



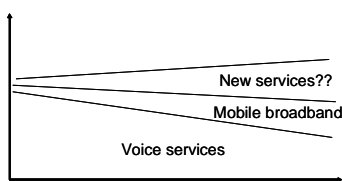
Operator challenges

- network related
- business related

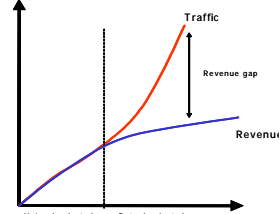
Jan Markendahl
November 06, 2012

Operator challenges – business related

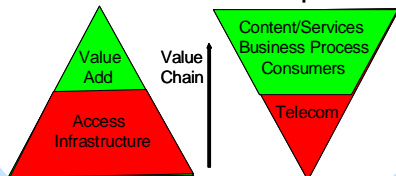
Revenue mix



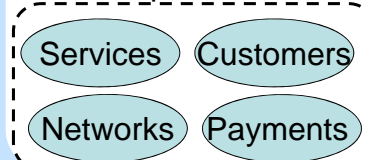
MBB profitability



Changing business landscape

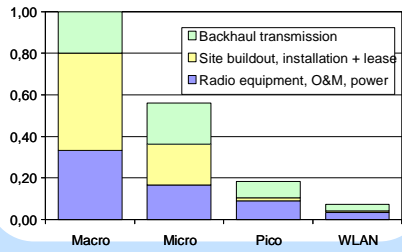


What to handle for operators?

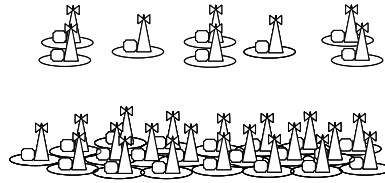


Operator challenges – network related

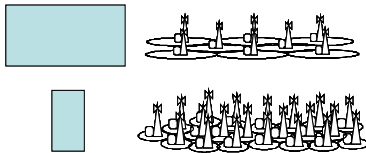
Cost structure



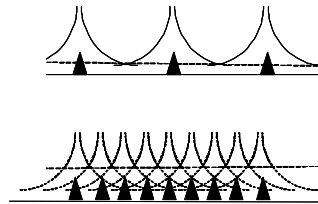
Scalability



Spectrum allocation



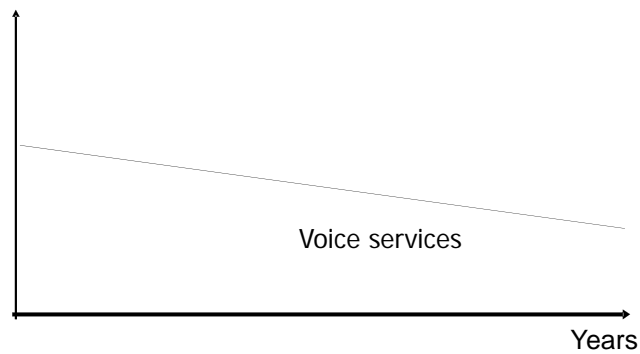
Data rate depends on range



3

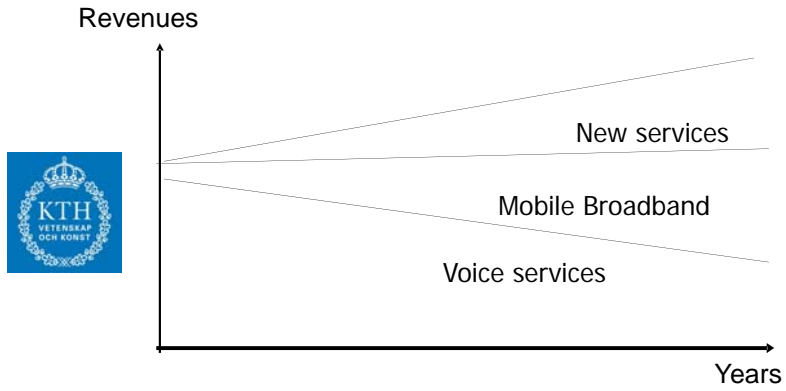
One motivation for our research Declining voice revenues for mobile operators

Revenues



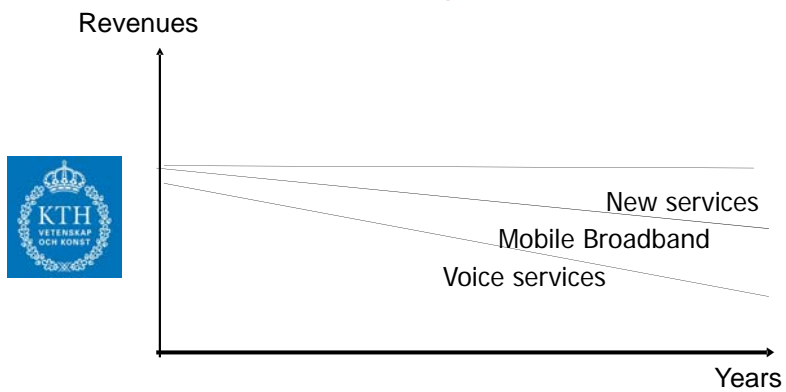
4

One motivation for our research
New services require new solutions



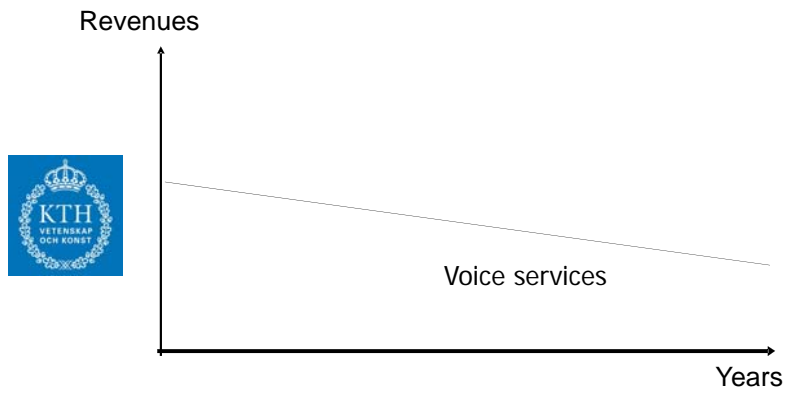
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One motivation for our research
New services require new solutions



