

Prepared for IK 2514 Wireless Infrastructure Deployment & Economics

Telecom regulation and spectrum



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Agenda



- About the regulator for electronic communications
- Competition Authority
- Telecom regulation
- Spectrum
- Regulated markets

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Key words

- Essential facility
- *Ex ante*
- *Ex post*
- SMP (Significant Market Power)
- Three criteria



Link to political economic area: EU vs member states

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The role of the regulator

- Sector specific – *ex ante* (decide on obligations for operators with significant market power (SMP))
- Safeguard price worthy services to end customers
- Implement directives/national regulation
- Allocate spectrum



What is the aim with telecommunication regulation?

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Competition Authority



- General purpose *Ex-post* (violation towards the rule of law) gives the competitive authority a mandate to intervene
- Other regulatory bodies, like for example issuing of building permits

Telecom and competition authorities are commonly separate agencies, but Ofcom in the UK combine the two roles

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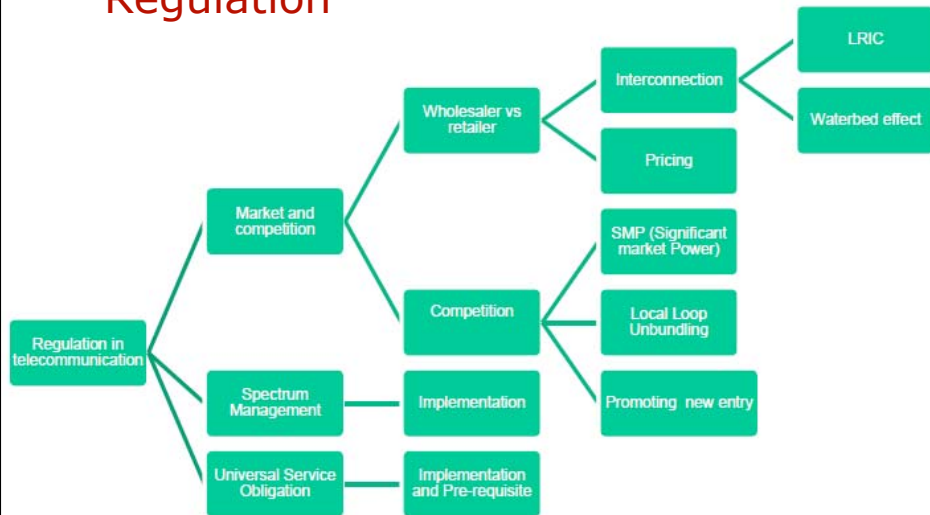
Ex ante vs ex post regulation



- *Ex ante* regulation is anticipatory intervention
 - concerned with market structure
 - number of firms and level of market concentration
 - entry conditions and
 - the degree of product differentiation
- *Ex post* regulation addresses specific allegations of anti-competitive behavior or market abuse.
It aims to redress proven misconduct through a range of enforcement options including fines, injunctions, or bans.

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Regulation



Source: Erik Bohlin, Chalmers

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Essential facility



- Doctrine
- Bottle neck (railroads, monopolist refusal to deal...)
- Not replicable (like the copper access network)
- Investment ladder
- Access to enable a service or function

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Dominant regulatory paradigm



- The mindset of telecoms regulators has been shaped by neoclassical economic theory stating that social welfare is maximized under conditions of perfect competition
- Competitive conditions
- Bottleneck infrastructure where SMP and dominance may be exercised, justifying *ex ante*, sector specific regulation

Link this to the key concepts

- Essential facility
- Ex ante
- Ex post
- SMP (significant market power)
- Three criteria

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Relevant markets defined by the Commission

Retail level

1. Access to the public telephone network at a fixed location for residential and non-residential customers



Wholesale level

2. Call origination on the public telephone network provided at a fixed location
3. Call termination on individual public telephone networks provided at a fixed location
4. Wholesale (physical) network infrastructure access (including shared or fully unbundled access) at a fixed location
5. Wholesale broadband access
6. Wholesale terminating segments of leased lines, irrespective of the technology used to provide leased or dedicated capacity
7. Voice call termination on individual mobile networks

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SMP status – EC Directives



- An operator designated as having SMP is subject to specific obligations that the National Regulator Authority (NRA) determines
- Cost-oriented tariffs (except for mobile operators)
- SMP criteria

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SMP criteria



- Dominant position
- Market power (market shares) >25%
- Control of infrastructure not easily duplicated
- Technological advantages or superiority
- Absence of or low countervailing buying power
- Economies of scale and scope
- Vertical integration
- Highly developed distribution and sales network

