Mobile Infrastructure Sharing

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Original presentation in Zanzibar Workshop,
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Sources of this presentation

1. Promoting site-sharing in Ministry of Communications, Israel
2. Engineering analysis in ATDI for site-sharing in Singapore
3. Owner of a site shared by 2 operators in one mast

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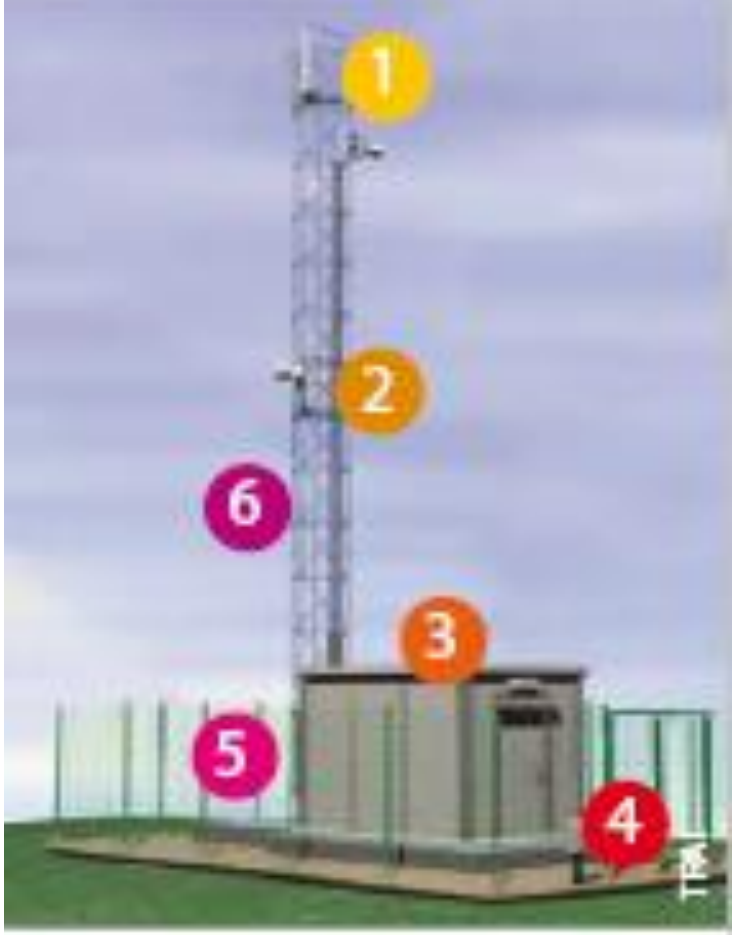
1. Definitions of infrastructure
2. Passive sharing: site and mast sharing
3. Active sharing: RAN and core sharing
4. Implementing nation-wide Mission Critical Communications networks, competition concerns



1. Antenna or antennas
2. Feeder or feeders
3. Shelter and support cabinet
4. Transmission equipment
5. Real estate
6. Mast

ITU Sharing Infrastructure
ITU news magazine

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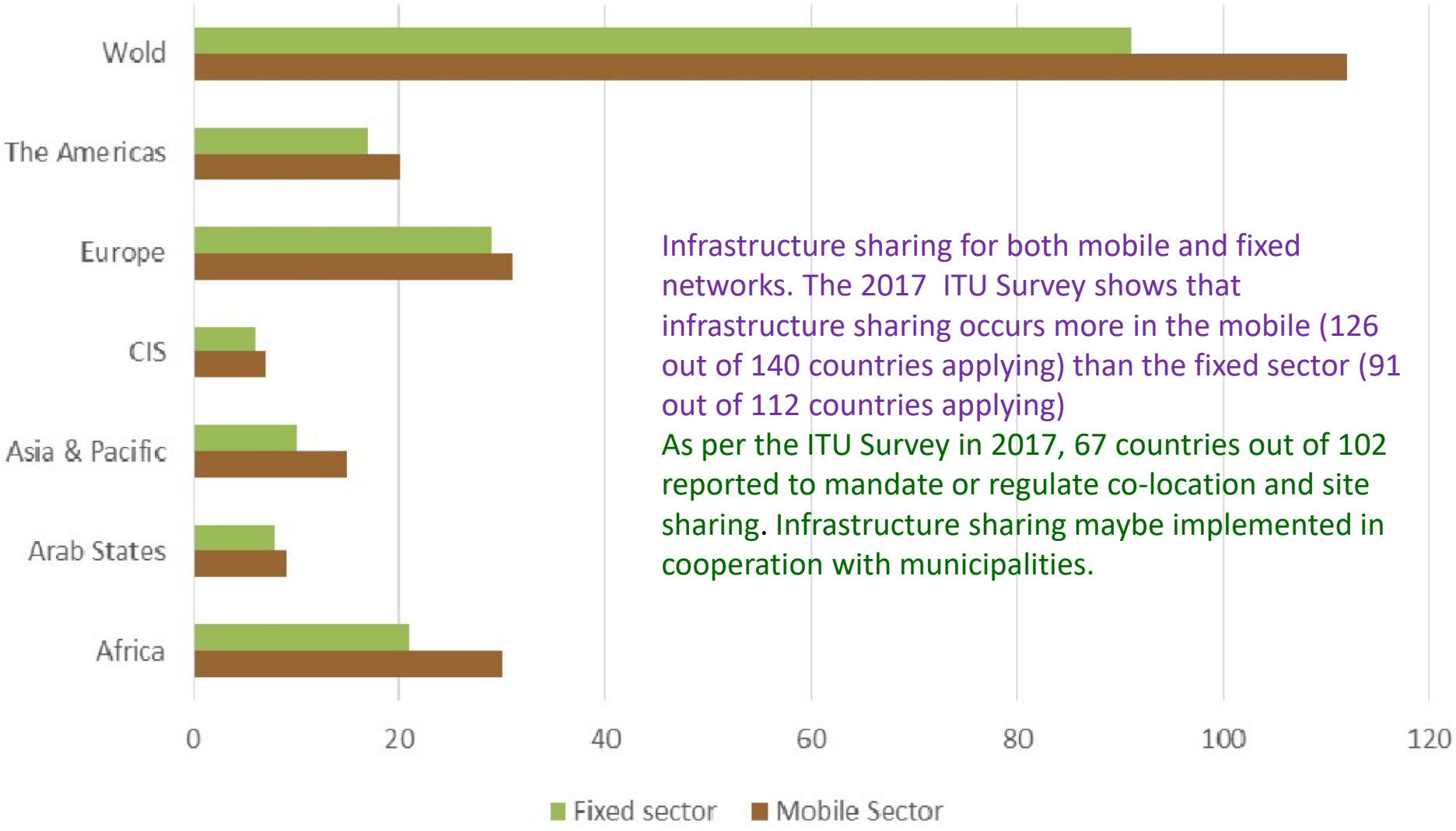
Possible methods of sharing guided for high capacity networks