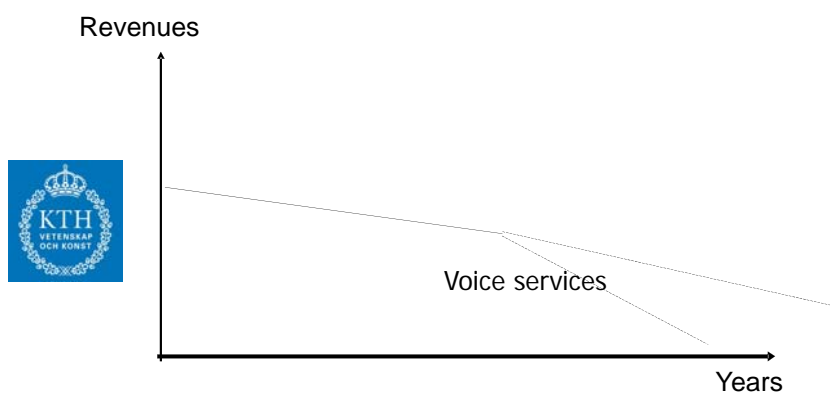
6

Declining voice revenues



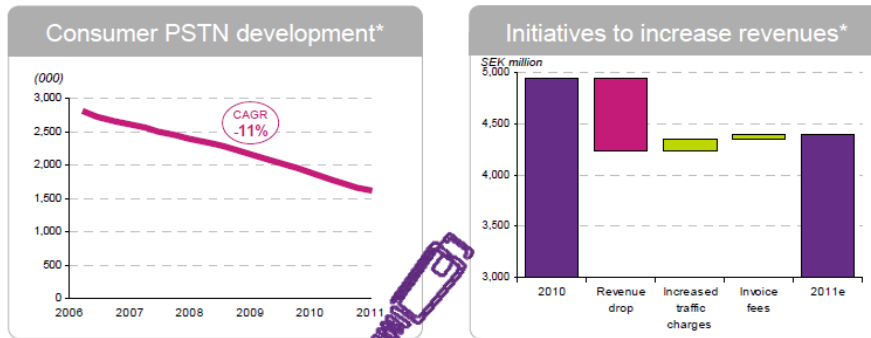
7

Declining voice revenues for mobile operators



8

Controlled decline in consumer PSTN

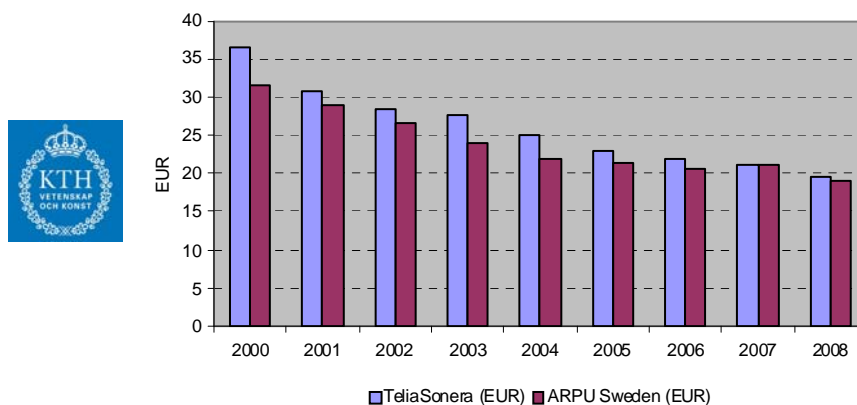


* Example from Consumer segment Sweden

25

TeliaSonera

Revenues for mobile voice services in Sweden 2000-2008



From Mölleryd, Markendahl, Werding and Mäkitalo conference paper presented at CTTE 2010, May 2010

10

More operator challenges

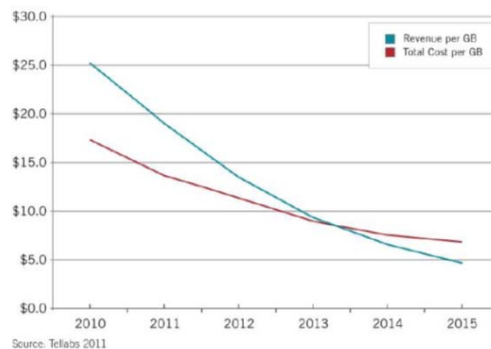


Freday 4 February 2011
Newsletter by M. Sjödin

Mobile data traffic will increase 26 times until 2015 .
The data traffic growth will require more radio frequencies
Operators will face an "end of profit"



North American mobile carrier 'end of profit'

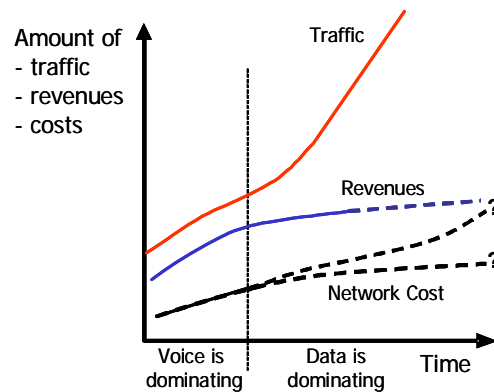


Source: Tellabs 2011

11

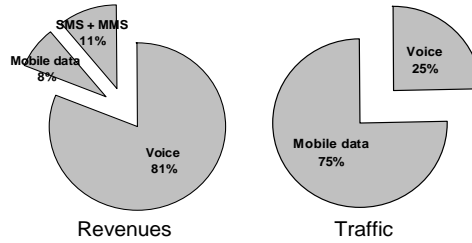
The revenue gap "de-coupling" of traffic and revenues"

- Flat rate tariffs create large increase of data traffic
 - Many GB per user per month
 - Data traffic up >100 % per year
 - Revenues do not follow



12

Traffic, prices and revenues



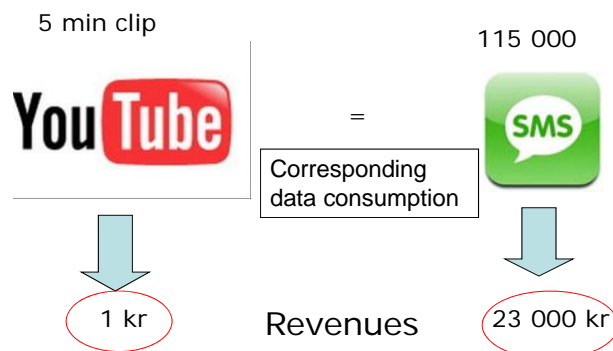
Traffic and revenue for different services at the Swedish market Q4 2008

EUR per MB	2007	2008
Voice	1,46	1,36
SMS	439,5	351,6
Mobile data (laptop)	0,014	0,011

Estimated price per MByte for voice, SMS and data for one Swedish operator

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One big data challenge (Thanks to Bengt Mölleryd)



Antagande: YouTube 0.5 Mbit/s och med 5 min clip, $60 * 0.5/8 * 5 = 19$ MB. Pris ca 0,05 kr per MB. SMS 160 bytes = 6250 SMS per MB. Pris 0,20 kr per SMS.

Vidare är SMS mycket lönsam med EBITDA på 90%. Om man antar 15% av omsättning är SMS och en total EBITDA marginal på 35% skulle ett tapp av SMS innebära att marginalen faller till ca 25%

14

14

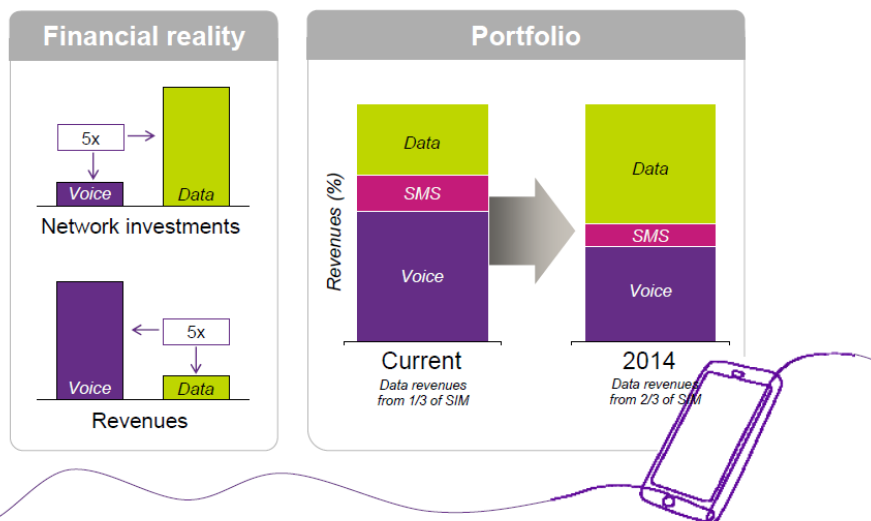
Traffic, prices and revenues

- Amount of voice data 10-20 MB per month
- Amount of mobile broadband data 1–20 GB per month
 - The number of mobile broad band bits are 100 – 1000 more than the number of voice bits
- But we pay more or less the same, i.e. the price per data bit is 100 – 1000 times lower => the cost per bit must be 100 – 1000 lower



