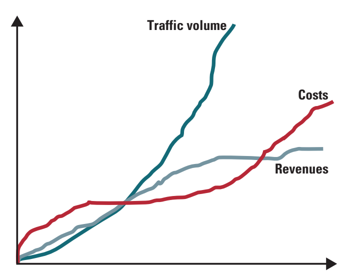
Mobile broadband – busting the myth of the scissor effect

Do we really understand the mobile broadband business? **New insights** about how consumers are actually using mobile broadband means it is now possible to debunk the assumption that revenues are **not keeping up** with traffic growth.

Figure 1
Free-hand drawing of the future?



Source: Frost & Sullivan 2009

DATA TRAFFIC GROWTH is arguably the most debated area within the business of mobile broadband. Numerous articles, reports, seminars, webcasts and statements discuss what is sometimes referred to as the "traffic tsunami," the "avalanche of data," and the "exabyte flood." All of them paint a problematic future where the challenges seem almost impossible to solve.

Some try to present technical or business solutions to the issue. These are however mainly based on the general assumption that revenue growth is not keeping up with traffic growth.

This phenomenon has also been called the "revenue gap" or the "scissor effect." However, the assumption implies that we know how traffic relates to revenue.

Others have attempted to show the relationship between revenue, traffic and cost over time, like the attempt made in the example in *figure 1*.

However, this and other similar graphs are purely conceptual. There is no scale to the axis, no source to the data and some curves appear to be drawn using the mouse on a computer.

There is nothing wrong with a conceptual approach to a topic, but using graphs like this, it is easy to make the wrong assumptions. Typically, the following conclusions are drawn:

1. Mobile broadband is unprofitable (and by the looks of it, will remain so).
2. A flat rate is not sustainable and users will have to pay per GB or even MB.
3. We need to find new technical solutions to be able to handle the ever-increasing data volumes.

The consequences of coming to these conclusions may be that overly cautious operators make decisions that result in poor growth.

Perhaps the most commonly used example of the scissor effect (*see figure 2*) has become something of a de facto standard in the industry and it is rarely challenged. In order to understand the picture better, we need to look deeper at what the curves actually show. The two curves in the graph represent Traffic and Revenue and are derived from the following formulas:

- **Traffic** = Subscribers x Traffic/Subscriber
- **Revenue** = Subscribers x Revenue/Subscriber

In order for one curve to "bend" upwards and the other to "flatten out," there must be an increase or a decrease of some parameter over time; otherwise the two would be straight lines. This means that the underlying assumption is that average traffic/subscriber always increases and that average revenue per subscriber always decreases.

Although the price of goods typically decreases over time and people generally increase their consumption over time, we still need to examine what is happening in the real world and to what extent it applies to our situation.

Average data volumes decline

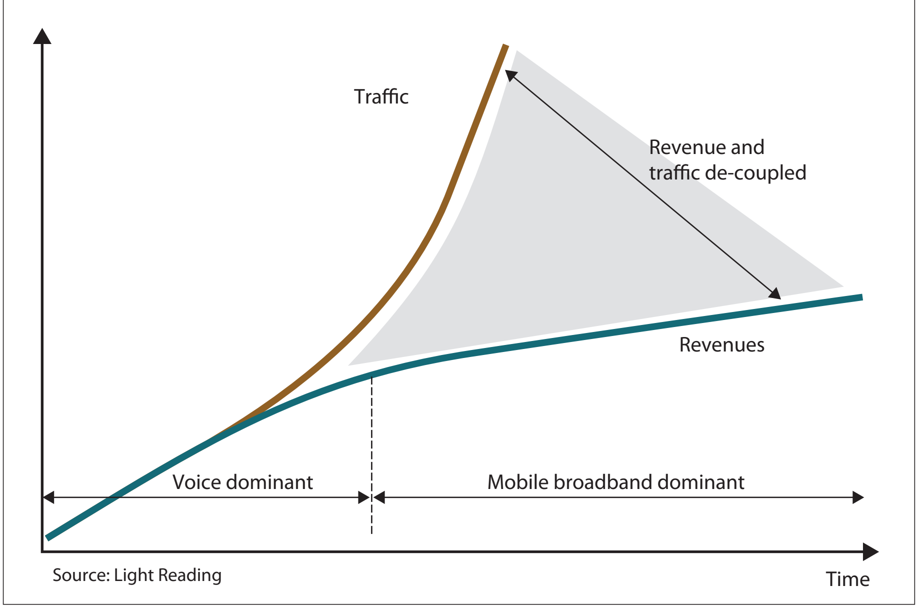
It is important to look at the market dynamics and understand mobile broadband's position in relation to, for instance, fixed broadband. In many markets, mobile broadband was launched at unsustainable price levels. Yet although mobile broadband is still in its infancy, there is evidence that price levels can and will stabilize. This means that the revenue curve will more or less follow the shape of the subscriber growth curve.