1. Passive infrastructure sharing (PIS)
2. Active infrastructure sharing (AIS)
3. Spectrum sharing in the AIS model

All about Infrastructure Sharing ITU-D 2018



Infrastructure sharing for both mobile and fixed networks. The 2017 ITU Survey shows that infrastructure sharing occurs more in the mobile (126 out of 140 countries applying) than the fixed sector (91 out of 112 countries applying)

As per the ITU Survey in 2017, 67 countries out of 102 reported to mandate or regulate co-location and site sharing. Infrastructure sharing maybe implemented in cooperation with municipalities.

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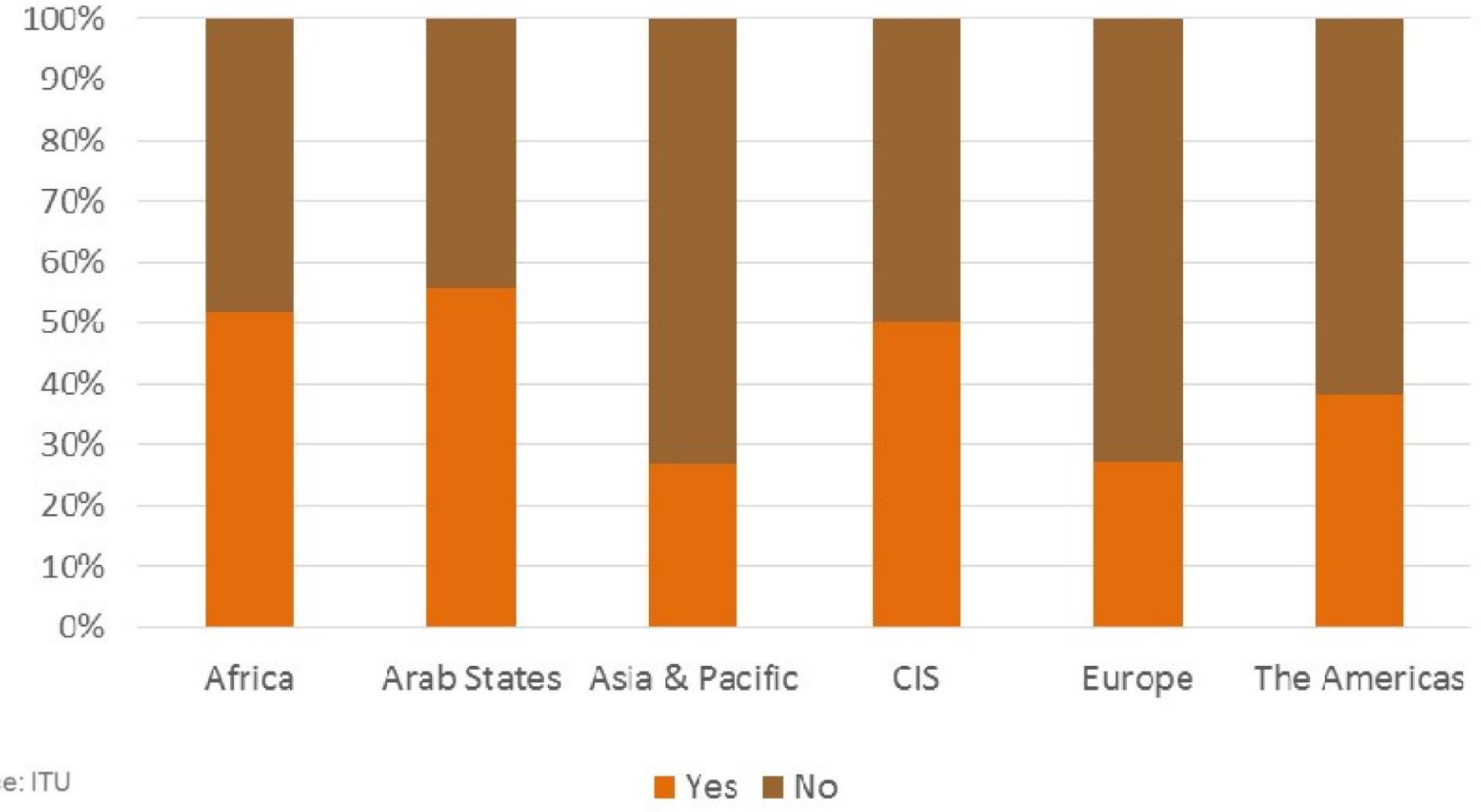
National Roaming and co-location? Infrastructure Sharing 2018

National roaming, which refers to the ability to connect from one mobile operator to another in the same country, continue to be implemented in all regions.