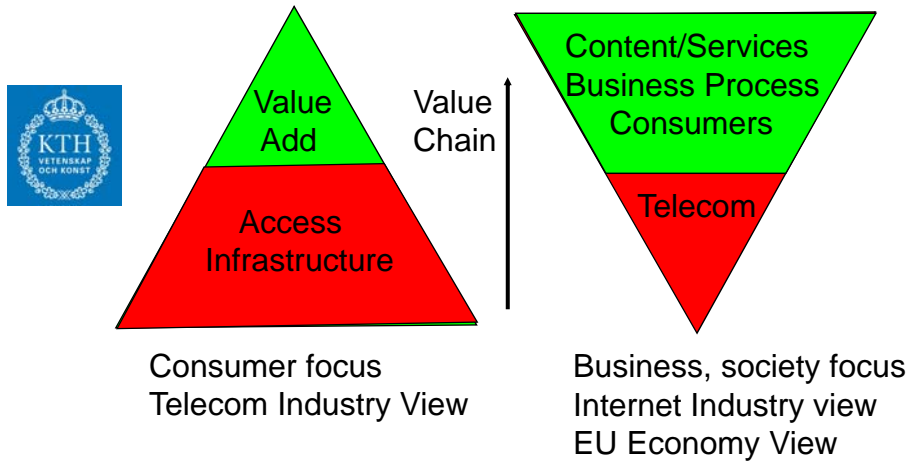
15

Rebalancing of pricing model needed



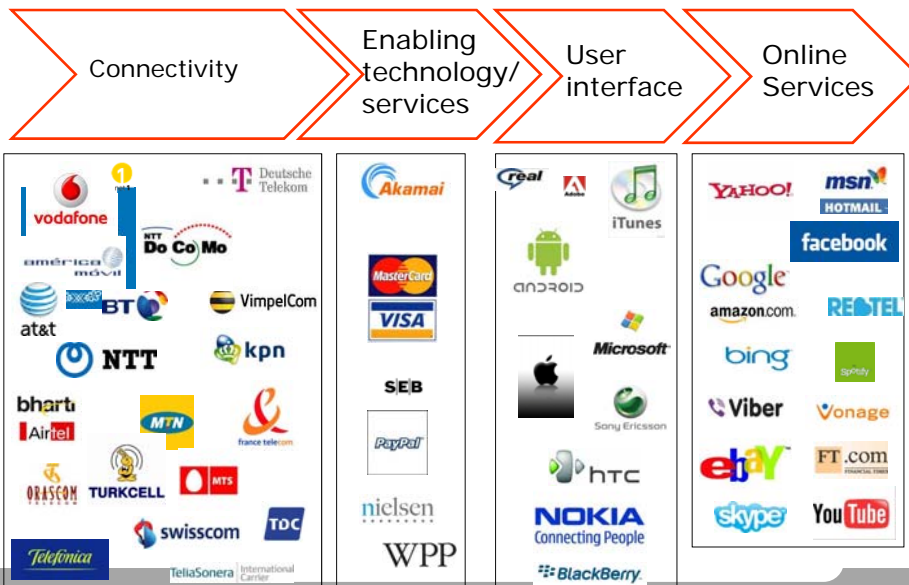
48

Changing business landscape combined with different perspectives



17

Competition from many actors



18 18

"New" services

Products Download **Mobile** Help Blog Logged in as **lenaplutt** - My account - Log out

Overview Learn more

Spotify
Everyone Loves Music

Spotify Mobile

A world of music in your pocket.

- Stream over WiFi or 2.5/3G
- Offline playlists
Play music even without a connection, for example when riding the underground or on a plane.
- Access your Spotify account
All your playlists will be made available.
- On-the-fly sync
Add a track to a playlist and see it appear immediately on your computer and vice versa.

[Learn more about Spotify Mobile](#)

Spotify for iPhone preview

0:00 / 1:49

19

Step 1- Manage the end-user interface in TeliaSonera's mobile channels

- Take ownership of the mobile interface using customer-friendly Clients and Softkeys to our services

Telia SurfPort

Hjem | 910/dygn | 50K | Favoriter | Mina sidor | S-påst

JAMES MORRISON **Klikka här**

Seraste Nyltt

Tippst Stöd Childhood

Lära in, Blinda fast, Söva ner.

Kina sänker räknan

Spara tusentals på elavtal

OMSPÅ -0.52%

TV-kanaler

TV4 Nyheter

Kanal 5 highlight

Discovery

MTV Hur

Nickelodeon

Val

YLE TV1

YLE TV2

MTU1

MTU2

Helsingin Sanomat

Perutit

Telia SurfPort

Topplistan | Sök | Vi rekommenderar | Genrer | Kampanjer | Min musik

Endast 1 kr!st.

Klicka här!

AKTUELLT

Rain On Your Parade 15,00kr
Duffy

The Maroon 5 Anthem (Radio Version) 15,00kr
Maroon 5

Hunger Hotel 15,00kr
Eskivare

Visa fler

TOPPLISTAN

Another Way To Die 15,00kr
Jack White & Alicia Keys

Silly Really 15,00kr
Far Gooale

Live Your Life (Explicit Album Version) (Featuring Rihanna) (Explicit Album) 15,00kr
T.I.

Visa fler

JAMES MORRISON **Klicka här!**

Klicka här!

Sök

Sök



TapExpense 2.3
Keep Your Numbers in Place

TapExpense helps you keep a record of daily expenses.

It is designed for both daily personal bookkeeping and business trip expense tracking. Multi-currency support makes it ideal for international travel.

Available on the [App Store for USD 4.99](#). Or try a [free Lite version](#) now!

Available on the iPhone **App Store**

Introduction TapExpense


Click to Play!

21

Source: IDATE

Revenue sharing for Apps?

Revenues from applications

	Previous	Now
 Developer	20%	70%
Publisher	20%	0%
Aggregator	20%	0%
Operator	40%	0%
Handset supplier	0%	30%

Type I-Mode *Apple*

22

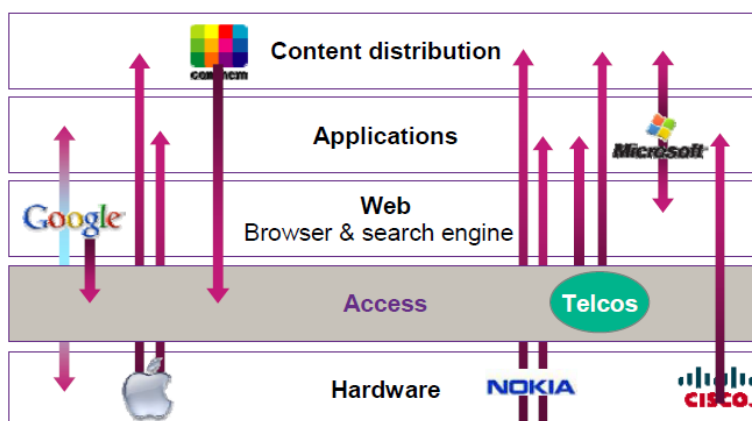
Mobile operators "joins forces" and form Wholesale Applications Community