More interesting is the development in average traffic per user. Based on operators reported subscriber and traffic growth as well as measured traffic data in selected Ericsson networks and measured subscriber growth, we see an interesting phenomenon.

In 2008, some operators noticed a decline in average traffic per user. In the case of markets with lower internet maturity this development appeared to be natural, since the number of advanced and experienced users would be quite low. Following this logic, the segment of the population would soon be reached for whom the internet was a new experience and data consumption therefore was rather limited.

But when we at Ericsson recently started to examine some of the most advanced and

Figure 2
The scissor effect – a picture that is rarely challenged



fastest growing markets in more detail, we saw a similar pattern. Average data volumes per user had flattened out or even started to decline during 2009.

There are two main reasons for this:

1. At a certain growth rate, new subscribers added to the network will consume less than the average user.
2. Operators have learned and started to use various traffic-management methods to limit usage.

The declines are probably a result of the combined effect of both factors. However, it is not currently possible to determine which one is the driving force, and this pattern has only been observed with a number of fast-growing operators so far.

Figure 3 (*see page 53*) is a conceptual picture with some guiding numbers that shows how traffic per user develops over time after the launch of a mobile broadband service. We see a very steep increase in volume, compared to earlier data services. But provided there is a certain growth rate, mobile broadband begins to attract more "normal" and "low" users. The time it takes and the market penetration required to get there may vary, but it can happen within two to three years of the launch. Figure 4 (*see page 53*) shows examples of traffic growth compared to subscriber growth for PC mobile broadband connections (dongles, PC-cards and embedded radio modems). The traffic was calculated using data from Ericsson's radio network controllers.

One of the most common and serious mistakes when looking at the "scissor graph" is to assume that traffic equals cost. As calculated (*see page 54: Calculating broadband cost*), the cost will keep going down as utilization increases and the network reaches a point where it cannot handle any more traffic. At this point, the utilization level is at its maximum and cost will not decrease further unless a new, more efficient technical solution is introduced. An example of this could be the introduction of HSPA 21 or 42Mbps or perhaps LTE.

We can safely assume it is already possible to get down to a fully loaded network cost of less than EUR 1 per GB at a level of around 15 percent average network utilization. Even

Charging models – thinking flexible

FOR UNCLEAR reasons, "flat fee" has got a bad reputation in the telecom industry. It is even hard to get a clear answer to why flat fee is a bad thing. It is probably the word "flat" that causes suspicion since it implies that revenues will flatten out. But there is an easy way to counter this simply by increasing the monthly fee as consumption increases, like power companies do with their yearly network fees. Instead of arguing for or against flat fee, a more pragmatic stance would be to look at the positive options regarding packaging and pricing of mobile broadband. We basically have two options in pricing:

1. The cost plus model – charging based on volume, usage, metered pricing and so on.
2. The value-based model – charging based on values like speed, quality, capacity, coverage, brand, entertainment, video, devices, services, experience, and so on.