Countries mandating sharing for national-roaming



Source: ITU

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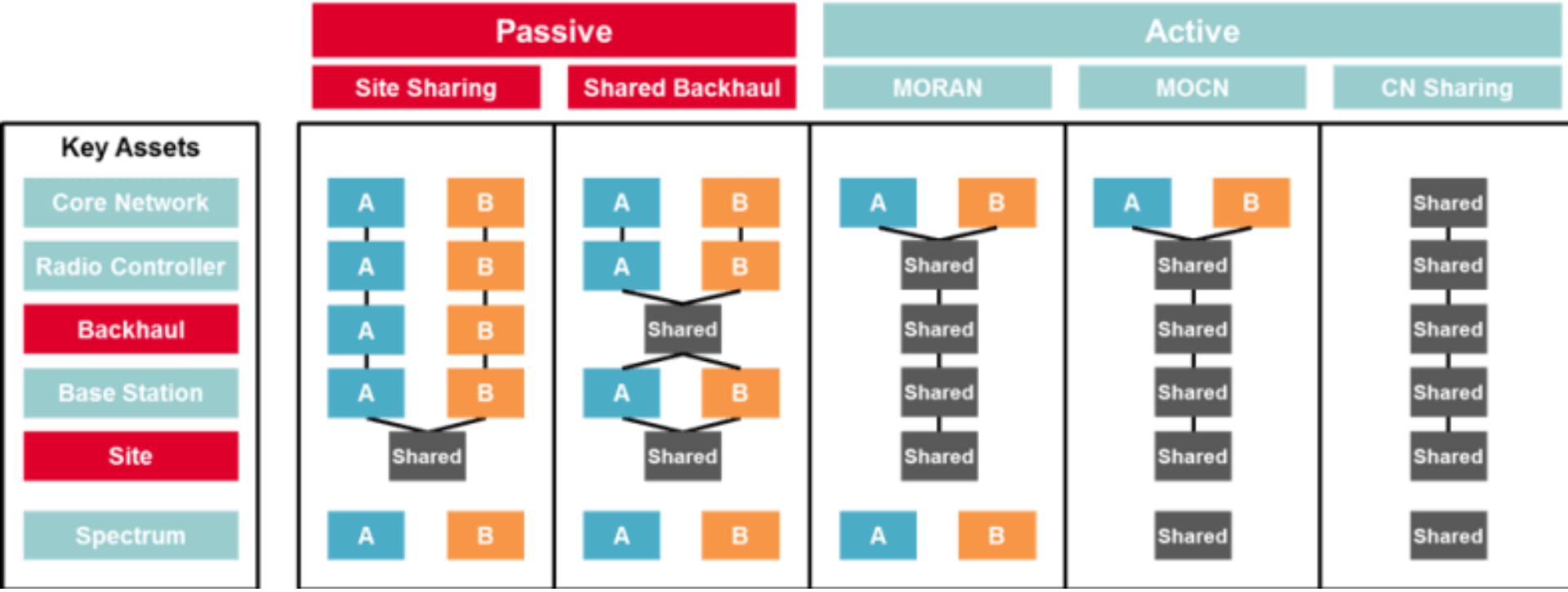
1. Proliferation of sites overgrows the environmental footprint, increases operators' expenses and delays the time-to-revenue.
2. Convergence of wireless infrastructure (like intra-country roaming agreements among operators and roaming between neighbor countries) decreases the number of antenna masts and human exposure
3. Sharing and co-location may include network, planning, base stations and RF spectrum
4. Passive sharing comprises common site, generator, air-conditioning, mast and antenna
5. Active sharing, operators may share equipment and RF. The problem is that more sharing may decrease competition. The deals of radio access network (RAN) sharing always face challenges in terms of ensuring differentiation and **competition** between different carriers' services

1. Infrastructure sharing leads to faster and wider roll-out of coverage into new and currently underserved geographical areas
2. Active sharing of the frequencies optimizes the use of the RF spectrum; active hardware: Tx, Ant, RF, switching, BTS, routers and the like)
3. Debate between many small cells and mast sharing, and its impact on radiation hazards.
4. If regulators increase the channel bandwidth of operators , the number of urban sites may decrease; thus, additional RF versus fewer antennas; see Mazar' *9.6.3 Test to Quantify RF Versus Sites; Shannon*
5. Infrastructure sharing is usually part of the telecommunicatons regulatory environment

1. Sharing avoids duplication of long-term investment
2. Sharing shouldn't harm competition
3. Infrastructure sharing is usually part of the telecommunicatons regulatory environment
4. Countries (Canada, UK, Israel…) oblige infrastructure sharing
5. Sharing shouldn't harm competition