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Three criteria test



- The presence of high and non-transitory barriers to entry
- A market structure which does not tend towards effective competition within the relevant time horizon
- The insufficiency of competition law alone to adequately address the market failures
- The EU Commission identifies markets that should be subject to regulation (can veto market definition but not obligations)
- The National Regulatory Authorities pursue SMP-analysis

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Regulatory toolbox



- LRIC (Long Run Incremental Cost) - the cost of producing a given increment of output, including an allowance for an appropriate return on capital to reflect the costs of financing investment in facilities used for interconnection
- SSNIP test (hypothetical monopolist) test, explore whether a company could raise prices with for example 10% without losing customers alternatively if customers switch to other products (substitutes), then these products should be included in the market

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Commission Guidelines



- Assess the magnitude of the barriers to entry
- Existence of sunk costs
- Control of infrastructure not easily duplicated
- Technological advantages or superiority
- Easy or privileged access to capital or financial resources
- Economies of scale, economies of scope
- Vertical integration
- Barriers to develop distribution and sales network
- Products or services diversification

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Regulatory authorities/interest groups



- US – FCC
- UK – Ofcom
- Sweden – PTS
- Regulatory bodies
- ERG (<http://www.erg.eu.int/>)
- ECTA (<http://www.ectaportal.com/en>)
- NRAs decisions has to be in line with the Commission's practice and the relevant jurisprudence of the European Courts

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Concluding

- Essential facility
- Ex ante
- Ex post
- SMP (significant market power)
- Three criteria (entry barriers, no movement towards competition, competition law)
- The role of the EU Commission
- The role of National Regulatory Authorities



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SPECTRUM

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UNITED STATES FREQUENCY ALLOCATIONS



THE RADIO SPECTRUM



Spectrum management



- Frequency planning
- Spectrum allocation
 - Administrative allocation
 - Auctions
 - Beauty contest

Spectrum Sweden



- Swedish spectrum policy vs. revised directives
- IMT bands have been allocated: 800, 900 and 1800 MHz
- Future spectrum releases

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The PTS spectrum policy



- Licences to use radio transmitters shall be as **technology and service neutral** as possible
- When selection procedures are required, an **auction** should be applied in the first instance
- **Second-hand trading** (transfer of licences) shall be promoted
- **Licence exemption** should be introduced where there is little risk of harmful interference and there are no other impediments

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The 800 award in Sweden



- Auction format similar to the Swedish 2.6 GHz auction (SMRA with switching)
- Starting bid at SEK 150 million per license
- Coverage obligations for one of the licenses:
 License holder shall cover households and working places that do not today have basic possibilities for broadband (today approx. 1000-1500)
 License holder promises to invest in coverage up to SEK 300 million

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The 800 award in Sweden



- The auction closed after 31 rounds and five days

Bidder	Bandwidth, MHz	Auction proceeds, SEK	Amount for coverage, SEK
HI3G Access AB	2x10	431 000 000	
Net4Mobility HB	2x10	469 000 000	300 000 000
TeliaSonera Mobile Networks AB	2x10	854 000 000	

- For Net4Mobility SEK 300 million comprise bids for coverage for those households and fixed places of business that lack broadband
- Com Hem AB and Netett Sverige AB also participated in the auction but did not win any licenses.

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900 MHz



- PTS decided in 2009 that the license holders in 900 should have their licenses renewed with new frequency arrangements and technical conditions
- However, the issue was under legal challenge, resolved by February 2011
- Current licenses have according to the decision been renewed with no changes when it comes to frequency arrangements and technical conditions
- New frequency arrangement and technical conditions entered into force in May 2011

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Spectrum Allocation in Sweden today

	800	900	1800	2100	2600	Σ
Hi3G	10	5	0	19.8 5 TDD	10 50 TDD	44.8 55 TDD
TeliaSonera	10	10	35	0	20	75
Net4Mobility(T2+TN)	10	6	35	0	20	71
Tele2	0	9	0	0	0	9
Telenor	0	5	0	19.8 5 TDD	0	24.8 5 TDD
Sulab (TS+T2)	0	0	0	19.8 5 TDD	0	19.8 5 TDD

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Roadmap for release of more than 500 MHz "new" spectrum in Sweden

Awards

800 MHz	60 MHz	2011
1800 MHz	70 MHz	2011
3,5 GHz	56 MHz	2011
2010-2025 MHz (on hold)	15 MHz	2011
2,3 GHz	100 MHz	2013
1785-1805 MHz	20 MHz	2013
1,5 GHz	40 MHz	2013
2,8 GHz	200 MHz	2013
3,8-4,2 GHz	~ 200 MHz	2013/2015
(10,5 GHz (10126-10294/10476-10644 MHz))	168 MHz	2011)
(75 GHz (part of 71-76/81-86 GHz))	~ 8 GHz	2012/2013)



