Wholesale Open Access Network (WOAN) Project

Final report presentation

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Introduction and Background

- The National Intergrated ICT Policy White Paper of 2016 introduced a policy position on how “high demand spectrum” is to be licensed.
- Key changes brought by this policy are that all “high demand spectrum” will be assigned on an open access basis and all the currently unassigned high demand spectrum will be set aside for assignment to the Wireless Open Access Network (WOAN).
- The policy therefore:
  - Extended the open access principle to wireless networks
  - Introduced the need an open access provider dubbed “WOAN”
  - Designated all spectrum in the three currently unassigned mobile broadband spectrum bands to WOAN
- Following extensive engagements between DTPS and the relevant industrial players on the implementation of this policy, the department, with support of the industry, commissioned a study to determine and ascertain the coverage and capacity spectrum that will be needed by the WOAN.

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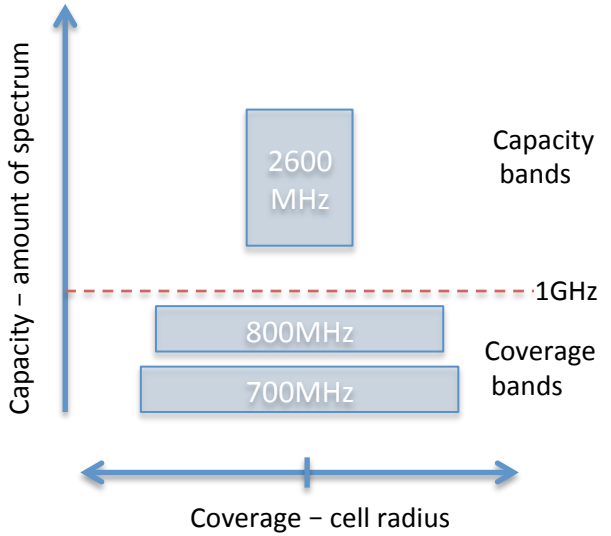
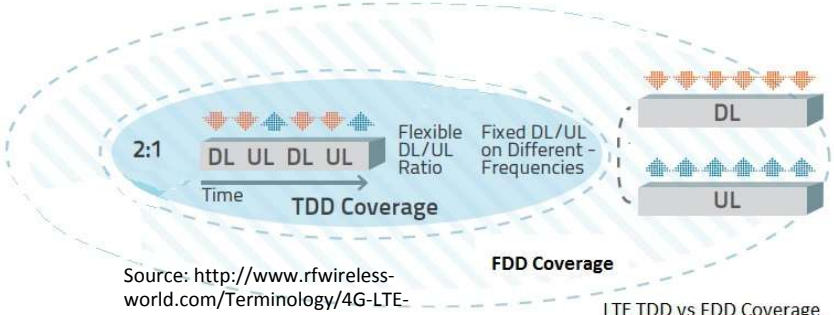
Key definitions – in the context of the National Integrated ICT policy

- Open Access in a network context refers to a scenario where "*wholesale access is provided to electronic communications network infrastructure or services on terms that are reasonable, effective, transparent and non-discriminatory*".
- High demand spectrum refers to spectrum where demand for access to the radio spectrum resource exceeds supply, or radio spectrum is fully assigned. All IMT spectrum is classified as high demand.
- Currently unassigned high demand spectrum in the context of the study refers to spectrum in the:
  - 700 MHz band
  - 800 MHz band and
  - 2600 MHz band

Other important terms used in the study

- Coverage spectrum or low band spectrum – The two terms are used interchangeably to refer to spectrum in the 700MHz and 800MHz band
- Capacity sectrum or high band spectrum - The two terms are used interchangeably to refer to spectrum in the 2600MHz band
- FDD - is implemented on a paired spectrum where downlink and uplink transmissions are sent on separate frequencies.
- TDD - is implemented on an unpaired spectrum, implying the usage of only one frequency for both downlink and uplink transmissions.





Source: http://www.rfwireless-world.com/Terminology/4G-LTE-Coverage-ATT-and-T-Mobile.html

LTE TDD vs FDD Coverage

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Project Objectives

General objectives

- The objective of the study is to advise the Department of Telecommunications and Postal Services and ICASA on the amount of spectrum required to ensure that the WOAN is viable.