Technical classification of infrastructure sharing; GSMA



Business/ownership classification of infrastructure sharing, GSMA

Unilateral Service Provisioning

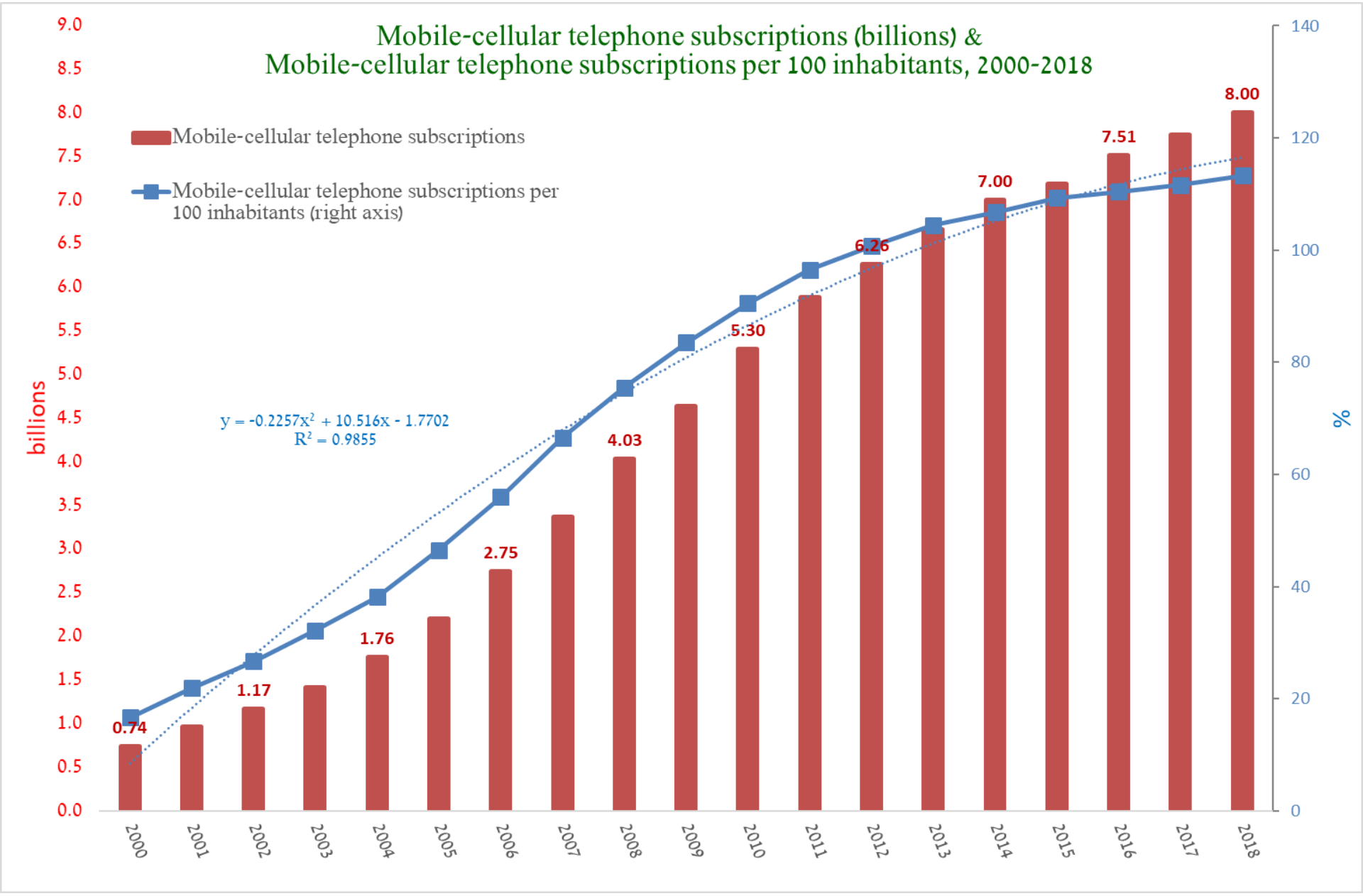
Mutual Service Provisioning

Joint Venture

3rd Party Service Provider

ITU-D Indicators

1. The 24rd Edition, Dec 2019 indicates that in 2018 there were 8 billion subscribers
2. Based on China and India data (millions of base stations), in average, roughly every 1,000 subscribers need one cellular mast,; see See H. Mazar, *Radio Spectrum Management: Policies, Regulations, Standards and Techniques*, Chichester, West Sussex: John Wiley & Sons, Ltd., 2016; Chapter 9 Section 9.6.2
3. So, there are more than 8 million base stations around the world


Mobile-cellular telephone subscriptions (billions) &
Mobile-cellular telephone subscriptions per 100 inhabitants, 2000-2018
Mobile-cellular telephone subscriptions
Mobile-cellular telephone subscriptions per 100 inhabitants (right axis)
billions
%
y = -0.2257x² + 10.516x - 1.7702
R² = 0.9855
0.74
1.17
1.76
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5.30
6.26
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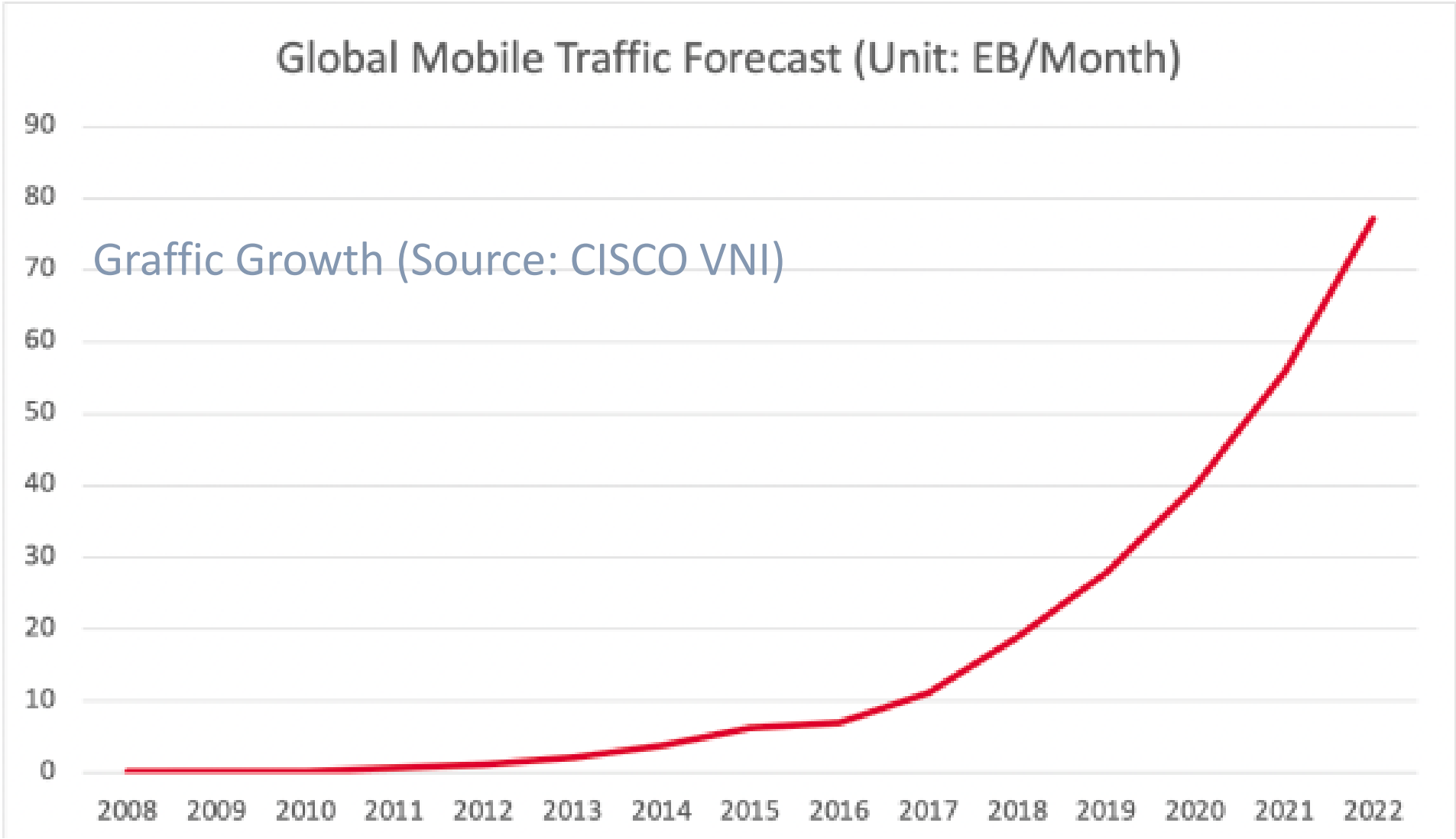


Graffic Growth (Source: CISCO VNI)

Benefits of infrastructure sharing- economic benefits

1. No duplication of hardware
2. Economies of scale for providers and users
3. Reduced investment costs for operators and expected lower prices paid by consumers
4. Easier access to costly resources for new or small-operators
5. Reduced cost and risk of deployment

Model of shared use	Savings of operators
PIS	Up to 30%
AIS	Up to 50%
Spectrum sharing in AIS	Up to 10%

