



# Introduction to Wireless Infrastructure Economics

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Communication Systems , KTH  
February 22, 2016

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## Case: Economic aspects of mobile networks and services

### Scope

- Analyze drivers, benefits and obstacles for operators to build and operate efficient mobile networks
- Each of you will get a country to analyze



### Your tasks

1. Describe the overall situation and main challenges in your country for mobile networks and services
2. Compare the network strategy, deployment status and offered services for two operators in your country
3. Identify and describe one mobile service offered in your country, it may be a success or a failure

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## Scope

It is about TWO things

1. the mobile networks and the connectivity
2. The services which are enabled using the connectivity

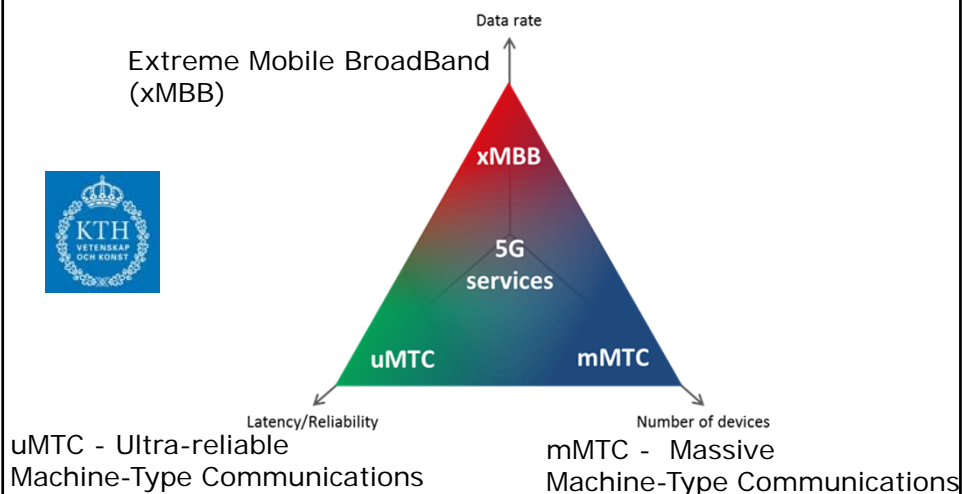


We will discuss TWO types of connectivity

1. Mobile broadband; data for humans, media etc
2. Machine type of communications (MTC)

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## Utmaningar och inriktning för 5G



2016-02-22

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## Schedule for the Case: Economic aspects of mobile networks and services



- February 22
  - Lecture: Introduction to tele-economic analysis, mobile broadband and the student case to analyse
  - Each student gets an individual assignment
- February 25
  - Lecture: Introduction to mobile services, Machine type of communication, Internet of Things
  - Q&A for your assignment
- March 2
  - Lecture on technical and business challenges
  - Feedback on draft home work assignments
- March 10
  - Oral presentation of your case
- March 2- 20
  - You will work with your case, report and presentation and review work of other students

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## What to do in order to pass



- Prepare a draft report and send for review
  - Max 4 pages in total
- Review reports of others in the review group
- Present review comments in group session
- Make a oral presentation of results
  - Max 6 minutes and 3 slides
- Attend the presentation seminar
- Revise report according to the review comments and submit a final version

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Activity	Deadlines
Home work is assigned to each student	16-02-22 ; 16.00
Draft report sent to teacher & reviewers filename: "country"_v1.doc	16-02-29; 16.00
Review comments sent to teacher and authors filename: "country"_review_by"name"	16-03-03; 10:59
Review session and discussions in review groups (no teacher present)	Anytime before 16-03-14; 16:00
Do your presentation slides, put together all slides in the review group and send to teacher filename: "countryA, countryB, countryC".ppt	16-03-08; 11:59
Oral presentation, Each review group will present together	16-03-10; 09:00-12:00 Max 6 min per student
Send final report version to teacher filename: "country"_v2.doc	16-03-15; 11:59
Feedback and grading send to student	16-03-22; 12.00 latest

