, 3GPP has specified High-Speed (HS)_FACH for the downlink and Enhanced Uplink (EUL)_FACH for the uplink. HS_FACH-enabled smartphones are already available and EUL_FACH-capable smartphones are expected during 2013.

ENHANCING COVERAGE

The ability to extend WCDMA/HSPA coverage efficiently is vital to turning the proliferation of low-cost HSPA smartphones into increased revenue from MBB services.

One key way of doing this is to refarm the 900MHz spectrum from GSM to WCDMA/HSPA. This spectrum typically gives a 6dB link budget advantage over the 2,100MHz spectrum, which translates into substantial coverage advantages. According to the Global mobile Suppliers Association (GSA), 57 commercial WCDMA 900MHz networks have been deployed in 39 countries (as of December 2012) [6].

Other WCDMA/HSPA coverage-enhancing measures include four-way receiver diversity (rather than two-way), lower speech rate for better voice coverage, and the capability for improved scaling of control and traffic channels.

ADAPTING DATA PLANS TO MARKET NEEDS

One important aspect of driving the uptake of MBB, and increasing ARPU overall, is to ensure that data plans meet subscriber needs, especially in markets where the ARPU has traditionally been low. The MBB pricing models used in more established markets may not be appropriate for many developing markets where ARPU can be one-tenth that of a developed market, for example.

With the trend to "bring your own device" (BYOD) in many mature markets, there are several new plans that are designed to attract new user categories. Often, operations are run by a mobile virtual network operator (MVNO) to differentiate from the major (owner) brand. These offerings tend to be characterized by a distinct internet flavor, no operator subsidies for devices and less customer support. Such approaches have proved successful in mature markets and have attracted new smartphone users.

Another trend in mature markets is "prepaid as postpaid." Traditionally, before data buckets were introduced, postpaid customers often represented a higher ARPU group than prepaid customers. Data buckets are often defined by a fixed traffic amount for a fixed price, which has made the distinction between prepaid and postpaid less important for operators. Bucket allowances are typically not exceeded, which provides increased revenue opportunities for operators.

With the increasing popularity of tablets in developed markets, operators have an opportunity to monetize this trend by offering attractive tethering add-ons and sharing plans.

Several operators have already successfully transformed their subscriber plans from traditional voice minutes and SMS volume-based charging to charging based on actual data use.

The increasing availability of low-priced smartphones will enable 2G/feature phone users to move to a highly capable WCDMA/HSPA smartphone next time they invest in a new device, for about the same price. As it is quite likely that the WCDMA/HSPA smartphone will be the main broadband-access device for many consumers, operators need to offer appropriate, affordable plans.

One way to enable MBB on these devices is to permit small payments such as pay-per-hour or pay-per-day. Further, some operators have developed plans that permit pay-per- (small) data volume, and here it is important that the consumer is given control of the actual data-traffic consumption. For instance, using the operator's own portal would not consume any of the data allowance, while accessing Facebook would. With consumers in control, over time they may be more willing to pay for a data bucket for internet access, resulting in increased operator revenue.

Yet another way to boost revenue is to allow consumers time-limited free MBB access to any predefined internet services in return for being shown advertisements before access is granted. An example could be 30 minutes of free internet use after a one-minute commercial.

CONCLUSION

Whether or not operators are rolling out LTE 4G networks, they will need to focus their attention on the performance of their WCDMA/HSPA networks if they are to deliver a consistent, high-quality user experience throughout their coverage areas.

Fundamentally, it is vital that network technology matches the capabilities and cost of the devices subscribers are choosing to use to access MBB services. For the foreseeable future, WCDMA/HSPA will be by far the biggest technology by subscription numbers and by population coverage.

WCDMA/HSPA already provides the backbone for most MBB services, and is being continuously developed to efficiently deliver a true broadband experience that is on a par with 4G – to any device, in any location. No other technology can make that claim.

GLOSSARY

ARPU	average revenue per user
BYOD	bring your own device
CELL_DCH	Cell Dedicated Channel
CELL_FACH	Cell Forward Access Channel
CPC	Continuous Packet Connectivity
EUL_FACH	Enhanced Uplink Forward Access Channel
GSA	Global mobile Suppliers Association
HS_FACH	High-Speed Forward Access Channel
MBB	mobile broadband
MVNO	mobile virtual network operator
TD-SCDMA	time division synchronous code division multiple access
URA_FACH	UTRAN Registration Area Forward Access Channel
UTRAN	Universal Terrestrial Radio Access Network

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