Prepared for IK 2514 Wireless Infrastructure Deployment & Economics

Telecom regulation and spectrum

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Agenda

- Why regulation
- The role of the regulator
- Regulation of electronic communication
- European Commission: Telecoms Single Market
- Conclusions

If regulation is the answer what is then the question?

How to organize road traffic?

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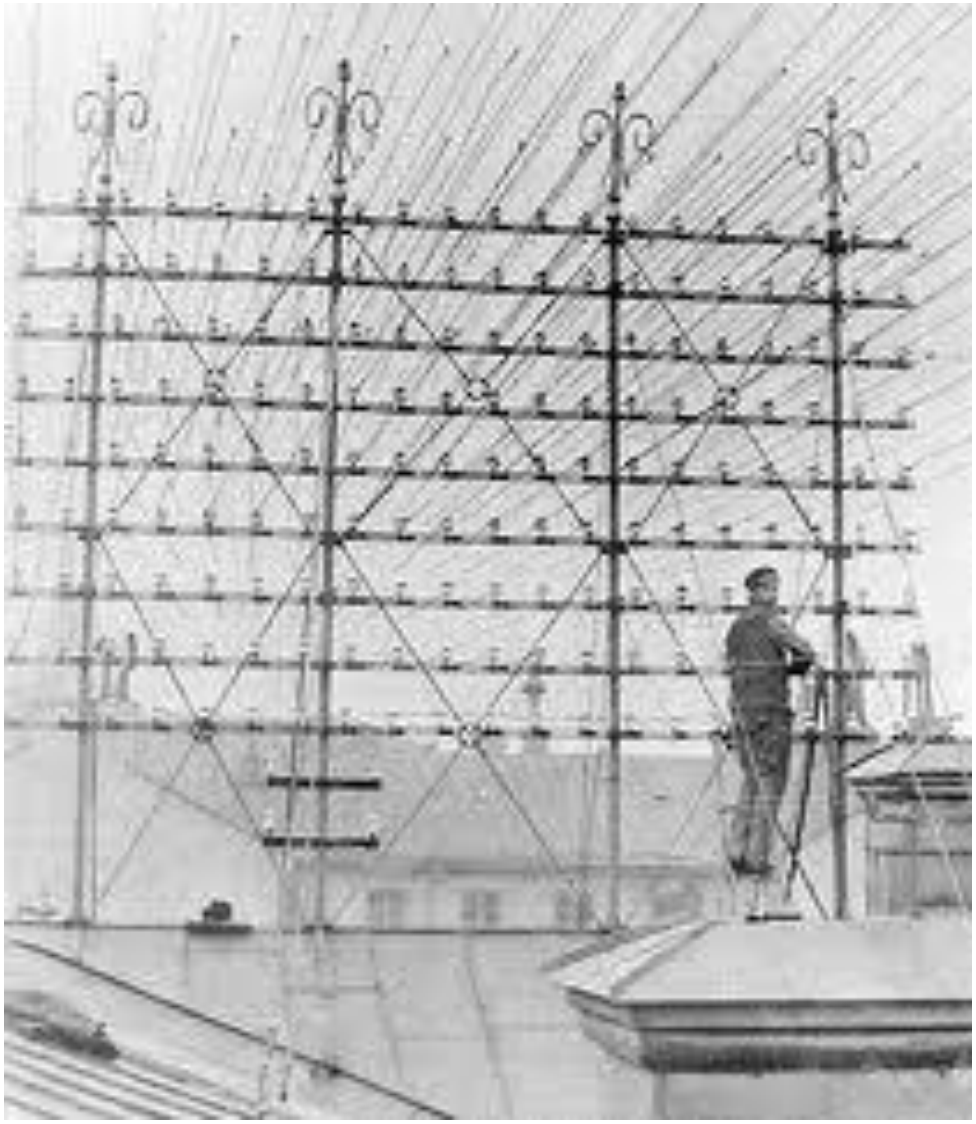
How to organize air traffic?

How to organize rail traffic?