## Reviewgrupper 2015

- Grupp A: Österrike, Frankrike, Kenya
- Grupp B: Portugal, Tyskland, Nigeria
- Grupp C: Grekland, UK, Iran, Nederländerna
- Grupp D: Estland, Australien, Norge, Sudan
- Grupp E: Danmark, Ghana, Finland



### Teachers

- Jan Markendahl, [janmar@kth.se](mailto:janmar@kth.se)
- Andres Laya, [Laya@kth.se](mailto:Laya@kth.se)

### Readings to start with



- **Business Innovation Strategies to Reduce the Revenue Gap for Wireless Broadband Services;** [J.Markendahl](#), Ö Mäkitalo, J Werding, Bengt G Mölleryd **Communications & Strategies**, 2009, No 75 [papers.ssrn.com](http://papers.ssrn.com)

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## Case: Economic aspects of mobile networks and services

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# WHAT IS Wireless Infrastructure Economics?

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# WHAT IS Wireless Infrastructure Economics?

Costs, Prices, Revenues, Profits

Money related to capabilities and resources  
Distribution of costs, cost structure models and analysis

Trade-offs between  
Capacity } ↔ { Network Costs  
Performance } { Amount of spectrum

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## TODAY, the first part



- First part is about overall picture, problems and challenges
- **Where are the costs?**
- In the fixed/Broadband networks?
- In the Mobile Networks?
- In the Radio Access Network of the Mobile networks?
- In the Core Network of the Mobile Networks?
- For a Mobile Operator in general?

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## TODAY, the first part



- First part is about overall picture, problems and challenges
- **Where are the costs?**
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- **Where are the revenues? What kind of services?**

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## TODAY, the first part

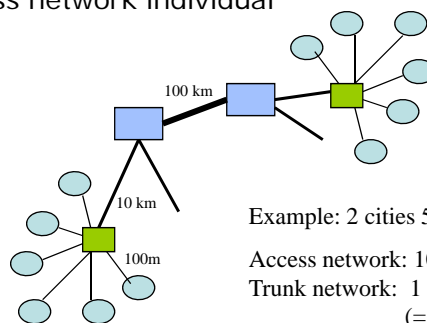
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## The “last mile” problem: Most investments in Access Networks

- Backbone network shared by many
- Access network individual



Example: 2 cities 50.000 user each

Access network: 100 m/user

Trunk network: 1 m/user

(=100 km/100.000 users)

2016-02-22

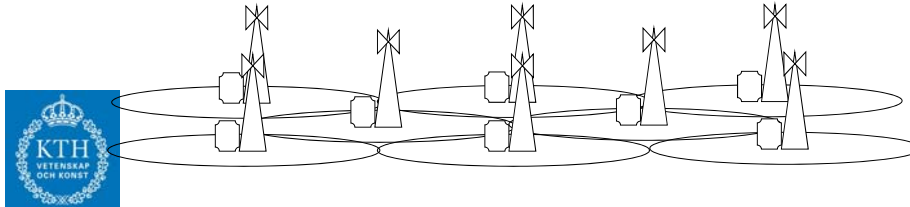
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## Cellular networks in rural areas

- large coverage areas per base station
- few base stations per area unit



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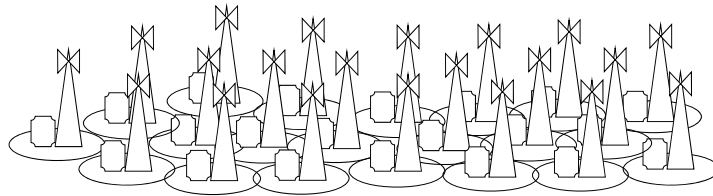
## Range limitations

- Typical ranges (NLOS):
  - 10 kbit/s (GSM) 25+ km
  - 500 kbit/s (EDGE) 5-10 km
  - 2 Mbit/s (UMTS) 2-3 km
  - 10 Mbit/s (HSPA) 500 m
  - 100 Mbit/s (LTE/WLAN) 50-150 m
- Coverage limited system

$$N_{BS} = \frac{A_{tot}}{A_{cell}} \propto \frac{1}{R^2}$$

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## Cellular networks in urban areas – many base stations per area unit



