White Paper

September 2009

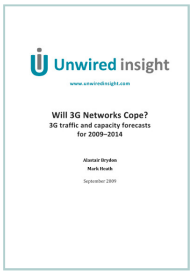
3G networks will evolve, but will they cope?

Unwired insight

Executive summary

"Some operators face the prospect of 3G capacity shortfalls"

Dr Alastair Brydon



This white paper is complementary to the report '***Will 3G Networks Cope?***' published by Unwired Insight.

'Will 3G Networks Cope?' considers the issues raised in this white paper in depth.

3G traffic volumes have increased substantially since 2007, and this trend is set to continue with many drivers for further growth. As 3G traffic volumes increase, 3G operators potentially face massive challenges. There is a danger that 3G networks will quickly become swamped by traffic.

3G enhancements, such as HSPA+ and LTE, cannot come too soon. However, while HSPA+ and LTE promise substantial increases in peak data rates compared with HSPA, it is important to recognise that, in practical networks, these will not equate to similar increases in network capacity.

So, some 3G operators face the prospect of 3G capacity shortfalls, and the need to invest substantially to build many new base station sites and to acquire additional spectrum.

3G operators also urgently need to find complementary ways to deliver services to mobile users, making effective use of WLAN access points, femtocells, mobile broadcasting solutions and sideloading.

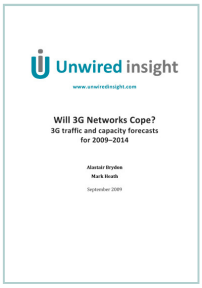
3G traffic volumes have increased substantially since 2007

Since 2007, 3G operators and equipment vendors have reported significant increases in cellular traffic volumes.

For example, in its Annual Report for the year ending December 2008, TeliaSonera reported that usage of mobile broadband and data had "exploded". It stated that mobile data traffic in its Nordic and Baltic operations increased by nearly 500% in 2008.

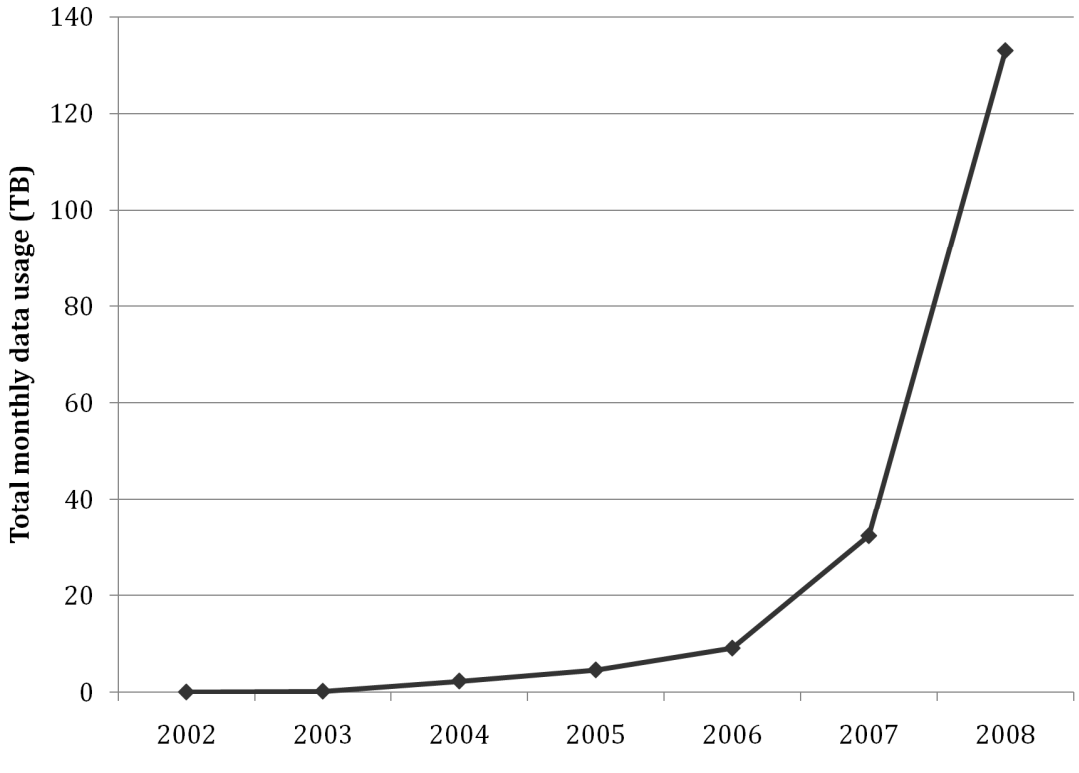
As shown in Figure 1, total monthly usage on all Hong Kong's cellular networks has substantially increased over the last six years (according to the Office of the Telecommunications Authority).