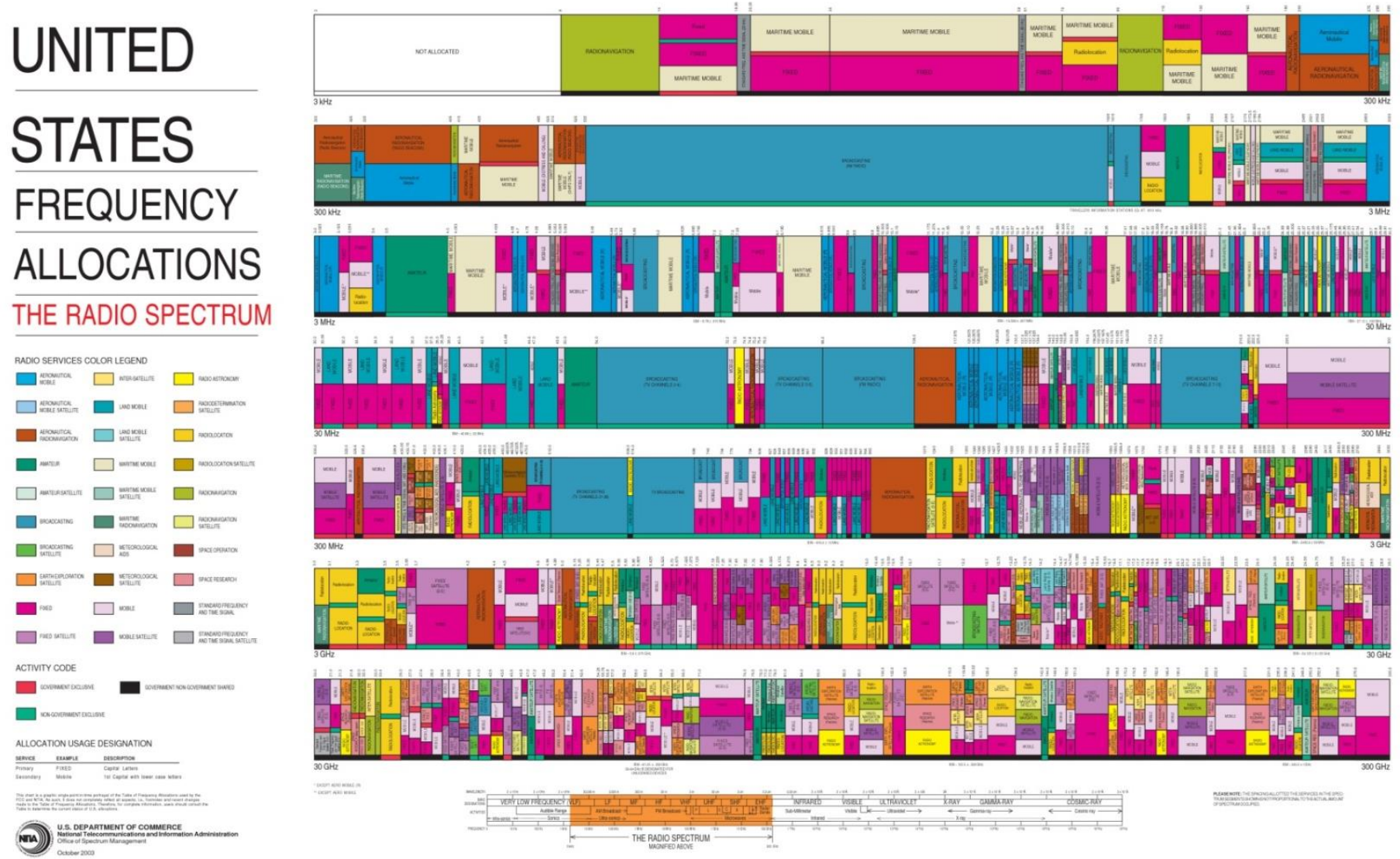
How to control the financial market?

How to maintain a natural monopoly?

Interconnection with other networks?



How to allocate spectrum?



Development of telecommunications

High fixed cost – low marginal cost
Economy of scale

Price deflation

Telecom 3.0
Regulation 3.0

Monopoly

Liberalization - competition

1880 1920 1980 2010 2020

Key words

- Essential facility
- *Ex ante*
- *Ex post*
- SMP (Significant Market Power)
- Three criteria (entry barriers, no movement towards competition, competition law)

EU regulatory framework - National laws and regulation

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Table	Perspective	Question	Issues
A	Denmark: challenger	View on regulation? How does it impact the business and the ability to provide services.	Interconnection, termination, network sharing, backhaul, spectrum
B	Sweden: incumbent	See above	SMP-obligations, unbundling, obligations, spectrum
C	Spain: new entrant	See above	Termination, interconnection, MVNO, backhaul, spectrum
D	Kazakhstan: dominating operator	See above	Interconnection, termination, backhaul, spectrum
E	Nigera: possible entry	See above	MVNO, interconnection, VoIP, termination, spectrum,

Examine the view and priorities on regulation for each perspective

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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?