Apart from being more creative and visionary, only the value-based model truly supports expectations on future services and devices as the industry moves into the third phase of mobile broadband: "connecting everything."

Care must be taken ***not to confuse the consumer*** with too many options or ones that don't make sense. An example would be speed differentiation offering 1, 1.5 and 2Mbps levels. ***The difference is insignificant*** and is also difficult to maintain with any credibility.

this number is somewhat extreme since it is based on the assumption that there is no other service, such as voice, to share the cost, lowering it further, to say EUR 0.5 or less.

The main lesson, however, is that cost per GB does go down as traffic volume increases. An equally important conclusion from the calculations is that we are already able to benefit from reaching a much higher utilization level in parts of the network. This is important when making such decisions as whether to launch a marketing campaign, or introduce new tariffs or services. If we were to use the fully loaded cost per GB as the basis for calculating the profitability of such a project, we would likely find it to be unprofitable.

If we want to know the cost of adding, say, 500,000 new subscribers using 1GB per month, then we should instead look at the possible network expansions that such a campaign would generate. As the calculation of marginal cost shows, even if every GB generated drove upgrades, cost per GB would in fact be EUR 0.1-0.2, or even below.

Because the network is still more or less empty and the required investment is much lower than in the example, cost will realistically be much lower. In fact, the network-related cost to add another GB in a newly launched network is zero, or at least close to zero.

Capacity is not a problem

We also need to know how much traffic we are actually able to handle. The calculation example (*See "Calculating broadband capacity," page 53*) uses a network with a total capacity of around 470PB. With average traffic per user of 1GB, it is possible, in theory, to handle 6 million PC users at 15 percent utilization with only one carrier; or more than 19 million smartphone users generating 0.3GB per month; or any combination of the two.

Strategic choices regarding peak rate and coverage will determine the total capacity in the radio network. Increasing the peak rate or coverage to be more competitive in the market will also increase capacity, sometimes quite drastically. So the total capacity is a minimum and non-scalable number that is quite large.

The core parts of the network like the radio network controllers, RNCs, and the service nodes for data traffic, GGSN's, are handled differently. They are typically dimensioned according to the expected capacity need and will always be utilized to a very high degree. They will also always be able to cater to the required capacity, provided that nothing unusual happens. Signalling from smartphones is sometimes discussed as a problem. But since it is only a matter of dimensioning the respective nodes towards the right balance of signalling and user data, this is easily handled. And as the cost calculation showed, the high utilization level we can maintain on such nodes makes the cost per GB marginal.

The key conclusion is that capacity is not a general problem, at least not for the majority of the networks. If we combine this with the real marginal cost, it is possible to easily double capacity at a cost per GB of EUR 0.1 to 0.2.

Business models for growth

One conclusion often drawn from the scissor effect is that the most common user business model, the flat fee, does not work. Completely unlimited usage at a fixed price forever is unsustainable, and so is having a flat fee at one price for an entire market. After all, no one sells vanilla to everyone who asks for ice cream.

It is from these two models that we derive the flattening out of the revenue curve. And this, in turn, leads to the negative conclusions we draw from the model.

We have already shown that with strong subscriber growth, we do not necessarily see a gap between subscriber and traffic growth. We also see that if ARPU is stabilizing, traffic and revenue grow at an equal pace, and the cost per GB goes down. This means that at least for Phase 1 and Phase 2 (*see sidebar to the left*) of mobile broadband, where subscribers are still added, we can easily survive or rather profit from the current traffic growth. Our revised scissor graph has now changed quite dramatically to look more like this: *figure 5*.

Since the problem is not this gap, the question instead becomes: How do we cater to strong subscriber growth without putting long-term business at risk? Using

The three growth phases of mobile broadband

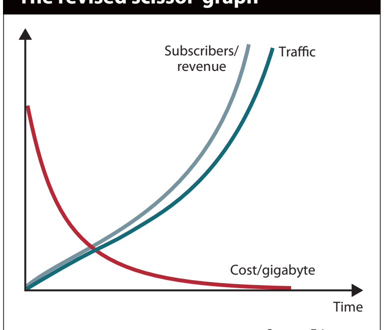
The long-term growth of mobile broadband shows three distinct growth phases.