Licence exempt

823-832 MHz	9 MHz	2011
1878,1-1879,9	1,8 MHz	2012
5,8 GHz (5725-5875 MHz)	150 MHz	2012
1875-1880 MHz	5 MHz	2013
(75 GHz (part of 71-76/81-86 GHz))	~ 2 GHz	2011/2012)

COMPLETED
ONGOING

Summary of the PTS spectrum release plan dec 2011²⁷

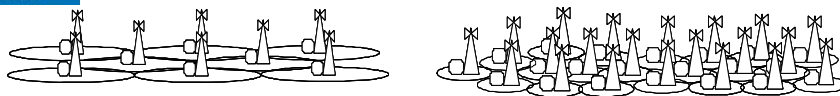
Crystal ball gazing

- More
 - Service and technology neutral spectrum
 - Focus on spectrum as a natural and production resource
 - Market mechanisms
 - Collective use of spectrum
 - Global harmonization
- Less
 - Central planning (command and control)
 - Limitations and political steering
 - Need for global harmonization



Questions

- How is the production cost affected by different levels of spectrum?
- How does the use of spectrum aggregation influence the evaluation of spectrum?



Base station density for “low” (left) and “higher” (right) depends on amount of spectrum and the carrier frequencies

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Estimate the value of spectrum

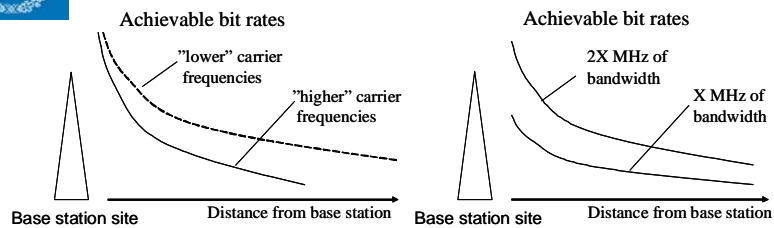
- **Economic value** of spectrum can be assessed by estimating the value of the economic activities through the contribution to the GDP
- **Marginal value of spectrum**
 - **Engineering value** is determined by cost savings in infrastructure of the operator’s network obtained when additional spectrum is used.
 - **Strategic value** reflects the expected position and competitive advantage an operator would hold in the market as a result of the assigned spectrum



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Approach - technical

- Coverage = $n * \text{cell range}^2$
- Capacity = Bandwidths (MHz) * number of sites * sectors * spectrum
- Bit rate = MHz * spectrum efficiency
- Busy hour = 12.5%



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Capex comparison - 700 MHz vs higher bands



	Traffic share			
	0%	15%	50%	100%
700 MHz	1,00	1,00	1,00	1,00
900 MHz	1,69	1,52	1,34	1,20
2100 MHz	4,05	3,33	2,45	1,96
2600 MHz	7,13	5,66	3,96	2,92

Capex for each band is normalized to cost of deployment in 700 MHz

Source: Azcoitia et al (2010)

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Case

Market assumptions



- Networks have been deployed 1300 sites
- Four operators - each has 25% market share
- 50% penetration of mobile broadband
- ARPU EUR 20
- Three levels of data usage : 5, 20 and 80 GB per month
- Busy hour rate: 12.5% (usage spread over 8 hours)

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Case

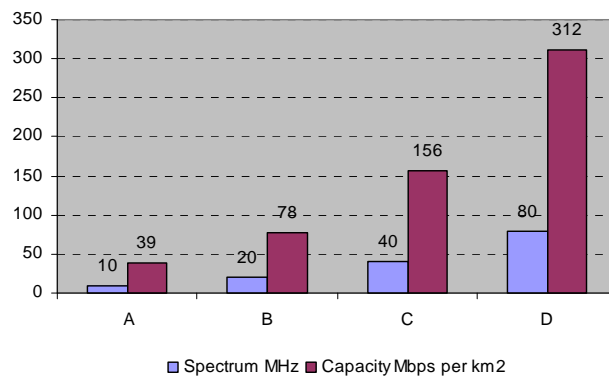
Four operators



- **A:** 2*10 MHz in the 2.6 GHz band = 2*10 MHz
- **B:** 2*10 MHz in the 1.8 GHz and the 2.6 GHz bands = 2*20 MHz
- **C:** 2*20 MHz in the 1.8 GHz and the 2.6 GHz bands = 2*40 MHz
- **D:** Two cooperating operators that both have 2*20 MHz in each of the 1.8 GHz and the 2.6 GHz bands = 2*80 MHz