Benefits of infrastructure sharing- better service & competition

1. Faster rollout and wider reach, especially in less densely populated areas
2. Fewer interconnection disputes between operators because they are forced to cooperate
3. Access to scarce resources for new or small operators
4. Improved services
5. Lower barriers to competition
6. Also disadvantages: may harm competition; operators may match prices and services

Benefits of infrastructure sharing- environnemental

1. Preservation of open spaces
2. Green impact of mobile infrastructure on landscape
3. Less proliferation of base-stations; people dislike cellular masts near them; sharing infrastructure reduces the number of sites
4. Saves energy and carbon; footprint of mobile networks
5. Reduction in nuisance factors associated with civil engineering work (noise, degradation of public roads, obstacles to road traffic, accidents, etc.)
6. Urban planning and Aesthetics
7. Reduced RF hazards: not near the shared base station, but in general

Disadvantages of site-sharing

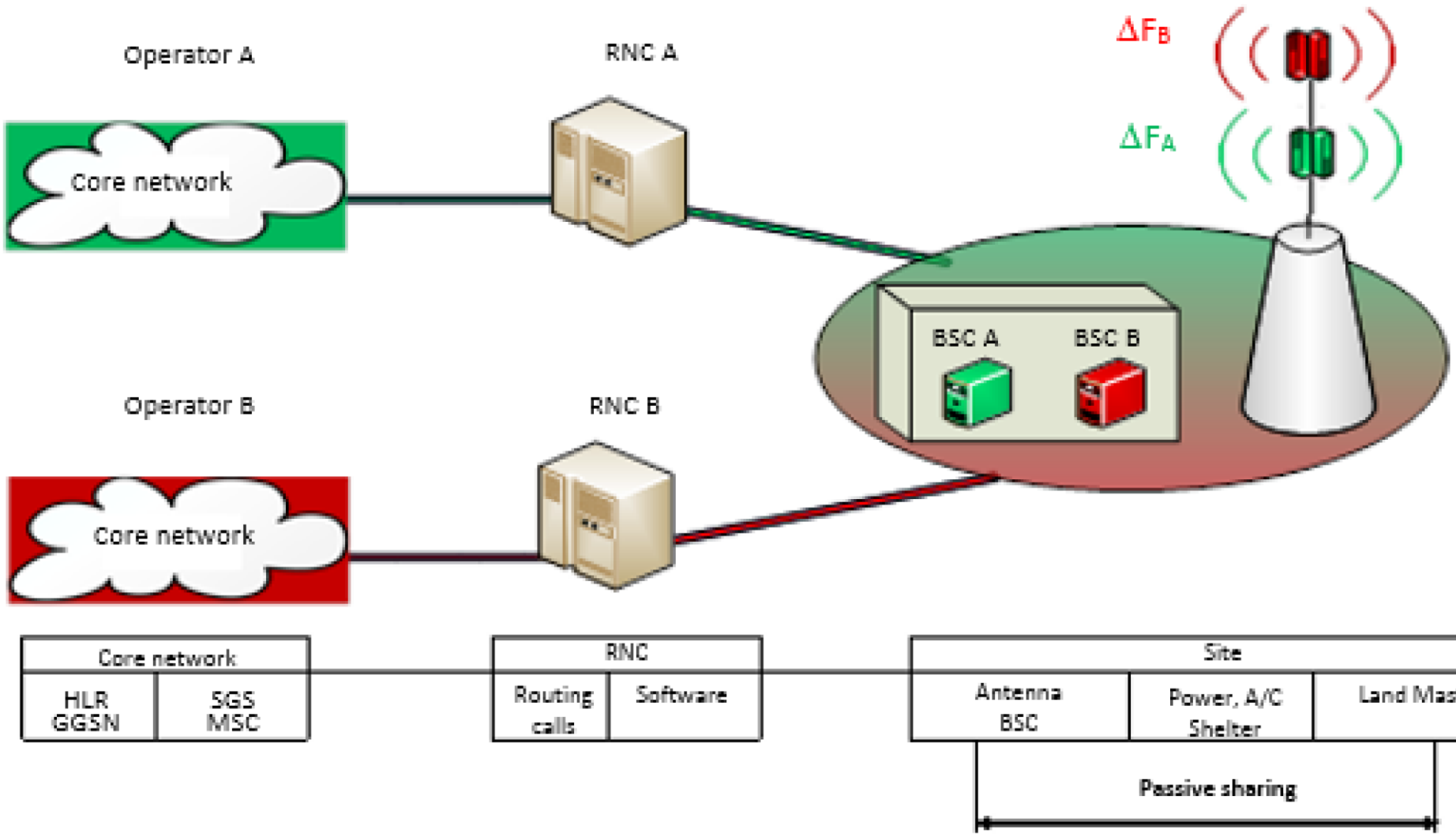
1. Increased EMF around the shared site
2. EMC problems among RF Transmitters & receivers
3. May affect negatively competition