PHASE 1: ***Uptake and growth***. This is where most markets are today. It is the start-up phase where operators use simple packaging and pricing to get the market going and reach a critical mass of smartphones and PCs.

PHASE 2: ***Differentiating services.*** A few markets are currently moving towards this. It is characterized by improved segmentation using speed differentiation, pre-paid plans and packages attracting the occasional user as well as the most advanced users. The main objective is to expand the market towards saturation in terms of PCs and smartphones. Machine-to-machine and "invisible broadband" start to take off and ARPU levels stabilize.

PHASE 3: ***Connecting everything.*** This lies in the future and will be characterized by a vast number of devices where everything is connected, sometimes called "the internet of things," and PCs and smartphones being outnumbered in the networks by other devices.

Figure 5
The revised scissor-graph



one price for all will lead to price pressure and loss of revenue for everyone, as will using only one package.

Good segmentation models are needed to differentiate from competitors, capture value and increase the size of the market. Introducing higher broadband speeds gives more opportunities to do this, as well as introducing low-end packages with small bucket sizes and time-based, pre-paid charging, which will also improve market segmentation.

Care must be taken not to confuse the consumer with too many options or ones that don't make sense. An example would be speed differentiation offering 1, 1.5 and 2 Mbps levels. The difference is insignificant and is also difficult to maintain with any credibility.

An example of successful packaging comes from an operator selling mobile broadband with "bucket" pricing. The package was originally called "10GB." It had a specified price and speed, and after the 10GB limit was reached, the user was throttled to around 200Kbps. The operator renamed it "Unlimited," but kept the same price, speed and throttling level. So it was exactly the same package, only with a new name. Subscriber uptake doubled.

This shows how sensitive consumers are to packaging. It was not the package itself that mattered, but rather that the name signalled the idea of a service that would always work. It also removed a difficulty for the consumer – what is a GB?

We can also utilize "fair usage" mechanisms very efficiently. Using priority mechanisms is far better than throttling at a central location ►

Figure 3
Traffic per user over time

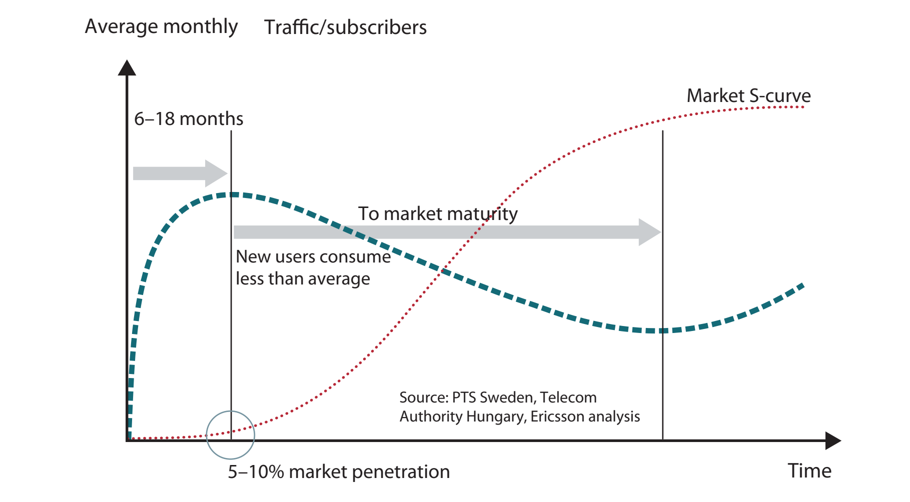
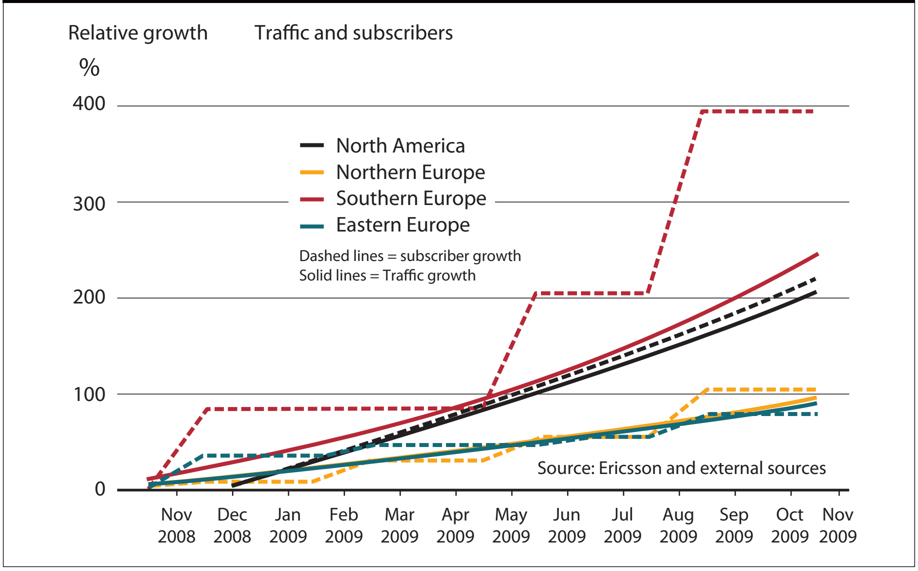