Specific objectives

- Estimate capacity of the WOAN if all the high demand spectrum is assigned to the WOAN [paragraph 2.2.2 of TOR].
- Determine sufficient amount of both coverage and capacity spectrum to meet Quality of Service targets of SA Connect [Modified Paragraph 2.2.3 of TOR to remove viability requirement].
- Determine amount of spectrum after identifying spectrum for WOAN, if any, available for other licensees [Paragraph 2.2.3 of TOR].

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Additional consideration - Key use cases for WOAN

- To achieve rural broadband targets – broadband targets are defined in the SA connect policy, these will be considered when making recommendations.
- Provide lower cost data – consideration will be made on how CAPEX and OPEX for WOAN could be as low as possible to enable low data cost benefit to consumers.
- Ease introduction of new service providers.

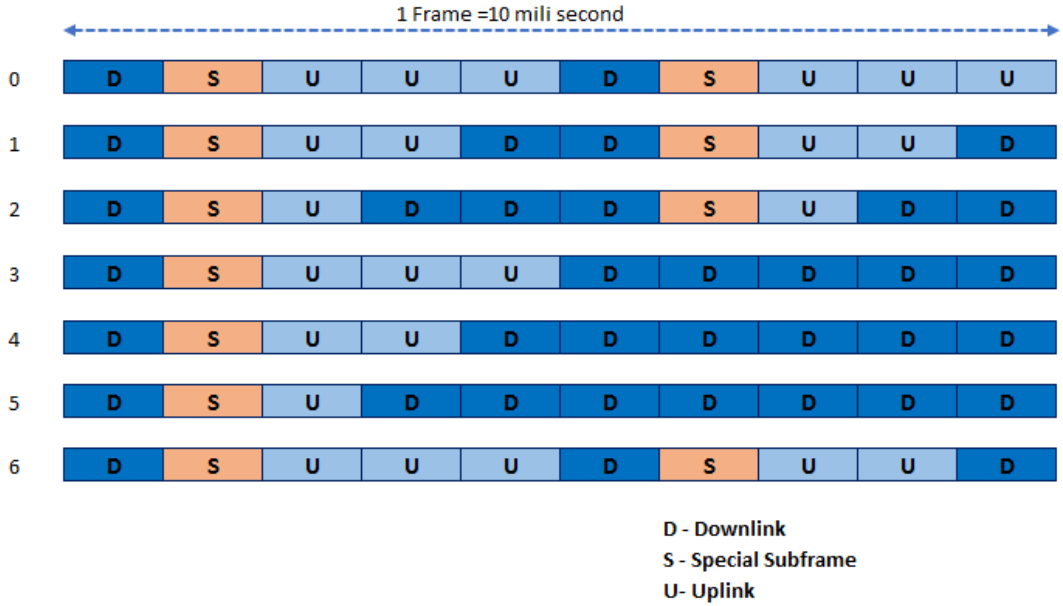
Project Scope

- Data collection, including workshops with stakeholders; operators, regulator, Internet Service providers and equipment vendors
- Modelling spectrum and capacity for WOAN with the following inputs:
  - 2011 Census data with population per demarcated zone (Source: Statistics SA reports)
  - Number of radios (channels), antennas, used at each site (Source: Operators – subject to NDAs with individual operators)
  - Current definition of edge of coverage area (Source: Workshops with industry)
  - Spectral efficiency curves for LTE-advanced now and in the future (Source: Mainly ITU studies)
- Developing recommendations on options for spectrum licensing to WOAN and incumbent operators.

Spectrum bands considered (in scope)

Name of Band	Duplex method	Spectrum range	Amount of spectrum
Band 28 – 700	FDD	703MHz-733MHz & 758-788MHz	2x30Mhz
Band 20 – 800	FDD	796-801MHz & 837-842MHz	2x25Mhz
Band 7 – 2600	FDD	2500-2570MHz & 2620-2690MHz	2x70Mhz
Band 38 - 2600	TDD	2595-2615MHz	25Mhz*

*** LTE TDD configurations**



Out of scope

- The following activities are not included in the study and are out-of-scope
  - A market study to determine possible market share of WOAN.
  - Detailed network planning and optimisation.
  - Consideration of backhaul capacity and spectrum requirements for such is out of scope of this study; it is therefore assumed that there is sufficient backhaul to deliver required capacity to each site.
  - Verification of some of the assumptions, such as projected market share for WOAN.
  - Forecast of Capital Expenditure by the WOAN.