In March 2009, T-Mobile in the Netherlands reported that total weekly usage of mobile data services increased from 2.5TB (equivalent to 10.8TB per month) to 3.1TB (13.4TB per month) in the first half of 2008. In the second half of 2008, total weekly mobile data traffic increased from 3.1TB (13.4TB per month) to 20.5TB (88.8TB per month) - a 561% increase in six months. Total mobile data traffic increased about seven fold in the 12 month period to the end of 2008.



The report '***Will 3G Networks Cope?***' assesses the traffic volume increases experienced by a wide range of operators and vendors.

Figure 1: Monthly cellular data usage in Hong Kong, 2002—2008 (Office of the Telecommunications Authority, Hong Kong)



Several factors will continue to drive 3G traffic volumes

3G traffic volumes will increase substantially in the next five years, driven by several factors.

Increasing 3G penetration as users rapidly migrate from 2/2.5G to 3G services. In most markets, the vast majority of mobile users are still supported by 2G (mainly GSM) networks, so 3G networks are only supporting a minority of cellular users. Within the next five years, the vast majority of 2G customers of incumbent 3G operators will migrate to 3G services.

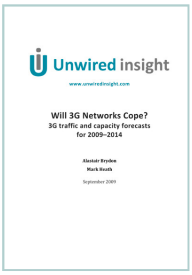
Increasing penetration of USB modems and datacards. The increasing penetration of USB modems to support mobile broadband services will have a significant impact on 3G traffic volumes. With penetration of USB modems and datacards well below 10% in most countries, there is significant potential for further growth. PC applications generally consume substantially more data than basic mobile phones, with usage of several gigabytes per month per device possible.

Increasing penetration of smartphones. With the success of smartphones such as Apple's iPhone, the number of smartphones has been increasing significantly year-on-year, and this growth is set to continue. By 2014, there will be nearly three times the number of smartphone shipments globally as there were in 2008. Recently, T-Mobile reported that iPhone users surf the Web 30 to 40 times more than other mobile data users.

Proliferation of flat-rate service bundles, with increasing usage allocations. Mobile data pricing for traffic-intensive services is becoming more affordable for consumers, with a proliferation of flat-rate tariffs for smartphones and flat-rate mobile broadband bundles, with generous monthly usage allocations. Pricing for some mobile broadband services has fallen below USD2 per GB. Consumers are increasingly adopting mobile broadband services as an affordable alternative to fixed broadband.

Changing service mixes, towards usage-intensive services. Before the introduction of mobile broadband services and mobile TV services, non-voice services were dominated by services that do not consume much network resource, such as text messaging, games downloads and small-screen (WAP) browsing. With an increasing penetration of USB modems and smartphones, the mobile service mix will continue to change considerably. Over time, the mobile service mix will have a greater proportion of usage-intensive services, such as full-screen Web browsing and video streaming.

Improving performance of cellular networks, with the introduction of 3G enhancements (such as HSPA+ and LTE). 3G enhancements will provide users with much greater peak speeds, which will better support usage-intensive services, thus helping to drive 3G traffic volumes.