Figure 4
Traffic growth compared to subscriber growth for PC mobile broadband connections



Calculating broadband capacity

► **DESIGNING A** mobile broadband network involves two strategic choices related to radio resources that will, in the end, determine the starting capacity. The two choices are:

1. What peak rate do we want to offer?
2. What coverage do we want?

The decision on peak rate (for example 7.2Mbps, 14.4Mbps or 21Mbps) will define the cell capacity of individual network nodes. At the basic level, cell capacity may be about 4Mbps, giving a theoretical capacity of 47,000GB a year for a three-sector site.

The decision on coverage will then determine, besides where we can offer the service, the total network capacity. With 10,000 sites and 47,000GB per site, the total theoretical capacity will be more than 470PB (million GB).

Backhaul capacity is then determined by the decision on peak rate. Each individual site must be able to deliver, as a minimum, the peak rate offered on the market. Using three sector sites, backhaul must then have one-third of the capacity of the radio network.

For the RNC and GGSN nodes, with high capacity (an RNC can handle close to 8PB in a year), we dimension mainly towards what is expected in the network. The RNCs must of course be located in a smart way in relation to where the radio cells are, so there may be a geographical element. But generally these nodes are dimensioned and placed to provide a reasonable balance between over-provisioning and cost.

To relate capacity to end users, we can use typical values of 1-2GB per month for PC subscribers and 0.2-0.3GB per month for smartphone users. One million PC subscribers will then generate between 12 and 24PB per year and 1 million smartphone users will generate between 2 and 3PB per year.

It is our conclusion that *we should step up our efforts* and work ahead, because the feared tsunami is really just a small wave before *the real flood that will be unleashed* by the next growth phases of mobile broadband.

in the network. It is also fairer to the consumer. Using functionality such as end-to-end traffic handling priority (THP) takes care of the heavy user while ensuring that the service always works.

With marginal cost per GB at EUR 0.1-0.2 and an ability to handle heavy usage, the need for operators to charge for increased traffic above "fair use" levels will in the long run depend on their ability to capitalize on their assets in terms of network capacity, subscriber base and the intelligence of their network.

Moving further ahead into Phase 3 of mobile broadband, new and modified business models will be needed to cater to all the new devices and services expected. Some of this is already evident in agreements like the one between Amazon Kindle and Sprint and AT&T, or the streaming music service Spotify with TeliaSonera.