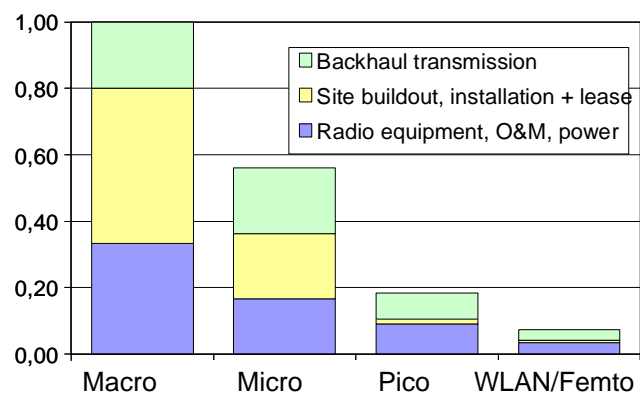
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## Cost structure of radio access networks

- It is not only costs for the base station equipment (the radio) but also for the transmission & sites



From  
Klas Johansson  
PhD thesis 2007



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## The infrastructure cost for capacity limited systems

- Spectrum limitation  
     $B_{tot}$  available bandwidth  
    Spectral /reuse efficiency  $K$

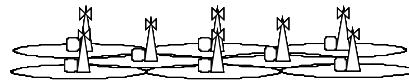


$$Cost \propto N_{BS} \propto \frac{N_{user} B_{user} K}{B_{tot}} A_{tot}$$

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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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- In the Core Network of the Mobile Networks?
- For a Mobile Operator in general?
- **Where are the revenues? What kind of services?**
- Voice
- Messages
- Data
- Music
- Other services

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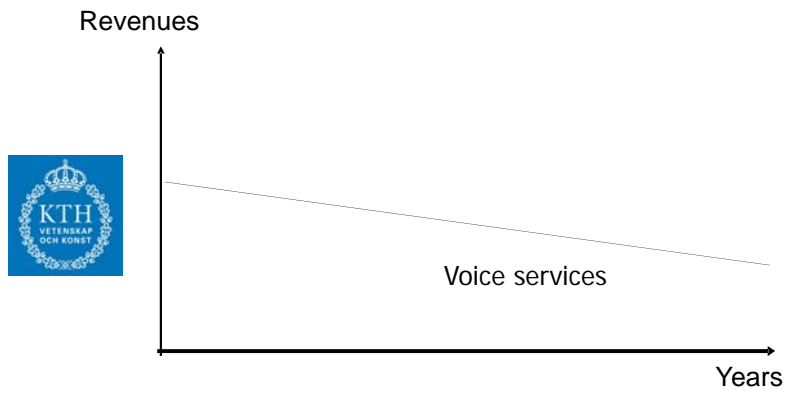
## Short exercise – work 2 and 2



- From where do Operators get their revenues?
- What kind of services and revenue share %

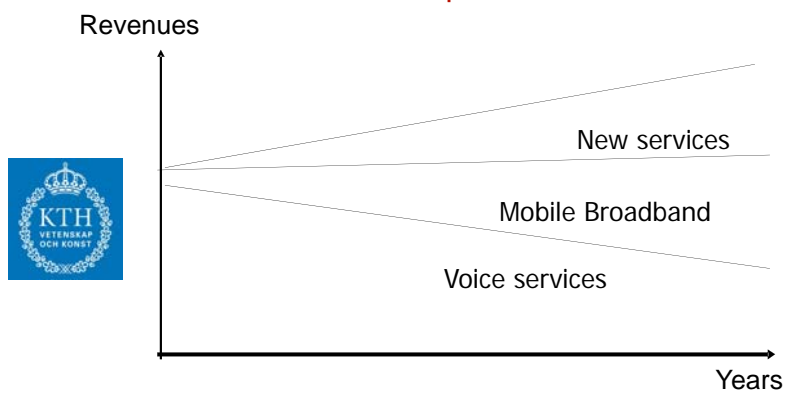
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One motivation for our research  
Declining voice revenues for mobile operators