The report '***Will 3G Networks Cope?***' provides a detailed assessment of the drivers for 3G traffic volume increases.

Increasing availability of easy-to-use data applications on smartphones. Widespread availability of usage-intensive applications on 3G devices (for example, Internet radio, catch-up TV and YouTube) will drive 3G traffic volumes. The advent of Apple's App Store, which provides an easy way for iPhone users to choose and download third-party applications is already being substantially improved. In April 2009, Apple announced that its one billionth application had been downloaded from its App Store.

Increasing usage of 3G devices indoors. Mobile users have been increasingly using their mobile phones instead of fixed phones to make voice calls. Many will access Internet services and a range of multimedia on their phones, even when they could access such services using a PC. Orange has stated that 40% of mobile TV usage in France takes place in the home.

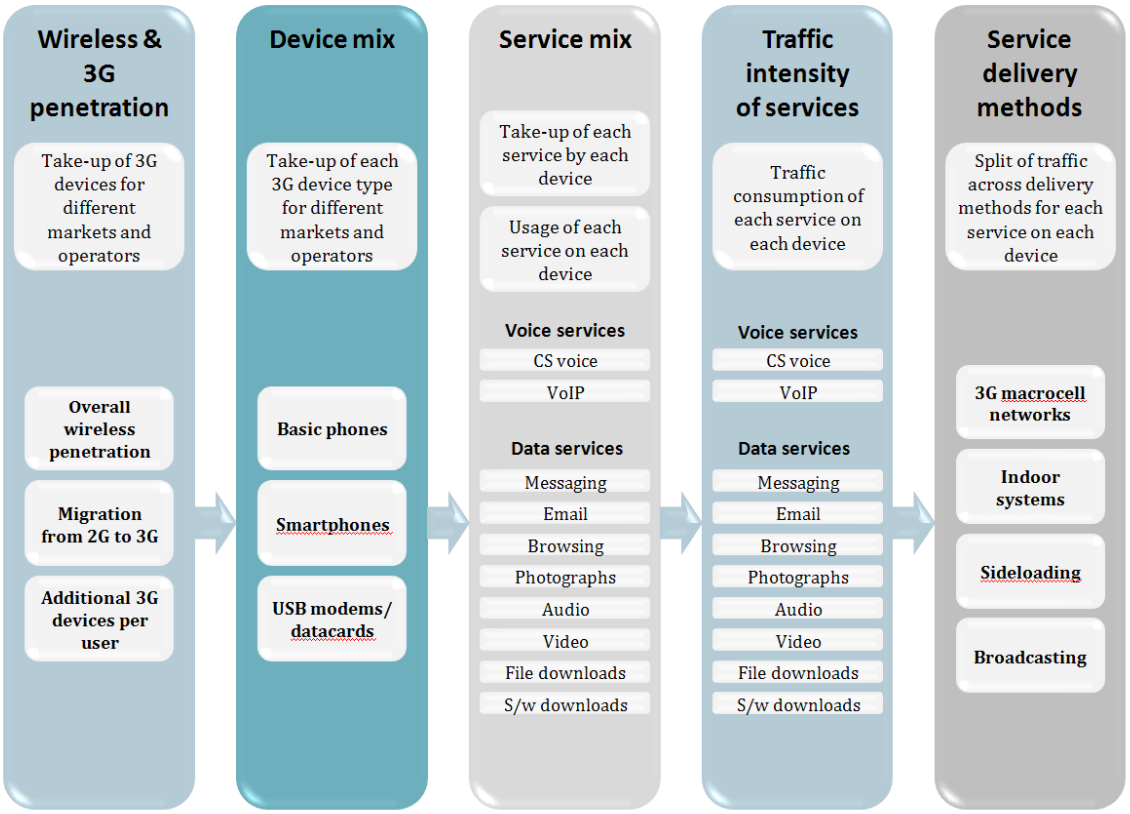
It is now important to understand and quantify future 3G traffic volumes