Competition Authority

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

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

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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Essential facility

- Doctrine
- Bottle-neck (railroads, monopolist refusal to deal…)
- Not replicable (like the copper access network)
- Investment ladder
- Access

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

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

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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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)
- Regulated price to terminate calls
- LRIC (Long run incremental cost)
- EU directive on mobile termination
- No termination on mobile data (but transit or peering are needed)

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

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Initiative from the Commission

- Telecom Single Market => connected continent
- Recommendation: Wholesale network access costing methodologies and non-discrimination
- Net neutrality, but specialized services on dedicated QoS
- Mobile roaming – decoupling of subscriptions while roaming, agreements between operators could give an exemption of decoupling, enable subscribers to always pay “local prices”.
- A single authorization for operating in all 28 member states
- Spectrum allocation – increased mandate to the EU Commission

For more information: www. ec.europa.eu/digital-agenda

Remedy	Example
Obligations to provide access, or other obligations	Origination, termination, unbundling, wholesale access,
Access to facilities	Place equipment, backhaul, support systems
Non-discrimination	Treat wholesale customers the same way as the internal retail operation
Cost oriented prices	Price regulation, LLUB, termination charges

Table	Role	Area	Issues
A	Regulator/EU Commission	Spectrum	Allocation methods, reserve price, single authorization
B	Regulator/EU Commission	Termination charges, pure LRIC, roaming	Termination, interconnect, MVNO,
C	Incumbent/challenger	Fixed infrastructure, LLUB, dark fiber, VULA	SMP, unbundling, obligations, price regulation
D	Regulator/EU Commission	Fixed infrastructure, LLUB, dark fiber, VULA	SMP, unbundling, obligations,
E	Incumbent/challenger	Termination charges, pure LRIC, roaming	Termination, interconnect, MVNO, spectrum
F	Incumbent/challenger	Spectrum	Allocation methods, reserve price, single authorization

Elaborate your view on regulation, and how the different issues should be handled by the regulator

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Conclusions

- Competition problems varies depending upon perspective
- Operators have to cope with regulation
- Essential facility
- *Ex ante*
- *Ex post*
- SMP (Significant Market Power)
- Three criteria (entry barriers, no movement towards competition, competition law)
- Mobile termination is declining in importance
- Competition is key to develop the market