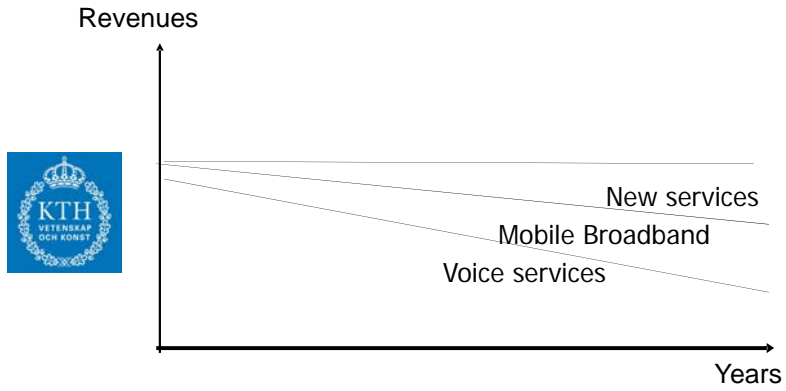
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One motivation for our research  
New services require new solutions



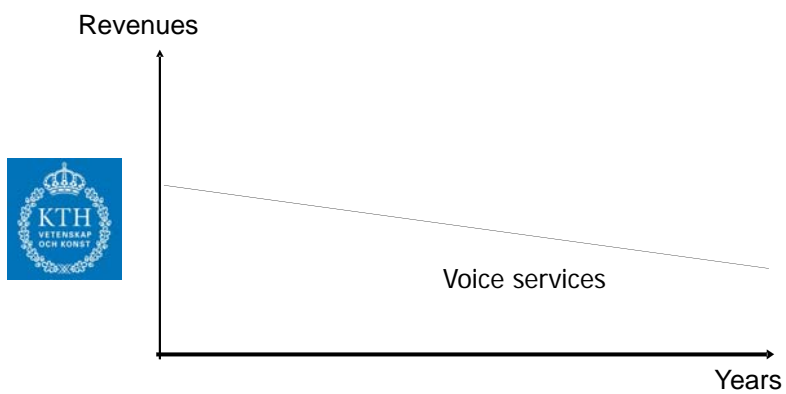
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One motivation for our research  
New services require new solutions



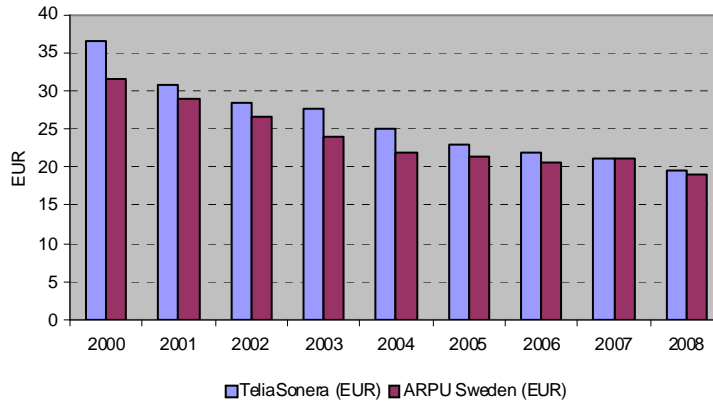
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Declining voice revenues



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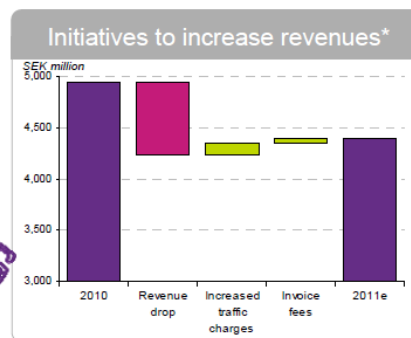
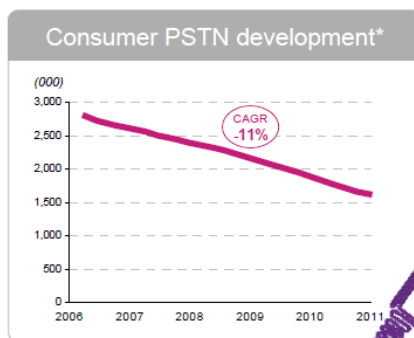
## Revenues for mobile voice services in Sweden 2000-2008



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

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## Controlled decline in consumer PSTN