Modelling spectrum and capacity for WOAN

- Assumptions:
  - Build initial model on assumption of access to 3G sites (reality will add additional sites and not use all 3G sites)
  - Build a set of virtual base station sites based on the actual site data from various operators (sites within close proximity treated as single site)
  - Assume base station radio density (using omnis or sectors) is roughly proportional to population density
  - Assume 700 and 800 MHz of WOAN add improved coverage **and** 2600 MHz WOAN adds capacity
  - The traffic distribution will be derived from literature, ITU-R M.2078, ITU-R M.2072, ITU-R M.1768.

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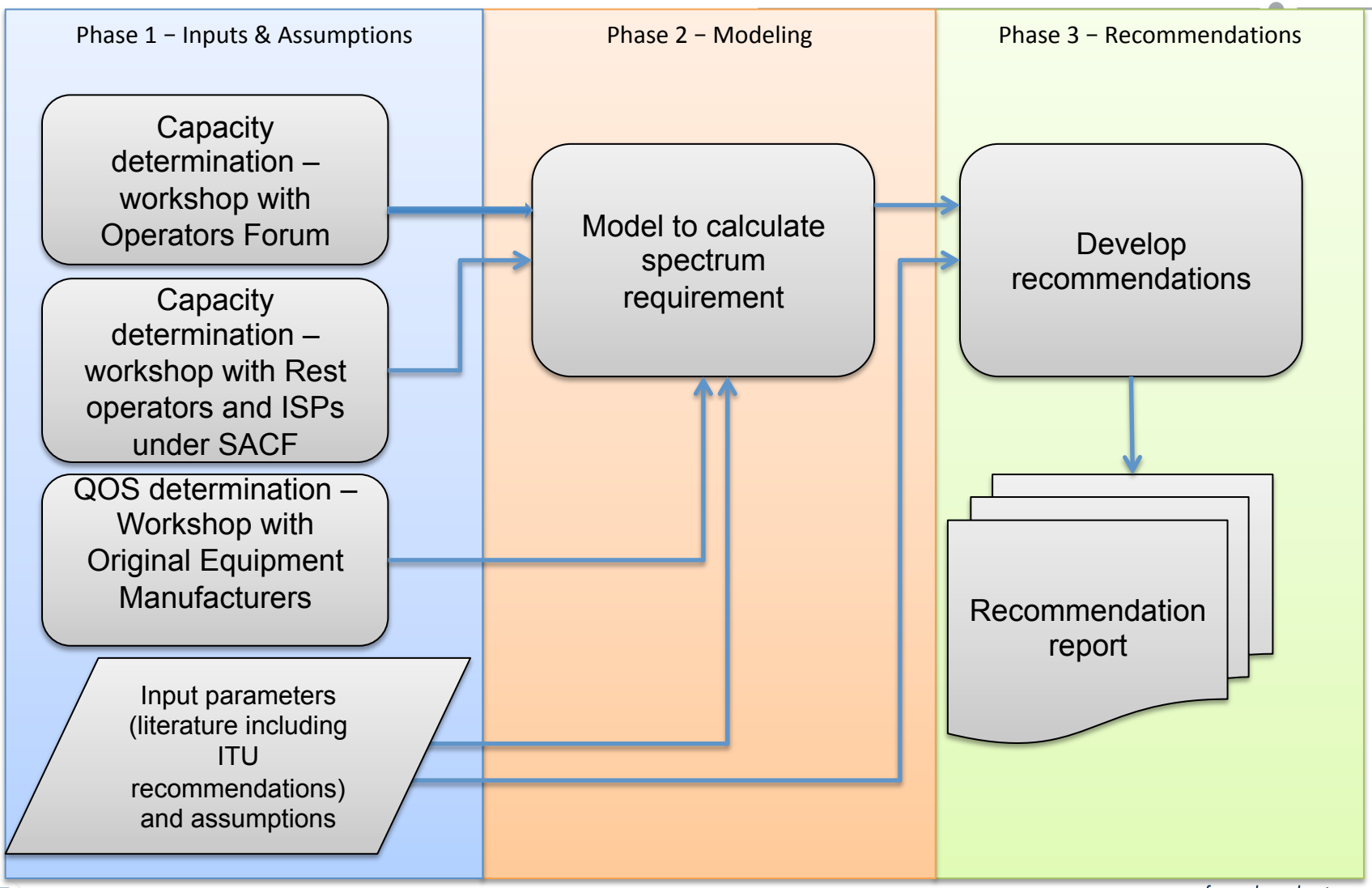
Project Approach