Regulatory authorities/interest groups

- US – FCC
- UK – Ofcom
- Sweden – PTS

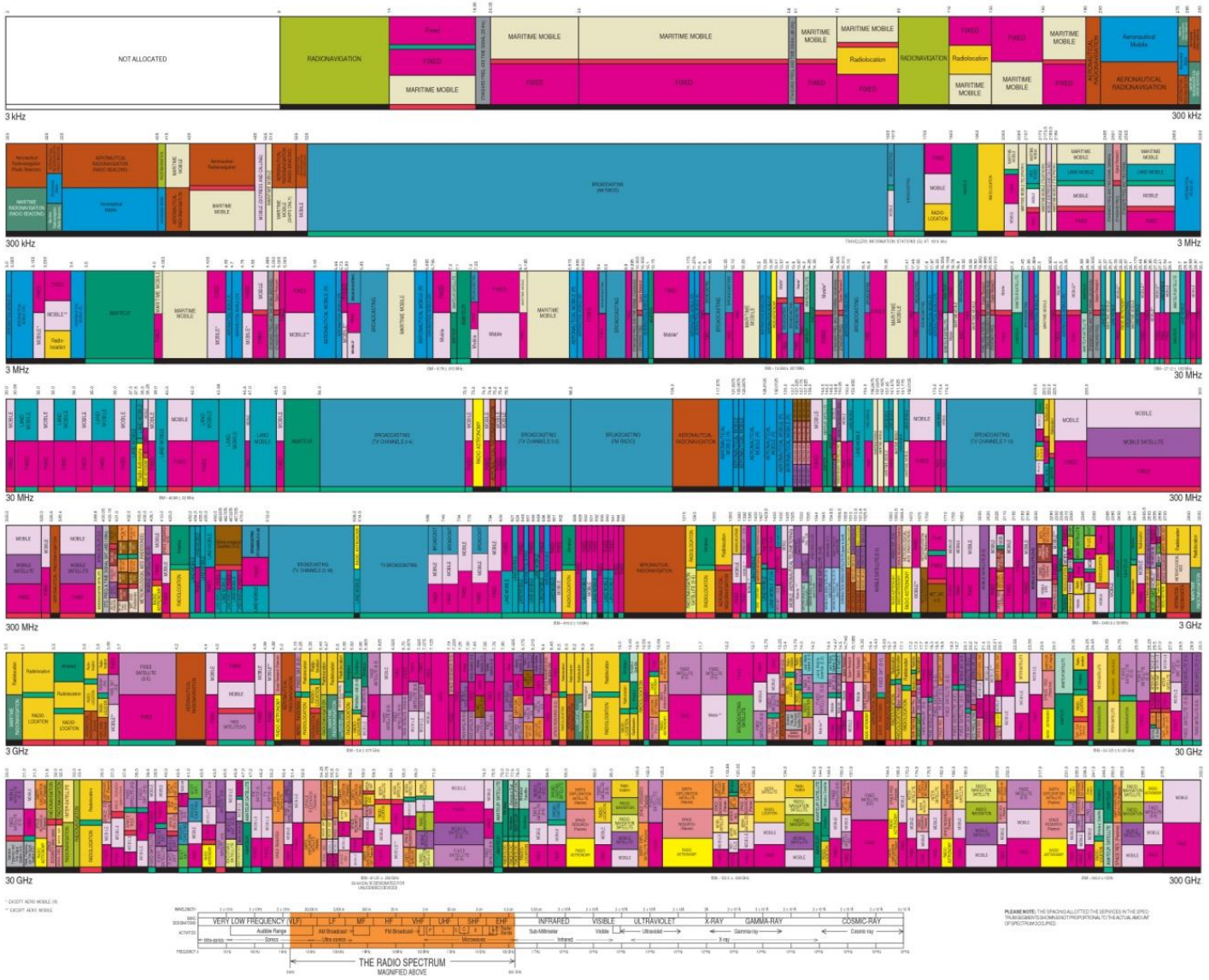
- Regulatory bodies
- ERG (http://www.berec.europa.eu)
- ECTA (http://www.ectaportal.com/en)

- NRAs decisions has to be in line with the Commission's practice and the relevant jurisprudence of the European Courts

SPECTRUM

UNITED STATES FREQUENCY ALLOCATIONS

THE RADIO SPECTRUM



RADIO SERVICES COLOR LEGEND

AERONAUTICAL MOBILE	INTER-SATELLITE	RADIO ASTRONOMY
AERONAUTICAL MOBILE SATELLITE	LAND MOBILE	RADIODETERMINATION SATELLITE
AERONAUTICAL RADIONAVIGATION	LAND MOBILE SATELLITE	RADIOLOCATION
AMATEUR	MARITIME MOBILE	RADIOLOCATION SATELLITE
AMATEUR SATELLITE	MARITIME MOBILE SATELLITE	RADIONAVIGATION
BROADCASTING	MARITIME RADIONAVIGATION	RADIONAVIGATION SATELLITE
BROADCASTING SATELLITE	METEOROLOGICAL AIDS	SPACE OPERATION
EARTH EXPLORATION SATELLITE	METEOROLOGICAL SATELLITE	SPACE RESEARCH
FIXED	MOBILE	STANDARD FREQUENCY AND TIME SIGNAL
FIXED SATELLITE	MOBILE SATELLITE	STANDARD FREQUENCY AND TIME SIGNAL SATELLITE

ACTIVITY CODE

GOVERNMENT EXCLUSIVE

GOVERNMENT/ NON-GOVERNMENT SHARED

NON-GOVERNMENT EXCLUSIVE

ALLOCATION USAGE DESIGNATION

SERVICE	EXAMPLE	DESCRIPTION
Primary	FIXED	Capital Letters
Secondary	Mobile	1st Capital with lower case letters

This chart is a graphic single-point-in-time portrayal of the Table of Frequency Allocations used by the FCC and NTIA. As such, it does not completely reflect all aspects, i.e., footnotes and recent changes made to the Table of Frequency Allocations. Therefore, for complete information, users should consult the Table to determine the current status of U.S. allocations.