To determine whether or not 3G networks will be able to cope with future traffic growth, it is necessary to quantify the traffic volumes that 3G macrocell networks will carry. This is very complex, because the traffic carried by 3G networks is affected by many factors, including:

- the total number of 3G devices
- the types of 3G devices used, which include basic phones, smartphones and USB modems and datacards
- the specific services users consume and the usage levels of those services
- the traffic intensity of each service (with big differences between services)
- the split of indoor and outdoor usage
- the proportion of indoor wireless service usage that is carried by indoor systems
- the proportion of service content that is sideloaded to 3G mobile devices
- the availability of broadcasting networks to deliver certain types of content, such as TV and radio, and the proportion of multimedia content that is carried by broadcasting networks.

We have developed a comprehensive service and traffic model, illustrated in Figure 2, to derive forecasts for 3G traffic. Our modelling reveals that 3G traffic volumes could increase by more than 20 times by 2014.

Figure 2: Structure of service and traffic model developed by Unwired Insight



Service content will not necessarily all need to be carried on 3G networks

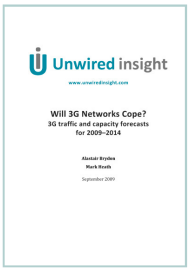
In order to accurately determine the volumes of traffic that 3G networks will need to carry, it is important to translate the services that mobile users will actually use to the amount of traffic that will be generated on 3G networks. This must take account of the fact that some services may be delivered using complementary methods, as shown in Figure 3.

Mobile broadcasting technologies, such as DVB-H, DMB, IMB and MediaFLO, could deliver multimedia content (notably mobile TV and radio) to 3G devices equipped with appropriate broadcasting receivers.

Mobile users with access to fixed broadband services have additional methods for the delivery of services. These are indoor systems (WLAN access points or 3G femtocells) and sideloading.

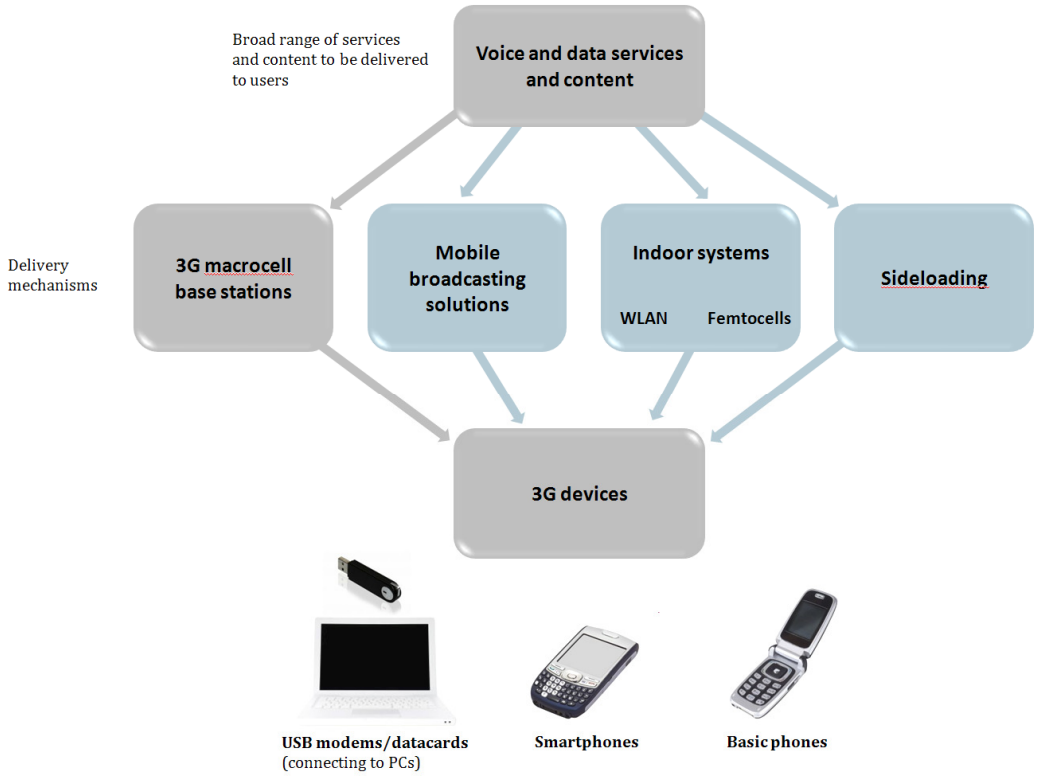
3G operators are planning to deploy (or are in the process of deploying) femtocells.