- The alliance launched by the 24 operators, is backed by the GSMA, and device manufacturers LG Electronics, Samsung and Sony Ericsson
- The alliance "will build a new, open ecosystem to spur the creation of applications that can be used regardless of device, operating system or operator"

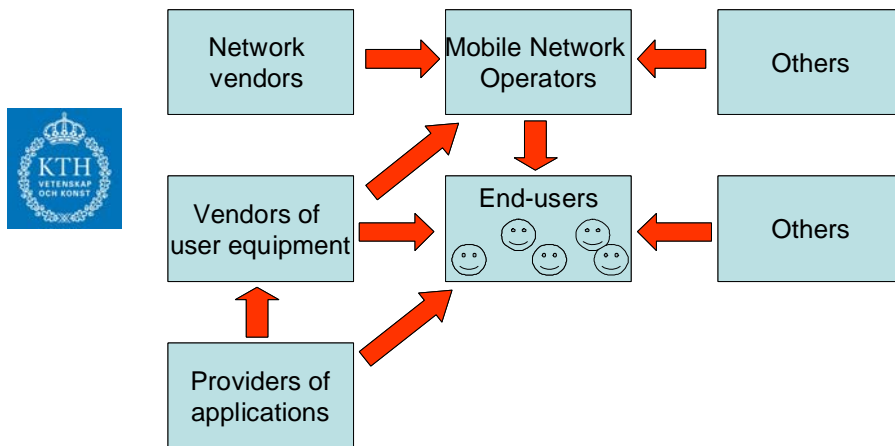


Changing competitive dynamics

Investor Day 2009



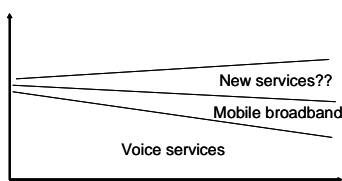
Many actors have business relations with the end-users



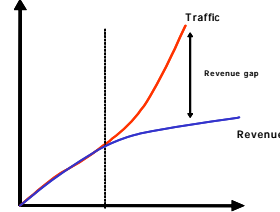
25

Operator challenges – business related

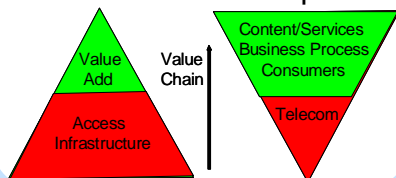
Revenue mix



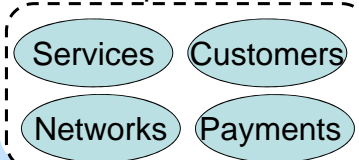
MBB profitability



Changing business landscape



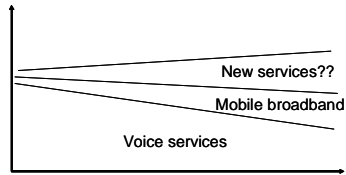
What to handle for operators?



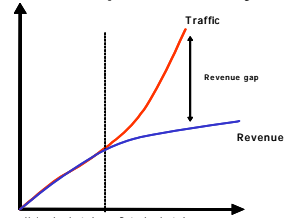
26

Operator challenges – business related

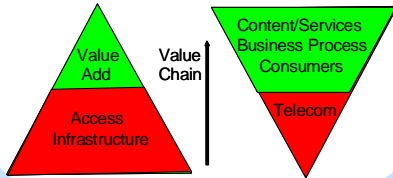
Revenue mix



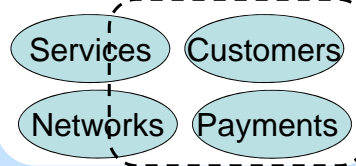
MBB profitability



Changing business landscape



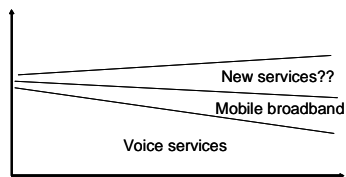
What to handle for operators?



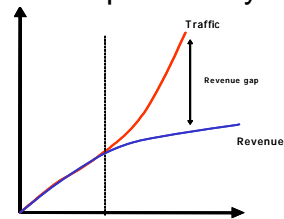
27

Operator challenges – business related

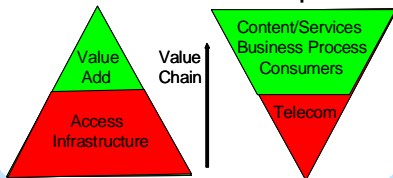
Revenue mix



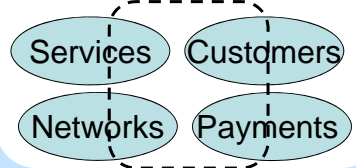
MBB profitability



Changing business landscape



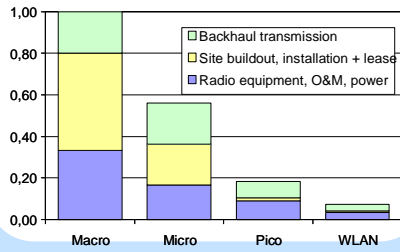
What to handle for operators?