U.S. DEPARTMENT OF COMMERCE
National Telecommunications and Information Administration
Office of Spectrum Management

October 2003

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, 1800, 2100, 2600 MHz
- Future spectrum releases

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

The 800 award in Sweden 2011

- Auction format similar to the Swedish 2.6 GHz auction (SMRA with switching)
- Started 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

The 800 award in Sweden

- The auction closed after 31 rounds and five days

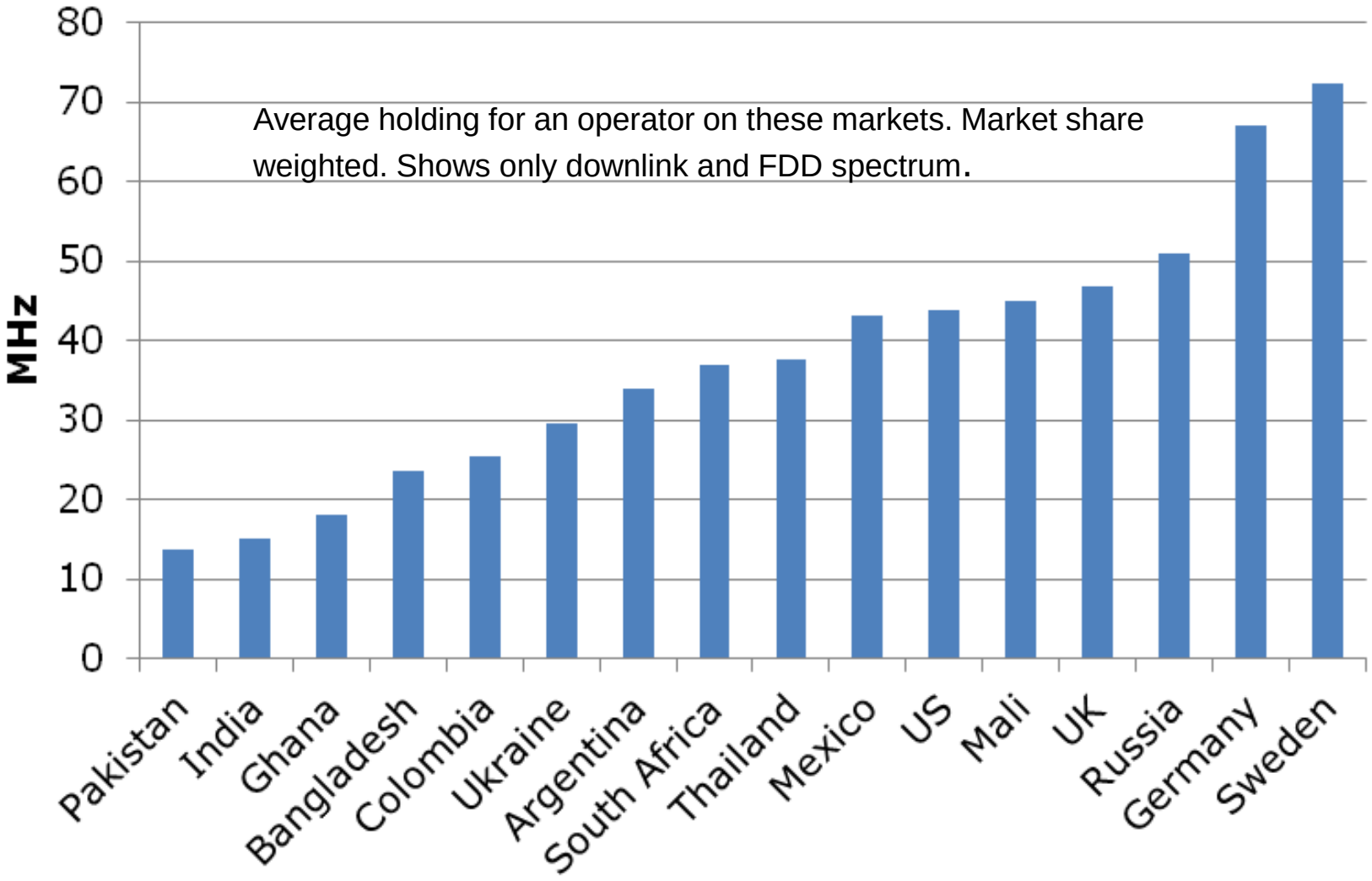
Bidder	Bandwidth, MHz	Auction proceeds, SEK	Amount for coverage, SEK
HI3G Access AB	2x10	431 000 000	
Net4Mobility HB	2x10	469 000 000	300 000 000
TeliaSonera Mobile Networks AB	2x10	854 000 000	

- 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.