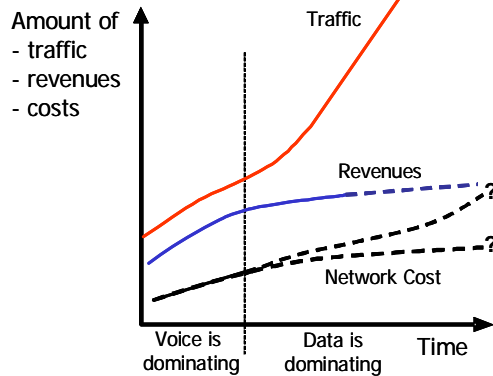


\* Example from Consumer segment Sweden

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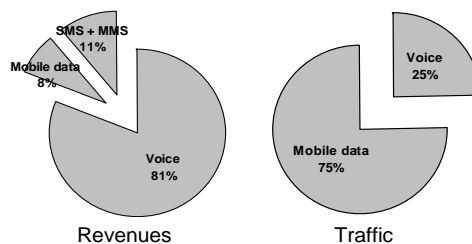
## The revenue gap "de-coupling" of traffic and revenues"

- 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



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## Traffic, prices and revenues



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

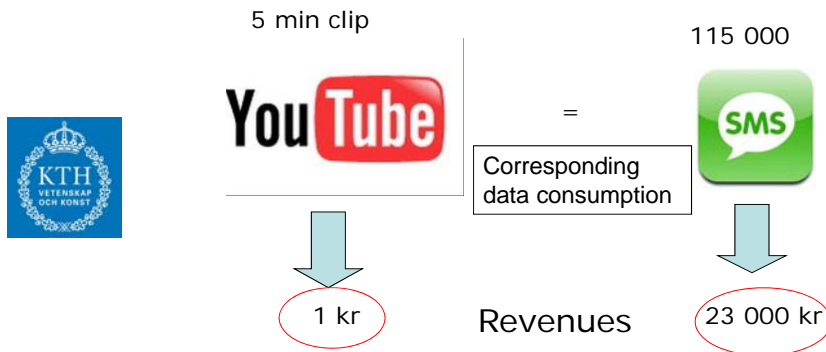
EUR per MB	2007	2008
Voice	1,46	1,36
SMS	439,5	351,6
Mobile data (laptop)	0,014	0,011

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%

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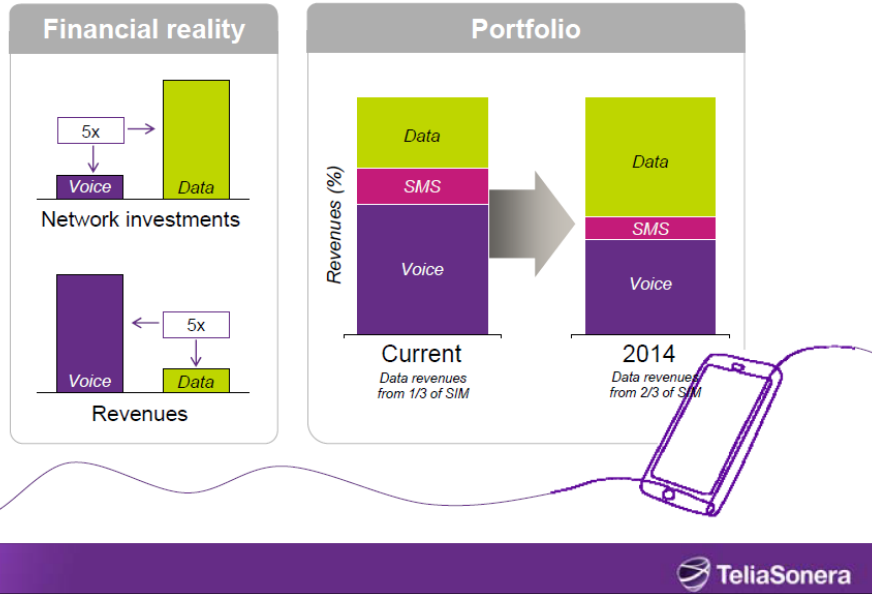
## Traffic, prices and revenues