By using real-world data, we can see that traffic and revenues may very well grow without a problem. The cost per GB goes down as utilization increases, and available capacity should enable operators to move a lot faster down the "learning curve" that typically develops. Calculating marginal cost, it is possible to easily double the required network capacity at a cost per GB less than EUR 0.1-0.2.

It is our conclusion that we should step up our efforts and work ahead, because the feared tsunami is really just a small wave before the real flood that will be unleashed by the next growth phases of mobile broadband. This flood will continue for many years and it will keep bringing paying users into the networks, creating once again the kind of growth the industry has been used to.

Calculating broadband cost

THE DISTRIBUTION cost per GB is calculated by dividing monthly, quarterly or yearly depreciated capital expenditure plus operational expenditure with the number of GBs distributed over the time period.

The value is dependent on how many GBs are produced in the time period and does not say much. In the first year, the cost may be EUR 60; if growth is strong it may reach EUR 10–20 in the second year. But looking forward to the point where average utilization is, say, 15 percent, it is easy to get to EUR 1.0 and even below. (*See figure 6*)

Looking only at the sites and nodes that need upgrading, we can use a very different utilization level in our calculations. For a radio node that needs a second, or a third carrier, we can use 50 percent utilization. For backhaul, RNC and GGSN we can use even higher numbers due to a higher degree of aggregation. The rise in operational cost when upgrading is generally quite marginal even in this context, owing mainly to power consumption. As a result, we end up with a marginal cost per GB at or below EUR 0.1-0.2. (*See figure 7*)

The choice of 50 percent utilization stems from a traffic peak to average ratio of roughly 1.4. The assumption of 70 percent peak utilization is a reasonable and safe number to use in order to maintain wanted service quality. A higher number will yield even lower cost per GB. Regardless, it is important to understand the difference between total and marginal cost and how to use them correctly when making calculations. (*See figure 8*)

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Figure 6
Broadband cost – low utilization