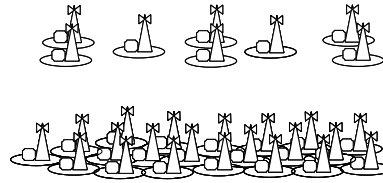
28

Operator challenges – network related

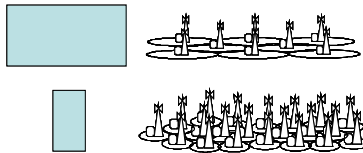
Cost structure



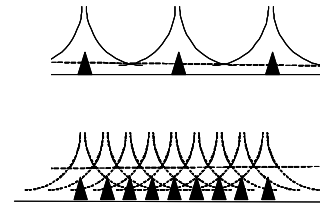
Scalability



Spectrum allocation



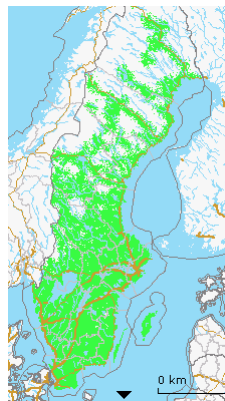
Data rate depends on range



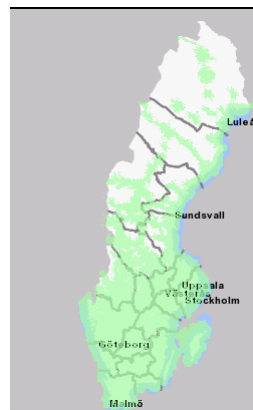
29

GSM Coverage

Tele2 - Telenor - Telia



~70% covered area



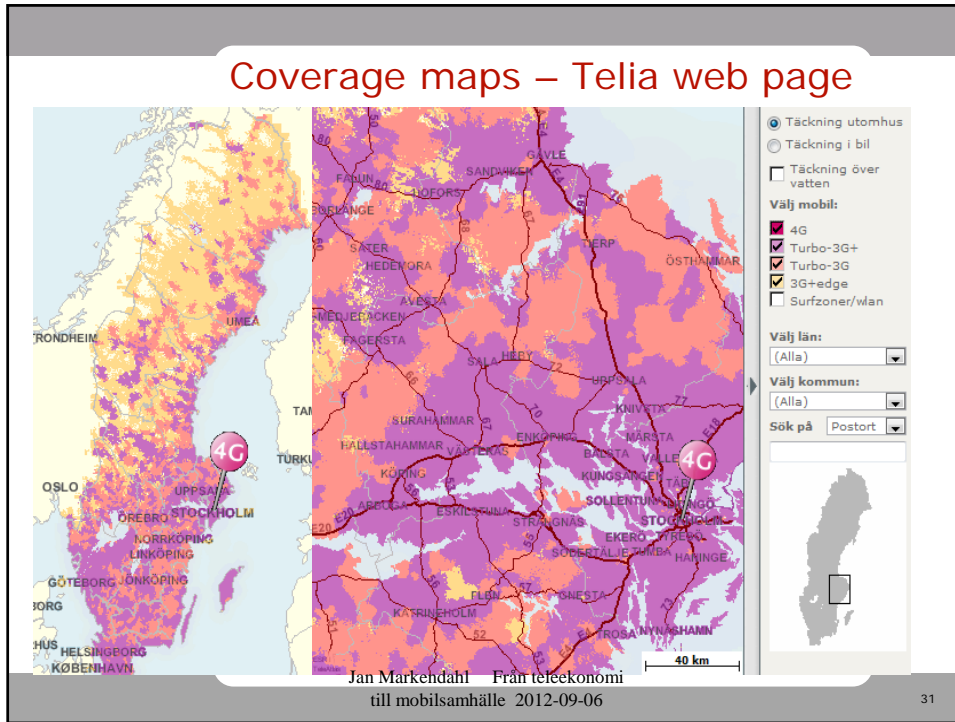
~65% covered area



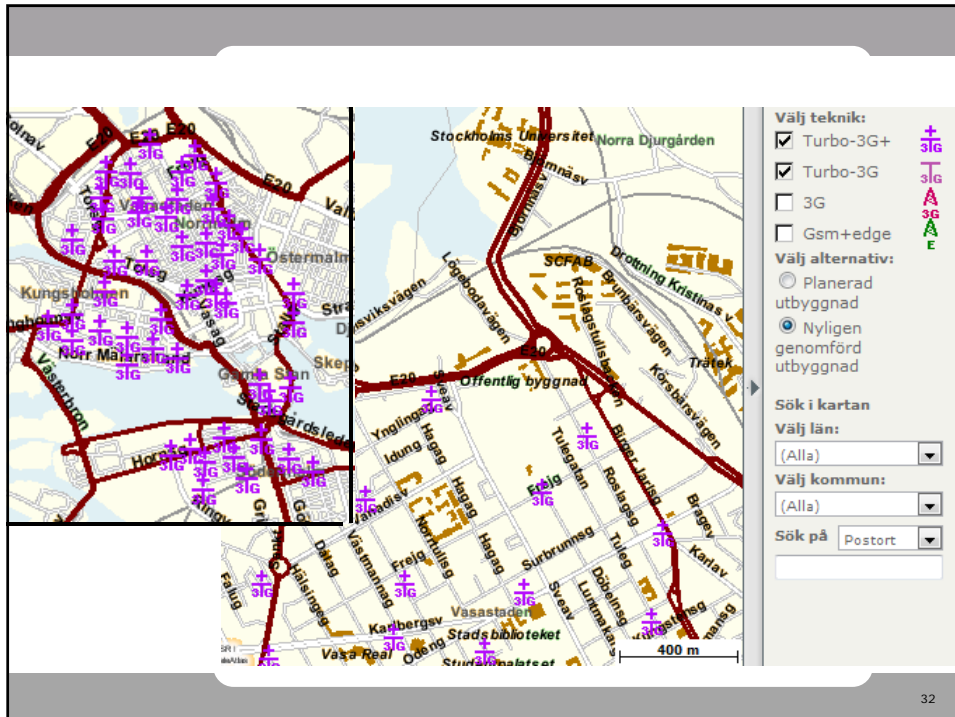
~90% covered area

30

Coverage maps – Telia web page

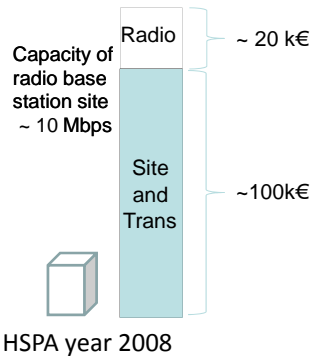


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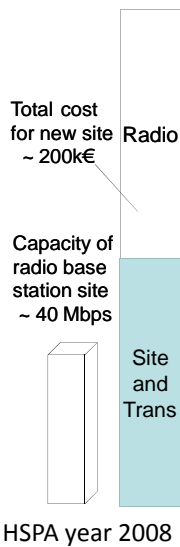
32

Cost structure, bandwidth and capacity



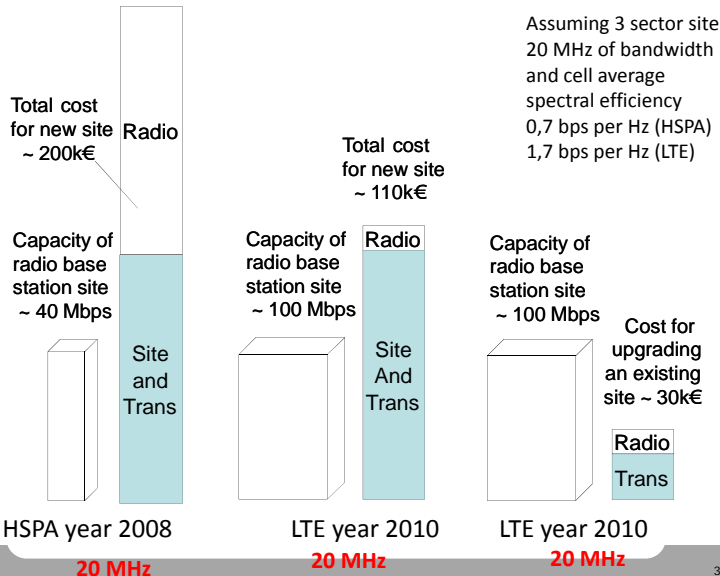
33

Cost structure, bandwidth and capacity



34

Cost structure, bandwidth and capacity



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Cost of radio equipment is decreasing rapidly

512 MSEK (50 MEuro)
~6 KEuro per base station

News article: 05 November 2009

Telenor to replace its infrastructure for mobile services in Norway

(Oslo/Fornebu, 5 November 2009): Telenor is going to replace its entire mobile services infrastructure in Norway during the next years, with the aim of creating a flexible and cost efficient platform for mobile services. Huawei and Starent Networks have been chosen as the technology providers for the wireless network and mobile core network, respectively.

The scope of the agreement includes the delivery of equipment across technology generations and frequency bands, as well as multi-base stations for 2G, 3G/UMTS and 4G/LTE. The change of providers will also entail digitisation, with the entire wireless network and core network being migrated to an IP-based platform.

"This is the biggest upgrade of the mobile network in Norway we have ever carried out. It will create a solid and flexible base for further developing the services offered by the Telenor mobile network and the quality of those services. Our aim is to provide customers with better, more innovative services across the country. This means better in terms of capacity, speed and stability," explains Ragnar Kårhus, head of Telenor Norway.

The replacement of infrastructure will represent a moderate increase in investments over the next two years, and thereafter improve our cost and

TELE2



~ 750 MSEK

Press release

Stockholm, 18th of December, 2009

Tele2 and Telenor select Huawei to deploy 4G network

Net4Mobility, the joint venture by Tele2 and Telenor, today announced that Chinese telecom equipment vendor Huawei will supply infrastructure and modems for next generation mobile communications, 4G, in Sweden. The agreement with Huawei comprises the deployment of the first nationwide 4G network in Sweden and modem services for the new network.