- 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

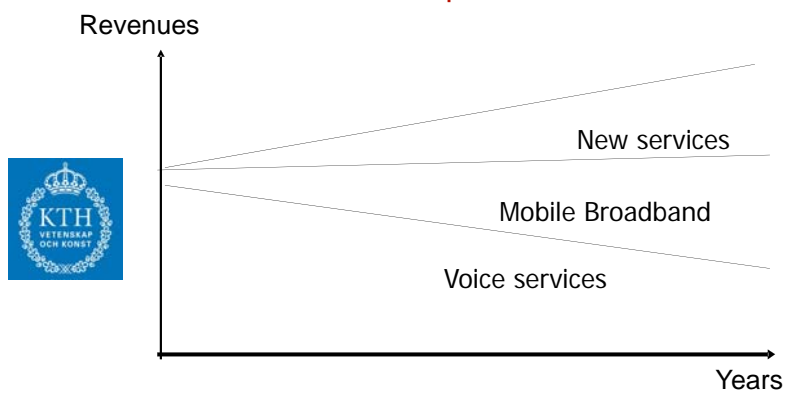


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## Rebalancing of pricing model needed



## One motivation for our research New services require new solutions



## "New" services

Products Download **Mobile** Help Blog

Logged in as **lenaplutt** - My account - Log out

Spotify  
Everyone Loves Music

**BETA**

### 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

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## 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

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## Revenue sharing for Apps?

### Revenues from applications

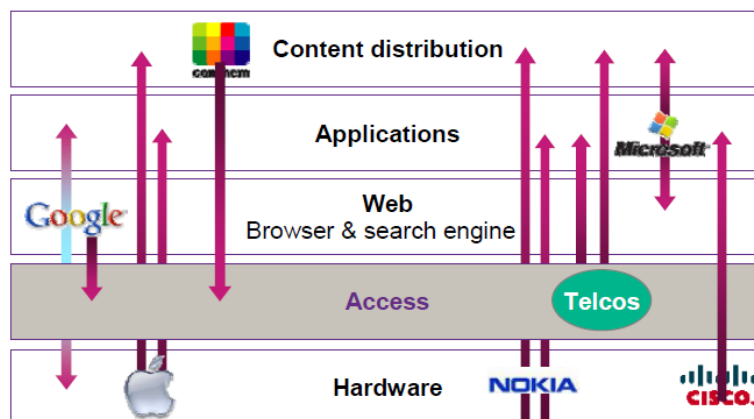


	Previous	Now
Developer	20%	70%
Publisher	20%	0%
Aggregator	20%	0%
Operator	40%	0%
Handset supplier	0%	30%

*Type I-Mode*      *Apple*

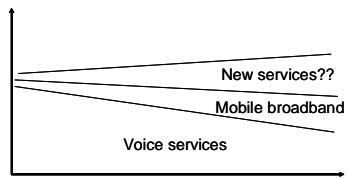
## Changing competitive dynamics

Investor Day 2009

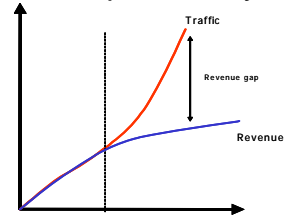


## Operator challenges – business related

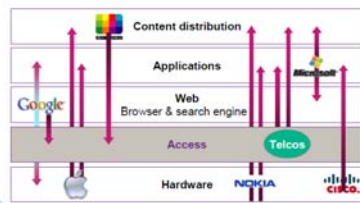
### Revenue mix



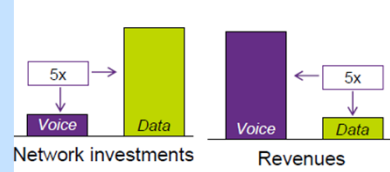
### MBB profitability



### The business landscape



### Investments



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- **Business Innovation Strategies to Reduce the Revenue Gap for Wireless Broadband Services;** [J Markendahl](#), Ö Mäkitalo, J Werding, Bengt G Mölleryd **Communications & Strategies**, 2009, No 75 [papers.ssrn.com](http://papers.ssrn.com)



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