The models developed by Unwired Insight take account of the alternative delivery methods that may be employed, to avoid overestimating the volume of traffic that 3G networks will need to support.



The report '***Will 3G Networks Cope?***' forecasts traffic volumes for the period 2009—14, broken down into individual delivery methods (including broadcasting networks and femtocells).

Figure 3: Distribution methods for delivery of services and content to 3G devices



A small number of services will have a disproportionate impact on traffic volumes

In order to accurately determine the volumes of traffic that 3G networks will need to carry, it is important to account for the differences between services in the amount of traffic they generate.

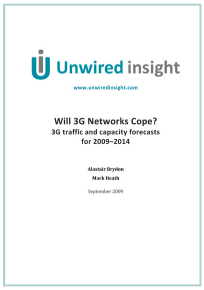
Different services have vastly different characteristics in terms of the network capacity they consume. We refer to this characteristic as the 'traffic intensity'.

A small number of services (including mobile broadband access and video services) will have a disproportionate impact on wireless traffic volumes.

For example, video streaming consumes about 26 times the network capacity of voice telephony. Similarly, a mobile broadband customer using 1GB per month consumes the equivalent network capacity of over 7000 minutes of voice telephony.

In contrast, an SMS message consumes a tiny fraction of the network capacity of a one-minute voice call.

Over time, mobile broadband services and video services will account for an increasing proportion of total traffic.



In the report '***Will 3G Networks Cope?***' individual services are modelled, with quantification of the number of megabytes of traffic realistically generated by each service.

Table 1: Data consumption for a range of mobile services

Service	Data consumed	Typical terminal(s)
1-minute voice call	0.14MB	Basic phone and smartphone
SMS message	0.00015MB	Basic phone and smartphone
Ringtone/logo download	0.002MB	Basic phone and smartphone
Game download	0.025MB	Basic phone and smartphone
MMS message	0.01MB	Basic phone (equipped with a camera) and smartphone
1-minute WAP small-screen browsing	0.065MB	Basic phone and smartphone
1-minute Web browsing	0.20MB	Smartphone
1-minute high-quality audio streaming (128kbps)	0.94MB	Smartphone
1-minute high-quality video streaming (500kbps)	3.66MB	Smartphone
Mobile broadband access (typical user)	0.5–1GB per month	USB modem/datacard

3G networks will continue to suffer capacity constraints despite 3G enhancements

Many are looking to 3G enhancements to boost network capacity to be able to support future traffic demand. As shown in Table 2, there are a number of enhancements planned.

3G enhancements will provide users with much greater peak speeds, which will better support usage-intensive services, thus helping to drive 3G traffic volumes. While HSPA has been deployed on a widespread basis (by more than 95% of W-CDMA operators), the attention of mobile network operators will focus on HSPA+ and LTE.

There is growing momentum behind HSPA+, and a number of 3G operators (including Mobilkom, Telecom Italia, Vodafone and AT&T) have announced their intention to deploy the technology in 2009. LTE deployments will start in 2010, with over 30 operators already committed to LTE.

A key feature of 3G enhancements as they progress from HSPA to LTE is a significant increase in peak data rates, where a base station attempts to maximise the data rate to end users that experience excellent radio conditions (for example, mobile users located very close to a base station). However, even with 3G enhancements, mobile users that experience very poor signal conditions will continue to achieve relatively poor data rates.