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

Average MHz per operator



Source: Cullen-International, NRA, Operator reports, author's calculation

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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	40	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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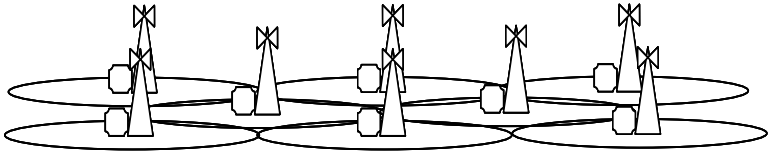
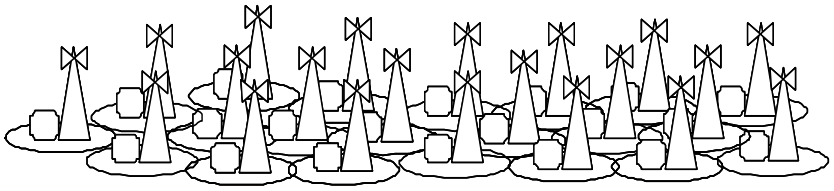
Questions

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





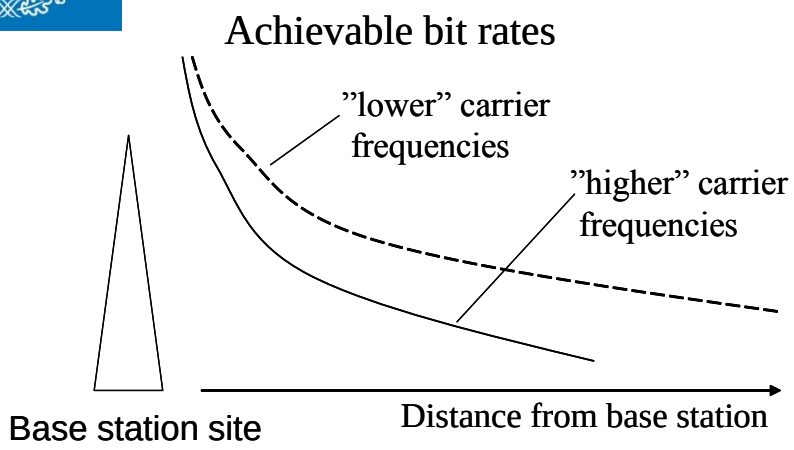
Base station density for “low“ (left) and “higher” (right) depends on amount of spectrum and the carrier frequencies

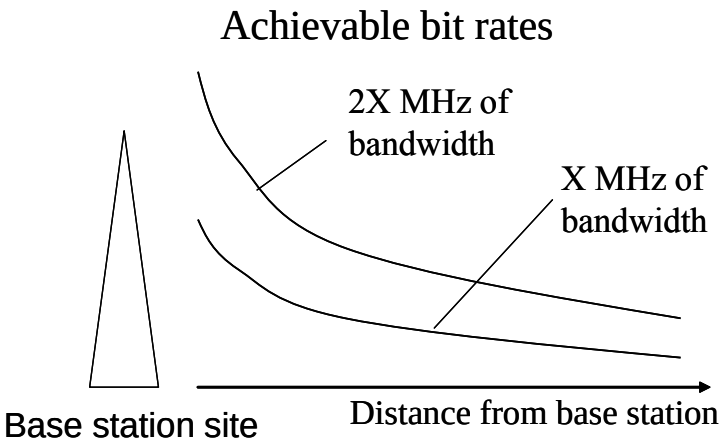
Estimate the value of spectrum

- **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

Approach - technical

- Coverage = π * cell range^2
- Capacity = Bandwidths (MHz) * number of sites * sectors * spectrum
- Bit rate = MHz * spectrum efficiency
- Busy hour = 12.5%





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)

License exempt - unlicensed

- PTS Regulation on license exempt (PTSFS:2007.4) on the 2.4 GHz and 5.3 GHz band for 'short-range device' (ISM), radio transmitters which provide either unidirectional or bidirectional communication and which transmit over a short distance at low power (WiFi)
- 2400-2483.5 MHz, maximum 100 mW e.i.r.p
- 5150-5250, 5250-5350 MHz, maximum 200 mW e.i.r.p

Source: 2006/771/EG – Commission decision of 9 November 2006 on harmonization of the radio spectrum for use by short-range devices (source: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:312:0066:0070:EN:PDF

Conclusions

- Spectrum is a vital and scarce resource making allocation decisions to key events
- Market mechanism in allocation but yet no spectrum trading
- The license exempt for WiFi underscores that allocation mechanism should be combined
- Exclusively allocated harmonized spectrum is set to be the main principle to allocation…