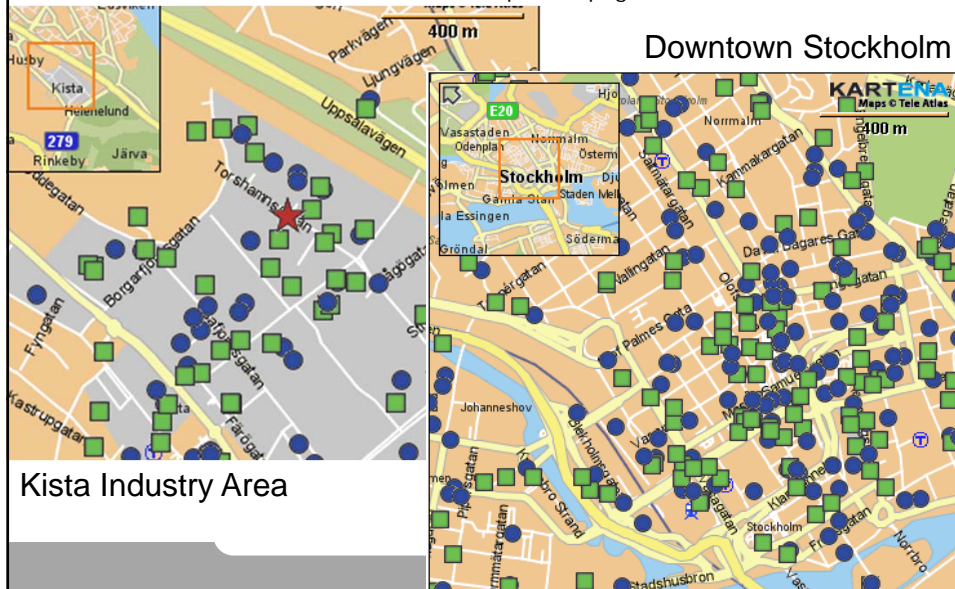
By combining the procurement of a network- and modem vendor, the operators secure an effective deployment and a commercial launch of high-quality 4G services in 2010. For customers, 4G enables increased mobility and use of high capacity services, with up to ten times the current speed of turbo-3G initially.

- Huawei provides high technology and cost efficiency, both vital components in our investments to build a nationwide 4G network. Tele2's customers will be able to access high-quality and affordable mobile services at speeds equivalent to some of today's fixed broadband connections, said Niclas Palmstierna, CEO, Tele2 Sweden.

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Base station site location in urban areas

from PTS "Transmitter map" web page, December 2009



Examples of Base station densities (Urban areas in Sweden)



<i>Name and type of area</i>	<i>Total density of sites</i>	<i>Typical densities for operators</i>
Residential area in Uppsala	~6 per km ²	1-3 per km ²
Residential area Akalla	~14 per km ²	3-5 per km ²
Central part of Uppsala	~20 per km ²	3-8 per km ²
Industry area Kista	~50 per km ²	7-20 per km ²
Central part of Stockholm	~130 per km ²	20-40 per km ²

To handle increasing user demand

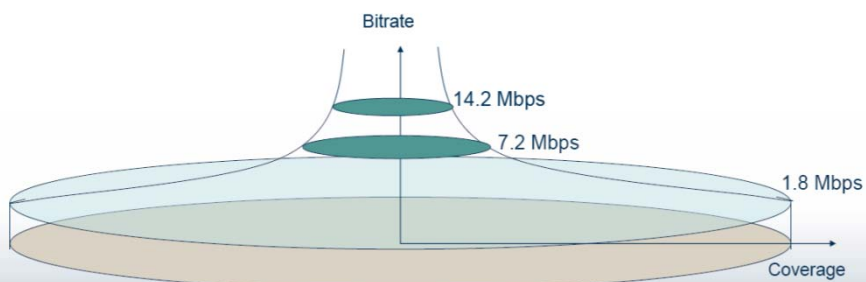
- Two main development paths
 - Improve network performance and capacity
 - Add more spectrum



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Coverage vs. bitrate

From Ericsson
Capital markets day
May 2008



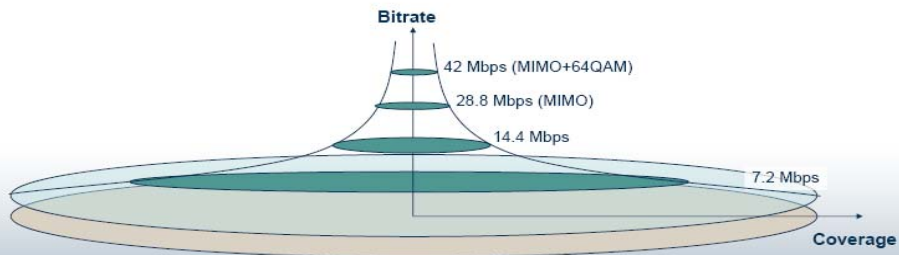
Double peak rate does not correspond to double capacity

ERICSSON

40

From Ericsson
Capital markets day
May 2009

Relation between Peak Rate & Coverage

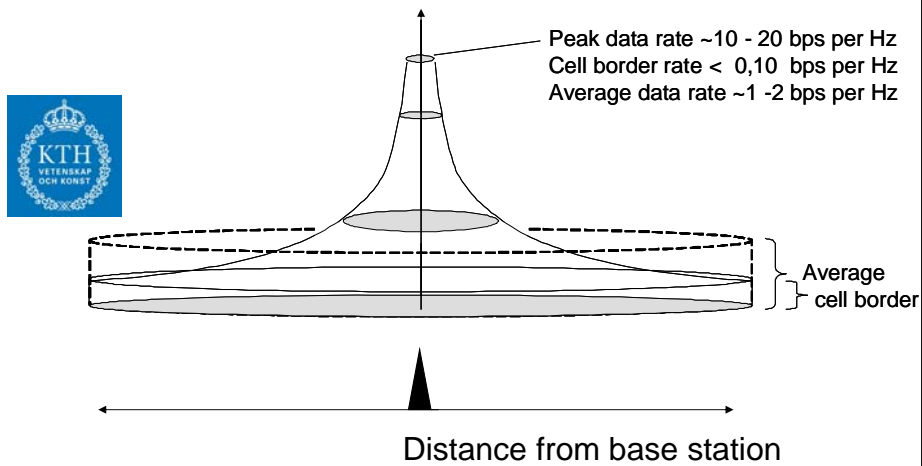


Capacity does not scale with peak rate

ERICSSON

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To improve the spectral efficiency
– i.e. more bits/second per Hz of spectrum



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HSPA and LTE capacity evolution