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Spectrum and capacity per km²



Spectrum: A: 10 MHz, B: 20 MHz, C: 40 MHz, D: 80 MHz

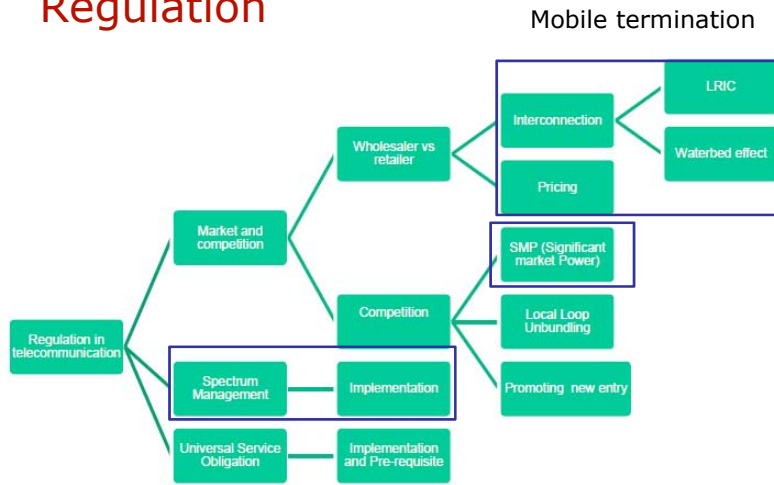
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Examples of regulated markets

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Regulation



Source: Erik Bohlin, Chalmers

Subscriber Identity Module (SIM)



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E.164

ITU recommendation for the international number plan that are used by PSTN

What is the link between a SIM-card and regulation?

Interconnection



- Communication between different networks
- Fixed to mobile termination
- Mobile to mobile termination
- Mobile to fixed termination

- Cost recovery
- Origination

What would a network be without interconnection?

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Mobile termination



- Monopoly on terminating calls (voice calls)
basis for this standpoint
- Regulated price to terminate calls
- LRIC (Long run incremental cost)
- EU directive on mobile termination
- Data is another story

What is the link between termination prices and prices that operators charge end-customers? Explore pricing strategies with on-net and off-net prices?

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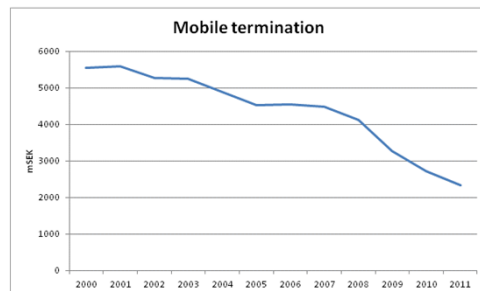
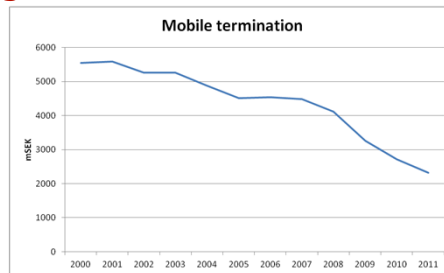
Mobile termination



- 2009
LRIC model updated, price of 0,32 SEK/min. All operators beside Tele2 adopted the price recommendation. Administrative court of appeal decided in June 2011 that PTS decision was invalid due to formal inconsistencies. Dispute resolution ongoing.
- 2010
Update of LRIC model, 0,26 SEK/min. All operators adopted the price recommendation.
- 2011
Price method SEK 0.21 from 1 July 2011- 30 June 2012. PTS has enforced Tele2 and TeliaSonera to comply. Tele2 has appealed the enforcement, process is in the Administrative Court. Other operators has adopted PTS calculation.
Draft calculation on pure LRIC : SEK 0.10 for 2012 and SEK 0.09 for 2013
- 2012
Price method SEK 0.15 from 1 July 2012. PTS has enforced Tele2 to comply. Tele2 has appealed the enforcement and requested inhibition, process is in the Administrative Court.
EU Commission urged PTS to implement pure-LRIC from 1 January 2013