It is only a lucky few within a base station coverage area that will experience data rates anywhere near the peak rates possible. These lucky few will, however, increase average throughput delivered by the base station, although by nowhere near the magnitude suggested by the peak data rates.

Table 2: Characteristics of W-CDMA, HSPA, HSPA+ and LTE

Technology	Description	Peak downlink speed per user	Peak uplink speed per user	Timescale
W-CDMA	First version of UMTS	Up to 384kbps (using 5MHz of spectrum)	Up to 384kbps (using 5MHz of spectrum)	First network deployed in 2001, with widespread roll-out from 2003
HSDPA	Enhancement that significantly increases downlink speeds	Up to 14.4Mbps (using 5MHz of spectrum)	Up to 384kbps (using 5MHz of spectrum), which is the same as basic W-CDMA	Available from mid-2005 and deployed by most W-CDMA operators by the end of 2007
HSUPA	Enhancement that significantly increases uplink speeds	Up to 14.4Mbps (using 5MHz of spectrum)	Up to 5.76Mbps (using 5MHz of spectrum)	Available from 2007
HSPA+	Further improvement to HSDPA/HSUPA, which utilises smart antenna technology	Up to 42Mbps (using 5MHz of spectrum)	Up to 11.5Mbps (using 5MHz of spectrum)	Available from 2008
LTE	Major enhancement, which can use wider allocations of spectrum than HSDPA, HSUPA and HSPA+	Up to 45Mbps (using 5MHz of spectrum) Up to 326Mbps (using 20MHz of spectrum)	Up to 13Mbps (using 5MHz of spectrum) Up to 326Mbps (using 20MHz of spectrum)	Available from late 2009/early 2010

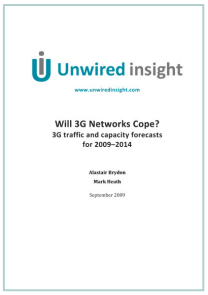
Some 3G operators will face capacity problems in 2010

Our modelling reveals that there are significant differences in the outlook for different types of 3G operator. Some will face major problems, with their HSPA networks having insufficient capacity in the short term to meet future traffic demands.

As shown in Figure 4, some incumbent 3G operators with large customer bases will face HSPA capacity shortfalls in mid-2010, or even earlier if customers migrate rapidly from 2/2.5G to 3G services.

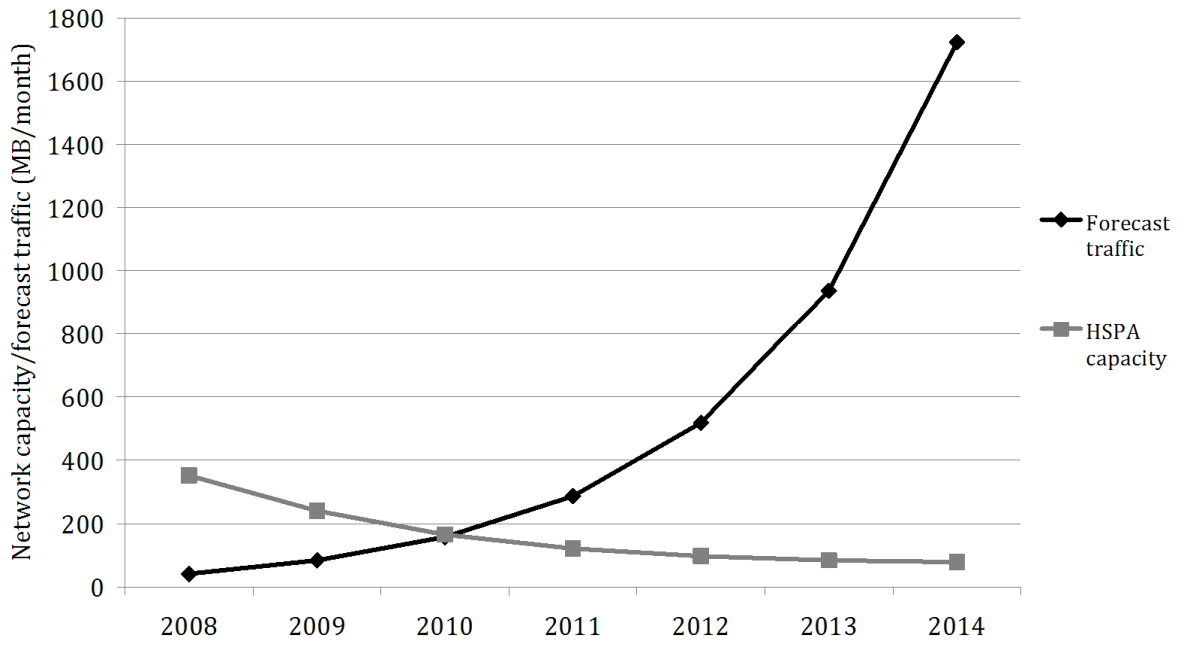
The effect of shortfalls of capacity will be that service users will experience degradation in the quality of service provided by a 3G operator, particularly at times and locations at which the network is heavily used.