From Ericsson
Capital markets
day, May 2008



The capacity will double – but not 100 fold

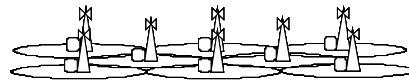
B18_c

ERICSSON

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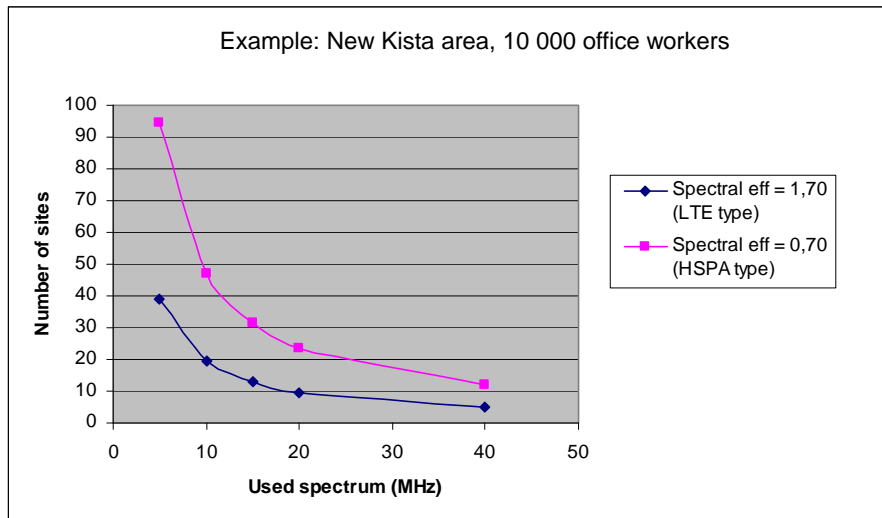
Spectrum, capacity and cost

- High bandwidth means high capacity per site,
i.e less number of base station sites



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Amount of spectrum and number of sites



45

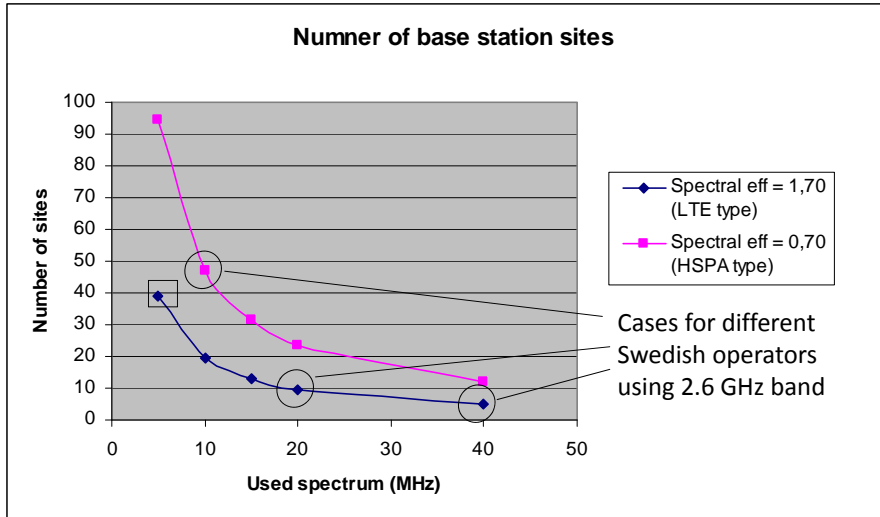
Short exercise – work in 4 groups

- How many base station sites need to be deployed in the following cases?
- Operator A, LTE in the 2.6 GHz
- Operator B, HSPA in the 2.6 GHz
- Operator C+D, LTE in the 2.6 GHz band and share network
- Operator E, LTE using unlicensed 1800 MHz band
- You are allowed to ask me one question per group



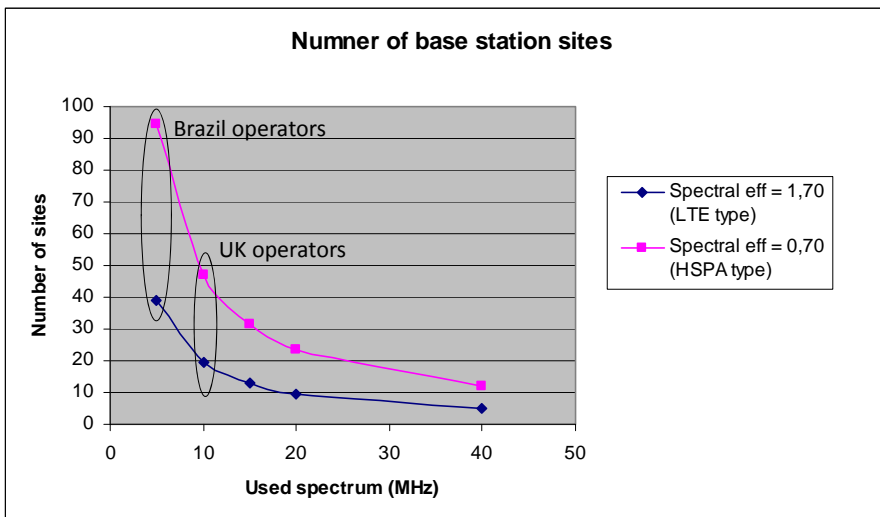
46

Amount of spectrum and number of sites



47

Amount of spectrum and number of sites



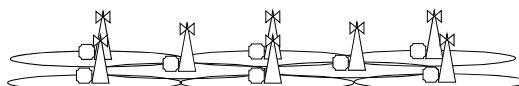
48

Scalability of cellular systems

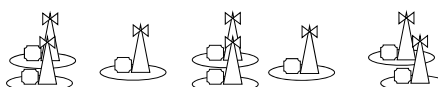
For a specified amount of spectrum and for the same type of radio technology deployment of N times more capacity at data rate X will imply N times higher costs



- Deployment for low or medium data rates



- Coverage for high data rates with existing sites



- Deployment needed for high data rates



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- Telenors löften helt orealistiska

KTH-professor dömer ut kampanj om nya mobilnätet

Av: [Helen Ahlbom](#)

[93 kommentarer](#)

Publicerad 20 maj 2009 00:00



Telenor lovar hastigheter på 150 megabit/s till nästan hela svenska folket i sin senaste reklamkampanj. Det är fullständigt orealistiskt om man inte bygger 100 000-tals nya basstationer, anser Jens Zander, professor i radioteknik på KTH.

"Leve Allemansrätten!" utropar Telenor i reklamfilmer och stora affischer över hela landet. "Nu bygger vi Sveriges modernaste mobilnät. Det ger mer än 99 procent av svenska folket 150 Mbps via luften", utlovar bolaget på reklamplats.

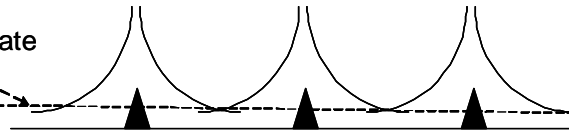


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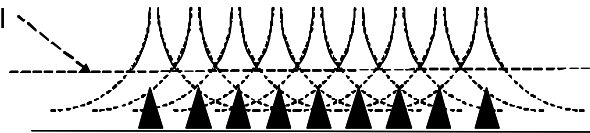
"Offered" bit rate vs coverage & load



"promised" data rate
at "low" level



"promised" data rate
at "higher" level



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Marketing by mobile operators



'The fastest Mobile broadband in Sweden - according to information retrieved from Bredbandskollen.se, November 25, 2010' (Telenor)⁴⁶

'Today the best Mobile broadband in Sweden was nominated and the winner is Tele2. This means that you can do web surfing at higher speeds with Tele2 compared to any other operator.'⁵⁰ 'We have the fastest 4G network in Stockholm.' (Tele2)⁵¹

'For the fourth year in a row the magazine 'Mobil' did nominate our mobile broad band to be the best in Sweden'⁵² (HI3G)

'4G. The fastest mobile broadband in the world for just 15€ per month until the Easter holiday, ordinary price 60€ per month.' (Telia)

'We are the operator with the best 3G coverage. Today 9,1 million Swedes can use our mobile broadband where they live'. '3 offers 98,5% coverage' (HI3G)

'Tele2 has the best mobile broadband in Sweden - according to the annual coverage test made by the magazine Mobil'