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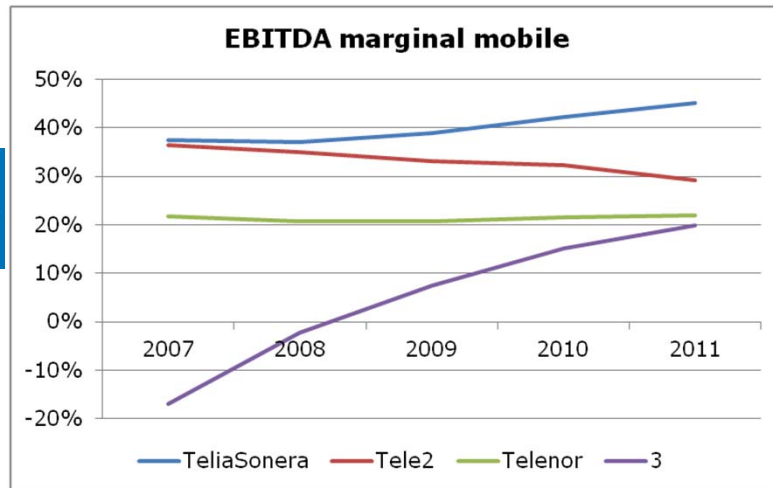
Termination - a declining share of total revenues



Source: Svensk Telemarknad

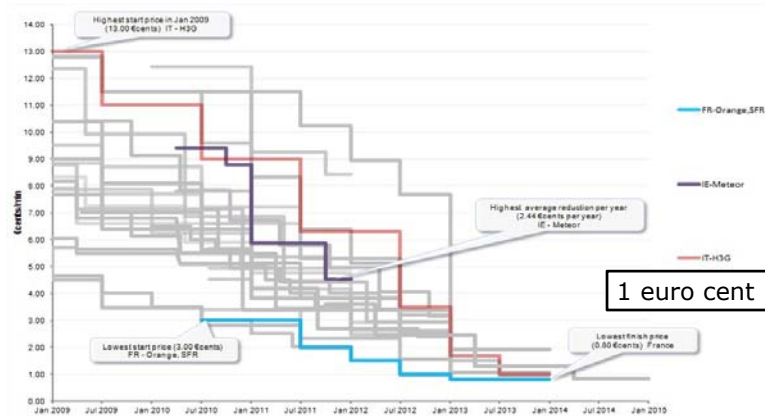
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But limited impact on EBITDA-margin



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MTR - glide path



Source: Cullen International

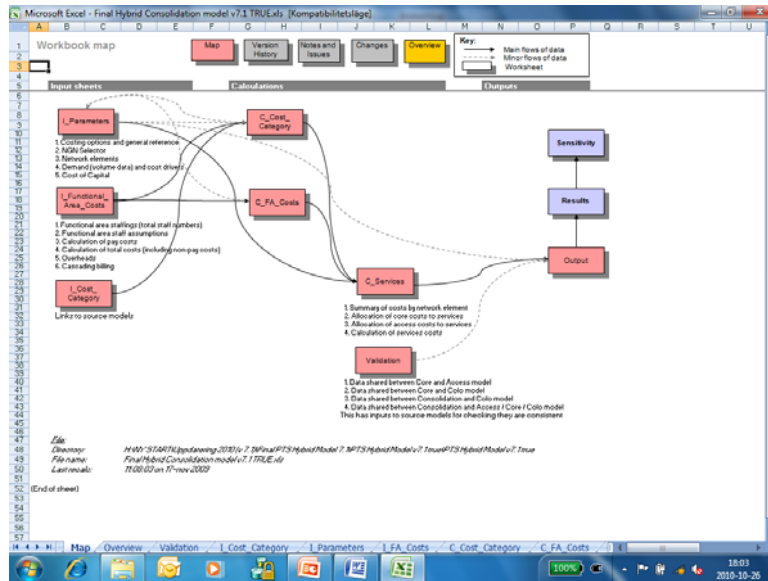
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LRIC model



- Efficient operator
- Calculate the current cost
- Forward looking cost
- Modeling a new network

Some examples of the LRIC model



Technology that undermine regulation



- VoIP (SIP)
- Call back
- UMA
- Multiple SIM cards
- Possibility for receivers to pay
- Other solutions?

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Next pure LRIC – no common cost



- EU recommendation on FTR/MTR
- "Common cost" in Swedish law
- Implementation of reviewed EU directives in Swedish law
- Draft calculation 0,06 SEK/min
- PTS continue to work on long term solution
- Considering different solutions: Bill and keep with fall back solution is one option
- Europe following suit down the glide path...

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Access to fiber



- Backhaul
- Ducts
- Dark fiber
- New deployment
- Leased lines
- Obligations by a SMP operator
- Other alternatives on backhaul: copper, cable, radiolink

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Concluding



- Mobile termination is declining in importance
- Operators have to cope with regulation
- Competition is key to develop the market

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