Passive infrastructure

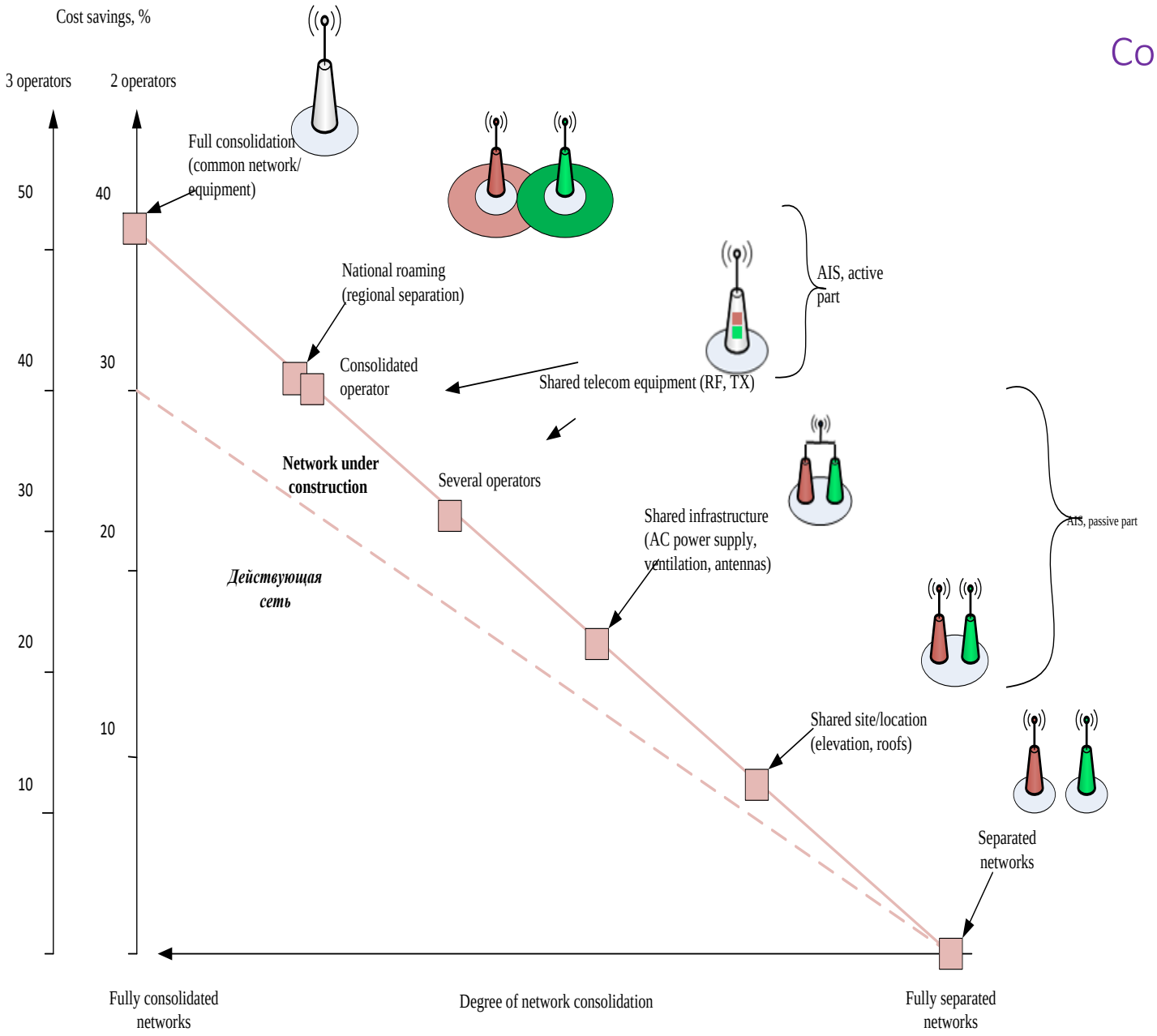
1. Not only with other Operators, with TV
2. sharing the non-electrical, civil engineering elements of base stations
3. (i) rights of way or easements, (ii) ducts, (iii) pylons, (iv) masts, (v) trenches, (vi) towers and poles, (vii) equipment rooms and associated power supplies, air conditioning and security systems
4. Passive elements are the physical network components that are not necessarily owned or managed by every operator
5. The passive infrastructure in a mobile network is composed mainly of: electrical or fibre-optc cables, masts and pylons, plots of land, towers, roof tops and other premises, shelter and support cabinets, electrical power supply, air conditoning, alarm systems
6. The regulator will need to (i) recommend the deployment of an open architecture, as opposed to an integrated vertical architecture; (ii) have a geographical informaton system (GIS) to determine the location and ownership of equipment to be shared; (iii) define certain infrastructure elements as essental; (iv) where appropriate, enforce operational separation of the body responsible for commercializing any sharing arrangements
7. Some countries, such as DRC and Côte d'Ivoire, provide for infrastructure sharing between operators in the sector, but also the possibility for a non-operator to make infrastructure available to operators, as is the case with TowerCo
8. Administrations follow has yet to be made clear in most of the regulations

Typical Passive model; Figure 10, Resolution 9

Figure 10: Typical PIS model



Cost savings depending network sharing, Resolution 9



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Active infrastructure; sharing active electronic network elements

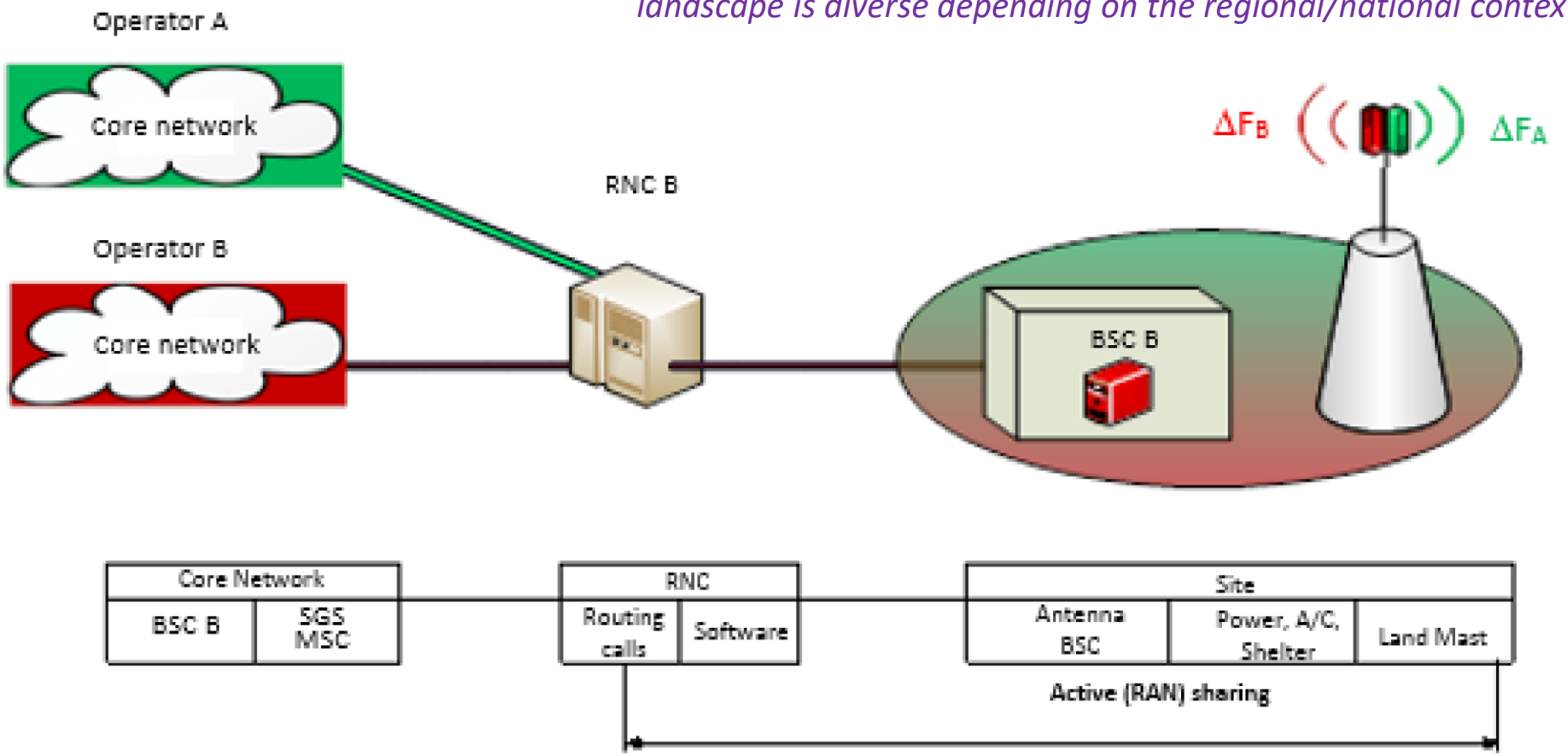
Efficient use of spectrum and network assets