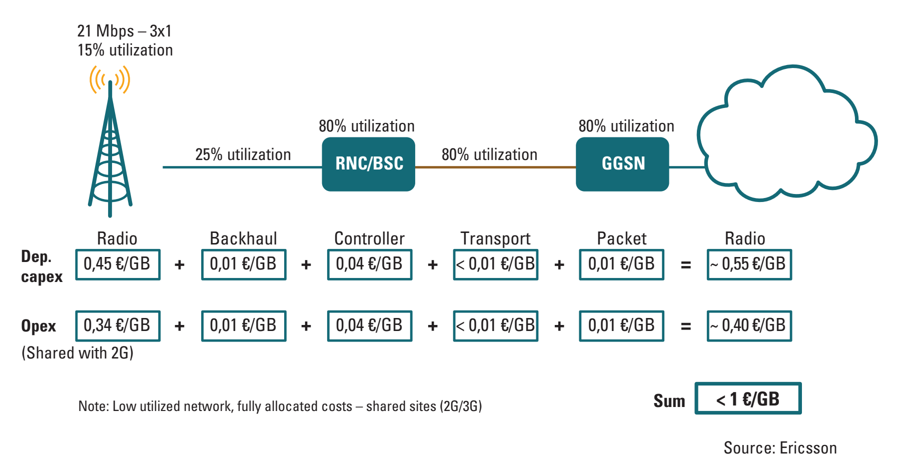


Figure 7
Broadband cost – ramping up utilization

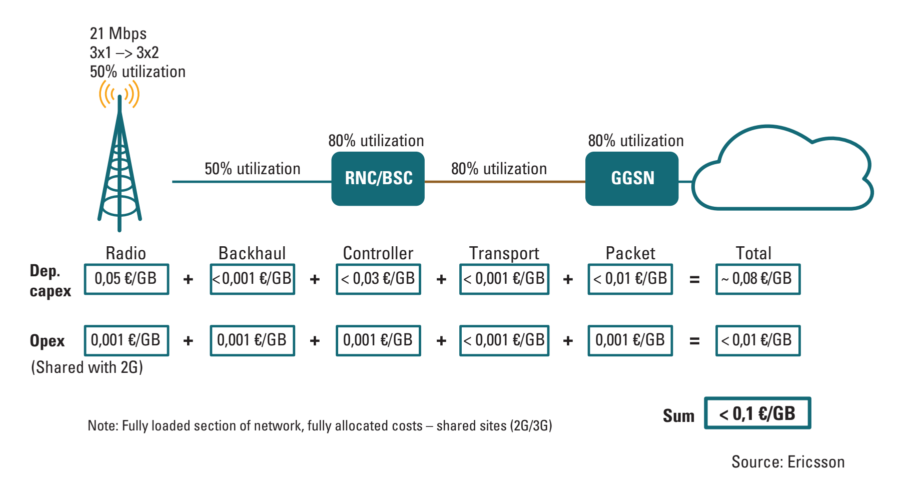
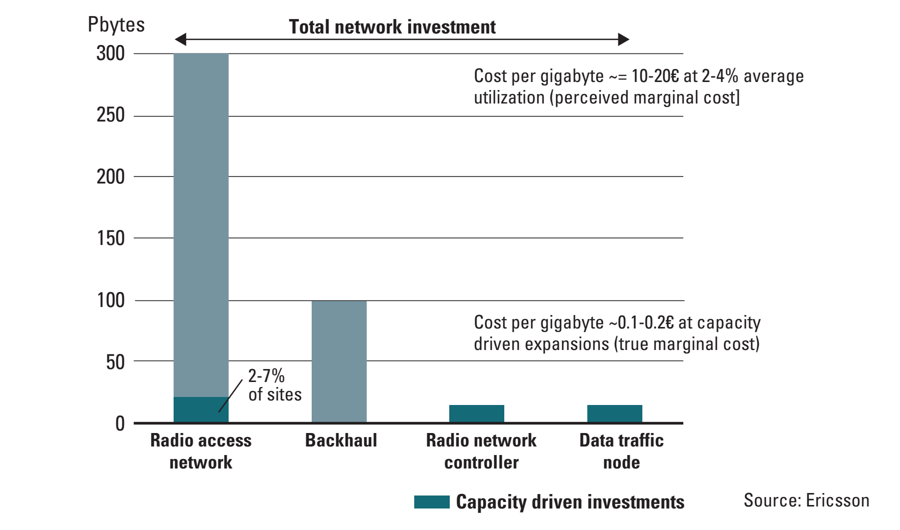


Figure 8
Total versus marginal cost



Data traffic on the rise

Mobile data traffic surpassed that of voice on a global basis in December 2009, according to Ericsson's measurements from live networks worldwide. Ericsson's findings show that global data traffic has grown by 280 percent during each of the past two years, and is forecast to double annually over the next five. The crossover occurred at approximately 140,000 terabytes per month in both voice and data traffic.

Traffic is forecast based on measurements from a large number of networks to establish a baseline. Traffic development is then modelled from the bottom up, based on sociological and macroeconomic data to build a regional model of traffic development for different user services such as voice telephony, web browsing, audio and video streaming among others.

The resulting data is compared with top-down modelling based on the general growth patterns of internet traffic. For voice traffic, the process is well known since it has been measured over a long period of time, so forecasting can be carried out with reasonable accuracy. However, data traffic measuring started relatively recently, making forecasting much more difficult.

The current Ericsson data traffic forecast is shown below.

Traffic volumes are driven by a combination of subscriber growth and per-subscriber traffic growth. Subscriber growth is well established, although at present, most operators and regulators do not report PC and smartphone subscriptions separately. This is one of the main difficulties with modelling traffic, since the traffic generated by a PC subscriber is about 10 times that of a smartphone subscriber, and a smartphone subscriber generates 10-20 times the traffic of an average data-enabled-phone user. The detailed knowledge of operators is therefore needed to assess the potential correctly, but models for subscription growth can also be built from device sales forecasts.

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