In contrast, new-entrant 3G operators will not suffer from severe short-term limitations of HSPA capacity, and will have a two-year window of opportunity to aggressively promote mobile broadband services.



The report '***Will 3G Networks Cope?***' assesses the outlook for different types of mobile network operator.

Figure 4: HSPA network capacity per device and forecast traffic per device for a 3G operator, for a modelled scenario, 2008–2014



There are big challenges ahead

Our modelling shows that 3G operators will face a constant challenge to provide adequate network capacity to keep ahead of future traffic demand.

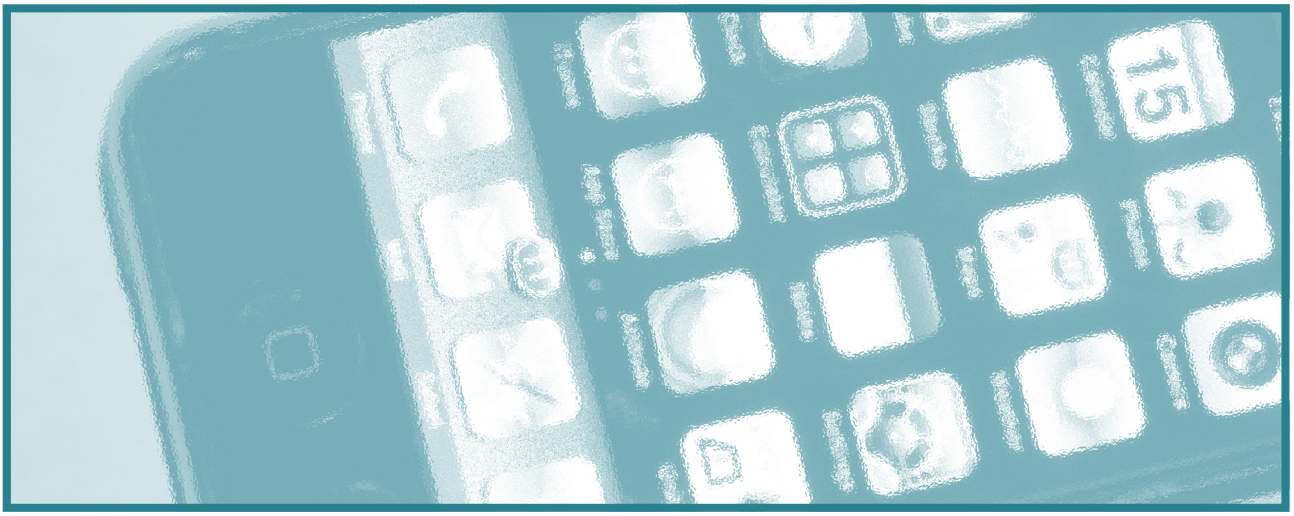
LTE will be an essential upgrade. Given that 3G operators will need to dedicate spectrum to support legacy HSPA devices and W-CDMA voice telephony services, there will be a significant challenge to secure additional spectrum for LTE, particularly for incumbent 3G operators will large customer bases.