1. Base stations and other equipment for mobile networks
2. Access node switches
3. Fibre-optic networks
4. Hardware active: Tx, Rx, Ant. Equipment of cellular and fixed wireless access
5. RF spectrum of cellular and fixed wireless access
6. Active infrastructure may affect competition
7. Some countries, like the Democratc Republic of the Congo (DRC), adopt the precautionary approach, and active infrastructure sharing is introduced gradually

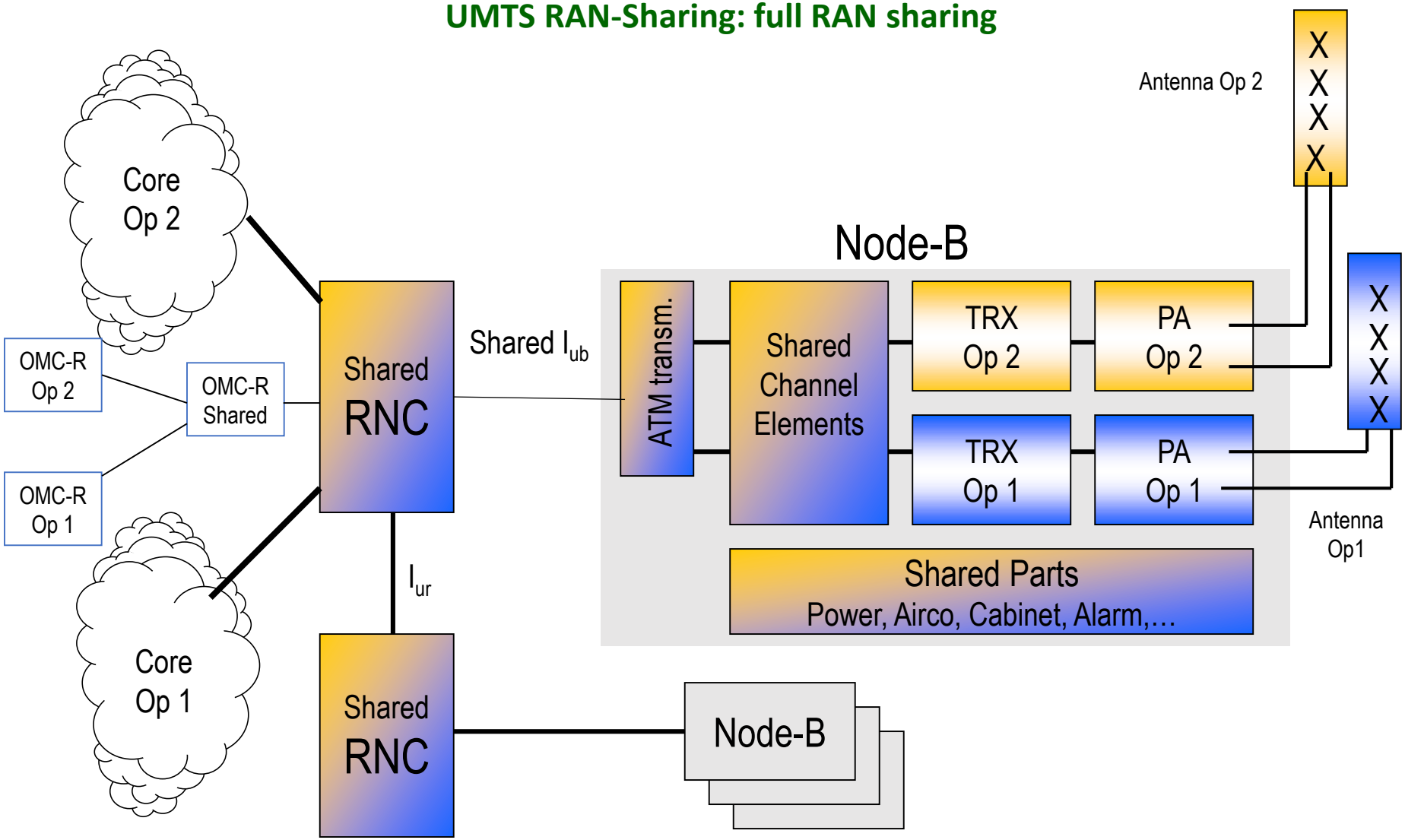
Typical Active Model; Figure 11, Resolution 9

Figure 11: Typical AIS model

spectrum sharing or use of unlicensed spectrum as the regulatory landscape is diverse depending on the regional/national context.



UMTS RAN-Sharing: full RAN sharing



Regional Initiatives- Africa

1. The West African ICT Common Market set guidelines adopted by WATRA (the West Africa Telecommunicatons Regulators' Association) Accra, September 2005
2. The eighth Forum on Telecommunicatons/ICT Regulaton in Africa (FTRA-2007), Nairobi 6/7 June 2007, highlighted the OpItcal Power Ground Wire (OPGW), implemented jointly by the incumbent operators of Mali, Mauritania and Senegal in partnership with the Société de Geston de l'Énergie de Manantali (SOGEM), as a good example of sharing

Network sharing can lower costs and risks for operators & **bring significant benefits** in terms of rollout speed, network coverage & service quality

1. In the European regulatory framework, **obligations to share infrastructure can be imposed only under strict conditions**, in order to address specific market failures or public interest objectives
2. **Voluntary sharing agreements**, both in fixed and mobile networks are **promoted and incentivised**, while providing for appropriate pro-competitive safeguards
3. All agreements continue to be subject to **ex-post competition law** – but there is significant scope for pro-competitive sharing