'The network, that we share with Telia, covers 99,8% of Sweden' (Tele2)⁵³

'Today 8 million of Sweden populations have coverage with Turbo3G+' (Telia)

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Industry focus



- Three main strategies to increase radio network capacity is described (Landström et al, 2011). ;
 - to improve the performance of the macro layer,
 - to build a denser macro layer (more base stations)
 - to add low power pico or femtocell base stations
- Current focus for R&D and standardization
 - To increase the peak data rate
 - To combine spectrum into larger chunks
 - To offload heavy data traffic from macro layer to local networks: picocells, femtocells or WiFi

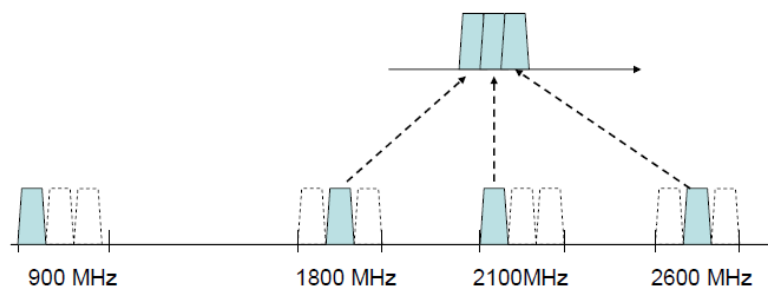
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Data rate, bandwidth and aggregation of carriers or bands

- The higher bandwidth the higher the data rate



Higher bandwidth by use of aggregation



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To offload data traffic from the macrolayer

From Vodafone:
Investor relation info, March 2008



- Assessing the technical potential of 3G Femtocells to:
 - improve indoor coverage
 - reduce the cost of wide area network rollout
 - reduce need for capacity in macro network
- Trials
 - lab trials successfully completed
 - field trials now underway with two vendors in Spain
- Potential benefits
 - brings dedicated 3G coverage into the home
 - offloads heavy data users from the wide area network in dense urban areas resulting in reduction in RAN capex where deployed

Innovative products delivering low cost enhanced indoor customer experience

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The capacity needs to be increase at least 1000 times the coming years

Contributions

- One enabler is "more spectrum"
- Another contribution comes from "better technology" (improved spectral efficiency)
- A third contribution is from "denser network"



3 minute discussion – discuss in groups

- How do you think the different aspects contribute?

(More spectrum) * (improved spectral eff.) * (denser network) = 1000

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Cooper's law

- “the number of “conversations” that can theoretically be conducted over a given area in all of the useful spectrum is doubled every two-and-a-half years (www.arraycomm.com/technology/coopers-law)
 - The improvement in spectrum utilization has been over a trillion times in the last 90 years and a million times in the last 45 years.



- “Of the million times improvement in the last 45 years,
 - 25 times were the result of being able to use more spectrum
 - 5 times can be attributed to the ability to divide the radio spectrum into narrower slices
 - Modulation techniques like FM, SSB, time division multiplexing, another 5 times or so
 - The remaining **sixteen hundred times** improvement was the result of confining the area used for individual conversations to smaller areas, what we call spectrum re-use”.

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To handle increasing user demand

- Two main development paths
 - Improve network performance and capacity
 - Add more spectrum
- Current focus for R&D and standardization
 - To increase the peak data rate
 - To combine spectrum into larger chunks
 - To offload heavy data traffic from macro layer to local networks: picocells, femtocells or WiFi



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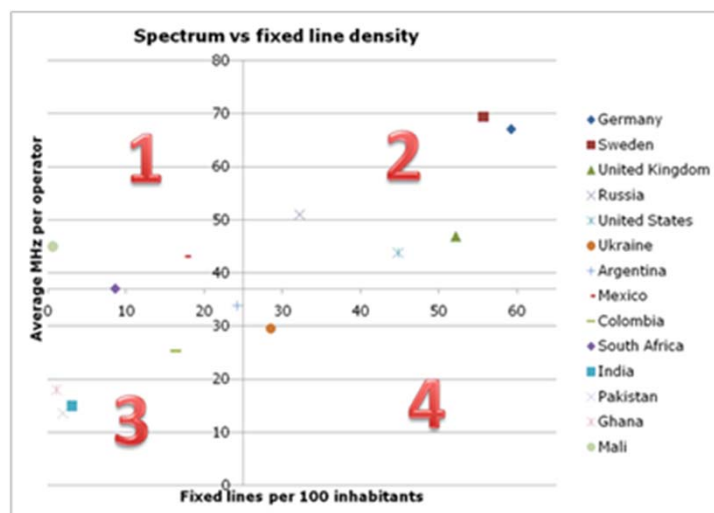
BUT, there are two "buts"

1. Spectrum alone is not the main issue
 - The traffic increases 1000 times the coming years
 - Only 2 – 5 times more spectrum is discussed
2. Regions and countries in the world are different
 - The world it is not like a "Sweden XL"
 - In countries like Sweden and Germany :
 - There is a lot of fixed line infrastructure
 - Operators have "quite a lot of" spectrum



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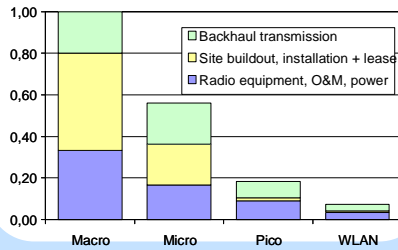
Differences between countries



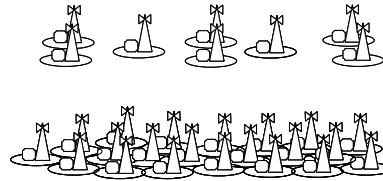
60

Operator challenges – network related

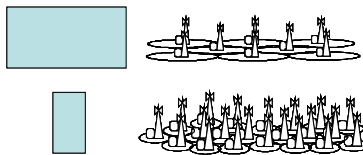
Cost structure



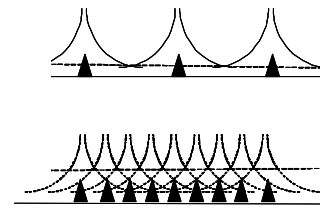
Scalability



Spectrum allocation



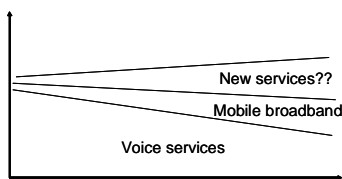
Data rate depends on range



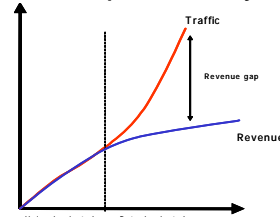
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Operator challenges – business related

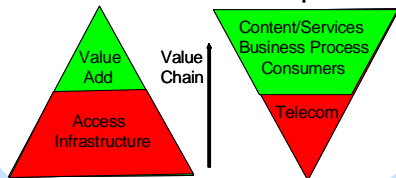
Revenue mix



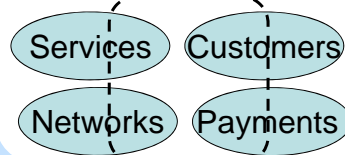
MBB profitability



Changing business landscape



What to handle for operators?



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Thanks for your attention



- Link to my PhD Thesis, February 2011
"Mobile Network operators and cooperation
– A tele-economic study of infrastructure sharing
and mobile payment services"
<http://www.impgroup.org/dissertations.php>
- Link to Telia investor relation information
<http://www.teliasonera.com/investors/reports-and-presentations/presentations/>