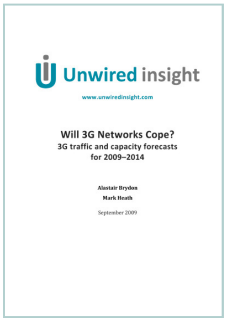
Furthermore, HSPA+ will need to be deployed on a widespread basis, because it allows data services to be carried more efficiently than HSPA. HSPA+ also allows circuit-switched voice to be carried more efficiently than basic W-CDMA.

Incumbent 3G operators must avoid competing aggressively with the mobile broadband services offered by new-entrant 3G operators. Short-term actions that they should consider are:

- avoidance of very low prices and/or very high monthly usage allowances for mobile broadband services
- application of fair-usage policies and/or service restrictions
- slowing down the migration of customers from 2/2.5G to 3G services.

Incumbent 3G operators must also pursue complementary ways to deliver services to mobile users, for example using WLAN, femtocells and mobile broadcasting networks.





The report '***Will 3G Networks Cope?***' identifies actions for a wide range of organisations.

Buy the report *'Will 3G Networks Cope?'*

Since 2007, 3G networks worldwide have experienced substantial traffic growth, due to strong take-up of mobile broadband services and the initial migration of 2/2.5G users to 3G services. Operators have reported annual increases in 3G data traffic volumes of 300—700%.

While 3G traffic volume increases have been manageable so far—because volumes have increased from very low levels—we forecast further large traffic volume increases, due to rapid migration of 2/2.5G users to 3G services, increasing proportions of smartphones and USB modems/datacards, and the introduction of HSPA+ and LTE.

For some 3G operators, today's HSPA networks will not support 3G traffic volumes for long, and they have big decisions to make.

Will 3G Networks Cope? answers your key questions:

- How will the service mix on a range of 3G devices (basic phones, smartphones and USB modems/datacards) evolve over the next five years?
- By how much will 3G traffic volumes increase in the next five years?
- What capacities will HSPA, HSPA+ and LTE networks realistically provide?
- Will 3G network capacity keep up with traffic volume increases? When will HSPA networks run out of capacity?
- When will HSPA+ and LTE be necessary, and what spectrum will be required?
- What are the implications for different types of 3G operator?

Why you need this report

- The risks are huge. 3G volumes are increasing dramatically and HSPA networks may not be able to support these increases for long.
- This report is unique in bringing together forecasts for 3G traffic volumes and network capacities.
- The report identifies the technologies 3G operators should invest in, and when.
- It quantifies how much spectrum will be required, and when.
- The report defines the best strategy for different types of 3G operator.

What you get

- 120 pages, 35 figures, 24 tables and 30 000 words.
- Usage forecasts for 2009—2014 derived from a comprehensive usage model.
- Network capacity forecasts for HSPA, HSPA+, LTE and LTE-Advance, for different spectrum allocations and deployment scenarios.
- Modelling of complementary delivery mechanisms to 3G macrocells, including WLAN access points, femtocells, broadcasting networks and sideloading.
- Evaluation of different types of 3G operator.

About Unwired Insight

With operators making multi-billion pound investments in wireless technology and spectrum, the risks of making the wrong decisions are huge.

Wireless technologies are becoming more complex and the demand for new wireless services is becoming more uncertain.

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• **Network and service models**. Through the development of advanced wireless network and service usage models, we are able to provide unique insight into the practical capacity, cost and capabilities of wireless networks.

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Web site: www.unwiredinsight.com

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