Better connectivity; BEREC Common Position on Mobile Infrastructure Sharing Mission Critical Communications networks

1. Service improvements in terms of coverage (digital land development) or quality of service (throughput, service continuity or other **mission-critical performance parameters** such as low latency and reliability, e.g. needed for connected and automated driving along highways)
2. Facilitate the development of IoT, machine type communication, network slicing for the next generation networks, management of legacy technology or services with a long lifecycle (such as GSM-based machine-type communications, including access to e-Call for cars), etc.
3. Reduction of cost of deployment for passive infrastructure of high speed electronic communications network (also in line with the broadband cost reduction directive)

Main Findings

1. Development of telecommunications network infrastructure and increasing penetration of broadband to bridge the digital divide
2. Infrastructure and spectrum sharing contribute to attain these objectives by providing opportunities to decrease operators' costs and increasing efficiencies
3. Getting sustainable investment, increasing network deployment, facilitating new services, increasing the competition and reducing telecommunication services tariffs for end users

Promotion of infrastructure and spectrum sharing

1. In mobile networks, infrastructure sharing is mostly based on Commercial agreements rather than on a specific regulatory mandate.
2. Member States may promote infrastructure, enabling regulatory framework tailored to market requirements , to :

I. Establish the basic commercial, technical, legal and economic forms and procedures for infrastructure and spectrum sharing along with the obligations and rights of operators
II. Foster sharing negotiations between operators
III. Apply appropriate dispute resolution mechanisms

Guidelines on infrastructure sharing

1. PRIDA may recommend that the guidelines, already proposed at the level of sub regional regulatory authorities and international forums (such as GSR) maybe implemented to take full advantage of the benefits of infrastructure sharing.
2. Governments and regulators may guide operators, through regulation or public investment, encouraging infrastructure sharing to optimize costs and accelerate network deployment, above all with regard to broadband.

Abbreviations

1. AIS Active infrastructure sharing
2. BTS Base transceiver station
3. CAPEX Capital expenditures
4. LTE Long-Term Evolution; 5G; IMT
5. OPEX Operating expenditures
6. PIS Passive infrastructure sharing
7. RAN Radio Access Network
8. RNC Radio Network Controller
9. UMTS Universal Mobile Telecommunications System

Relevant Material from Dr. Haim Mazar presentations (1); see http://mazar.atwebpages.com/Downloads

1. Academic_Course_Advanced_Wireless_Communications_Mazar1_Engineering_2020.pdf
2. Academic_Course_Advanced_wireless_communications_Mazar2_Services_2020.pdf
3. Academic_Course_Advanced_Wireless_Communications_Mazar3_Regulation_EMC_HumanHazards_2020.pdf
4. Cameroon_EconomicModels_African_RF_Spectrum23Aug19French.pdf
5. Cameroon_Yaounde_Commonwealth_SM Forum_Mazar_Nov16_Spectrum re-farming.pdf
6. CamerounCellulaires_affectation_bande_470 694_21Dec18_French.pdf
7. CamerounSolutions_techniquesDTTV_MPT_UHF_21Dec2018_French.pdf
8. China_Beijing_SRMC 9July15_National Spectrum Control.pdf
9. China_Beijing_SRMC 9July15_SRD.pdf
10. China_Chengdu_National Spectrum Control Xihua University.pdf
11. Delft_Univ_Cultural_Factors_Shaping_RF_Spectrum_Governance_24Sept2010_Mazar.pdf
12. European vs North American Wireless Regulations_Mazar_ITU world telecom 2011_2633.pdf
13. Geneva_ITU-RSG1SG5-IoT-Workshop_Mazar_22Nov16.pdf
14. Heron5G_RF_regulations_6June19_Mazar.pdf
15. How_Geography_and_Culture_influence_RF_regulation_NZL_case_Wellington_4Feb2010_Mazar.pdf
16. IMT_5G_frequencies_HERON_ATDI_Mazar.pdf
17. ITUD_Gambia_Optimised_Ways_to_Transmit_the_Video_Signals_16July2010_Mazar.pdf
18. ITUD_Gambia_Policies_and_Strategies_to_Optimise_RF_Spectrum_Use_14July2010_Mazar.pdf
19. ITU_regional_SM_conference_connecting_Yerevan13Dec2017.pdf

Relevant Material from Dr. Haim Mazar presentations (2); see http://mazar.atwebpages.com/Downloads

20. ITU_regional_SM_workshop_parameters_Yerevan14Dec2017.pdf
21. ITU_workshop_international_regional_and_national_regulation_of_SRDs_Mazar.pdf
22. International_Regional_National_RF_Regulation_Standardisation_Ruppin_Mazar.pdf
23. International_Regional_National_RF_Spectrum_Management_13Dec2011_Afeka_Tel_Aviv_Academic_College_of_Engineering_Mazar.pdf
24. January 2016_National Spectrum Control_China@SRTC&XHU.pdf
25. January 2016_SRD_Mazar_SNG&SRTC&XHY&GDRTC.pdf
26. Lusaka_ZICTA_Auctioning_Training_30Sept-4Oct19_Mazar.pdf
27. Paper WT11 Technical Symposium TS11 Haim Mazar_A Comparison between European and North American Wireless Regulations.pdf
28. Presentation WT11 Technical Symposium TS11 Haim Mazar_A Comparison between European and North American Wireless Regulations.pdf
29. Regulating_SRD_Israel_MoC_28Jan2019_Mazar.pdf
30. Regulation of SRDs_Mazar_TCBC_Baltimore_15April2015.pdf
31. Regulation_and_Standardization_of_Wireless_Communications_Israel_Europe_America_22Dec09_Ort_Braude_College_Mazar.pdf
32. WarsawEMF2019_Mazar_WRC19_5G_IMT2020_ITU4Dec19.pdf
33. Webinar_International_GoGlobal_Haim_Mazar_UHF_RFID_global_and_regional_ruling_19Feb13.pdf
34. Wireless_Communications_Coexistence_between_Israel_and_Neighbors_Ashdod_17May2010_Mazar.pdf
35. Wireless_Telecommunications_training_program_Nepal_Kathmandu_24_28Nov08_Mazar.pdf
36. ZICTA_CEPT&UK_9Jan17_Mazar.pdf
37. ZambiaZICTA_PricingModel19April2017Mazar.pdf
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