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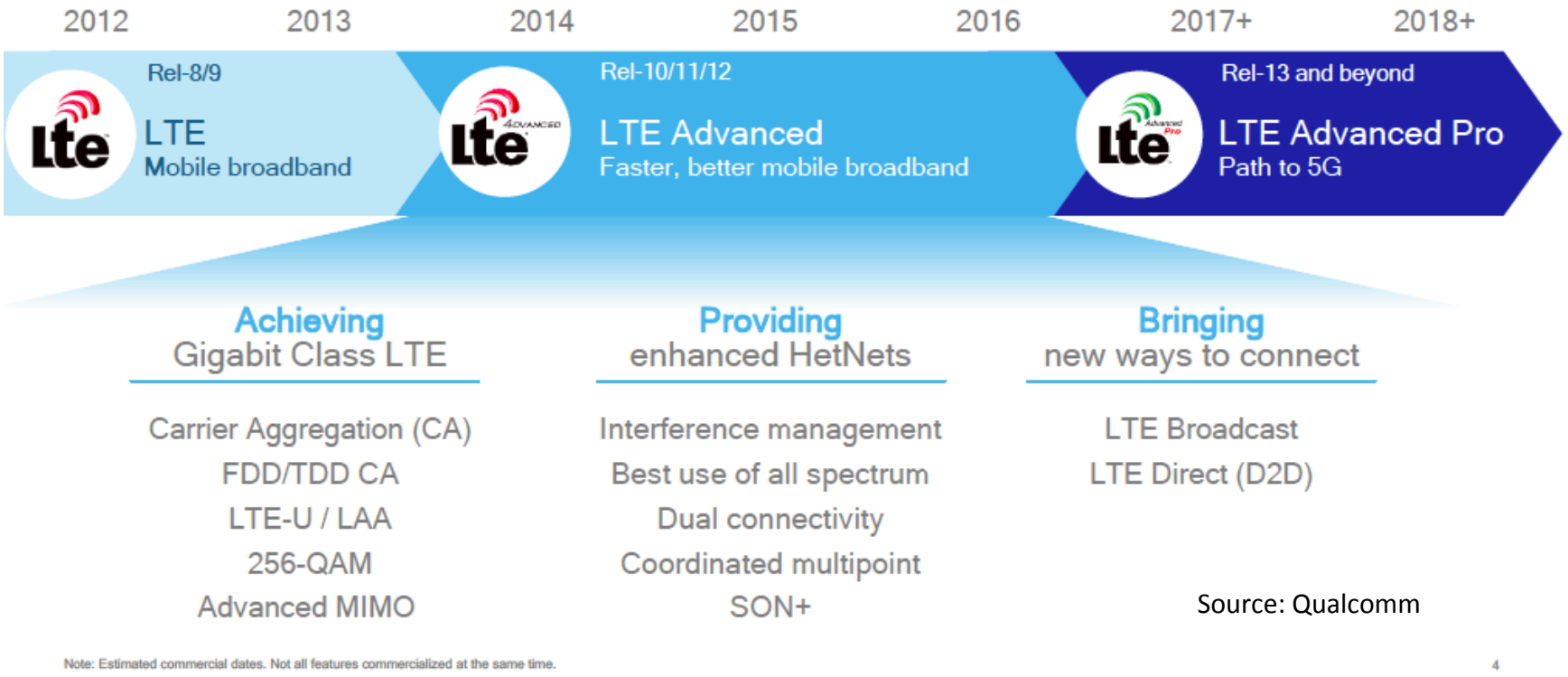
Stakeholder consultation process

1. Capacity definitions
   - Workshop with 6 operators – Operator's forum
   - 1:1 meetings
     - Under NDA: Vodacom, MTN, Multisource (Rain)
     - Other meetings: Smile communications, Telkom, Cell-C, Liquid
   - Workshop with rest of industry under SACF and Black IT forum
   - Detailed site data received from operators
2. Quality of Service
   - Workshop with Vendors; Huawei, Nokia, Ericsson, Intel and Qualcomm – could not establish contact with ZTE
   - 1:1 meetings
     - Nokia and Ericsson
     - Qualcomm
     - Intel could not share most of its information

From the point of view of an operator owning spectrum (used for this study)

- For an operator dimensioning or planning a network or for broadband planning or spectrum studies such as this, **aggregate capacity** in a cell is the most important measure of capacity.
- The **aggregate capacity** is a statistical representation of the sum of the capacities experienced by users randomly distributed across the cell area.
- This aggregate capacity factors in the spectral efficiency of the base station and end used device and is also dependent on the cell area.

LTE Advanced overview



Source: Qualcomm

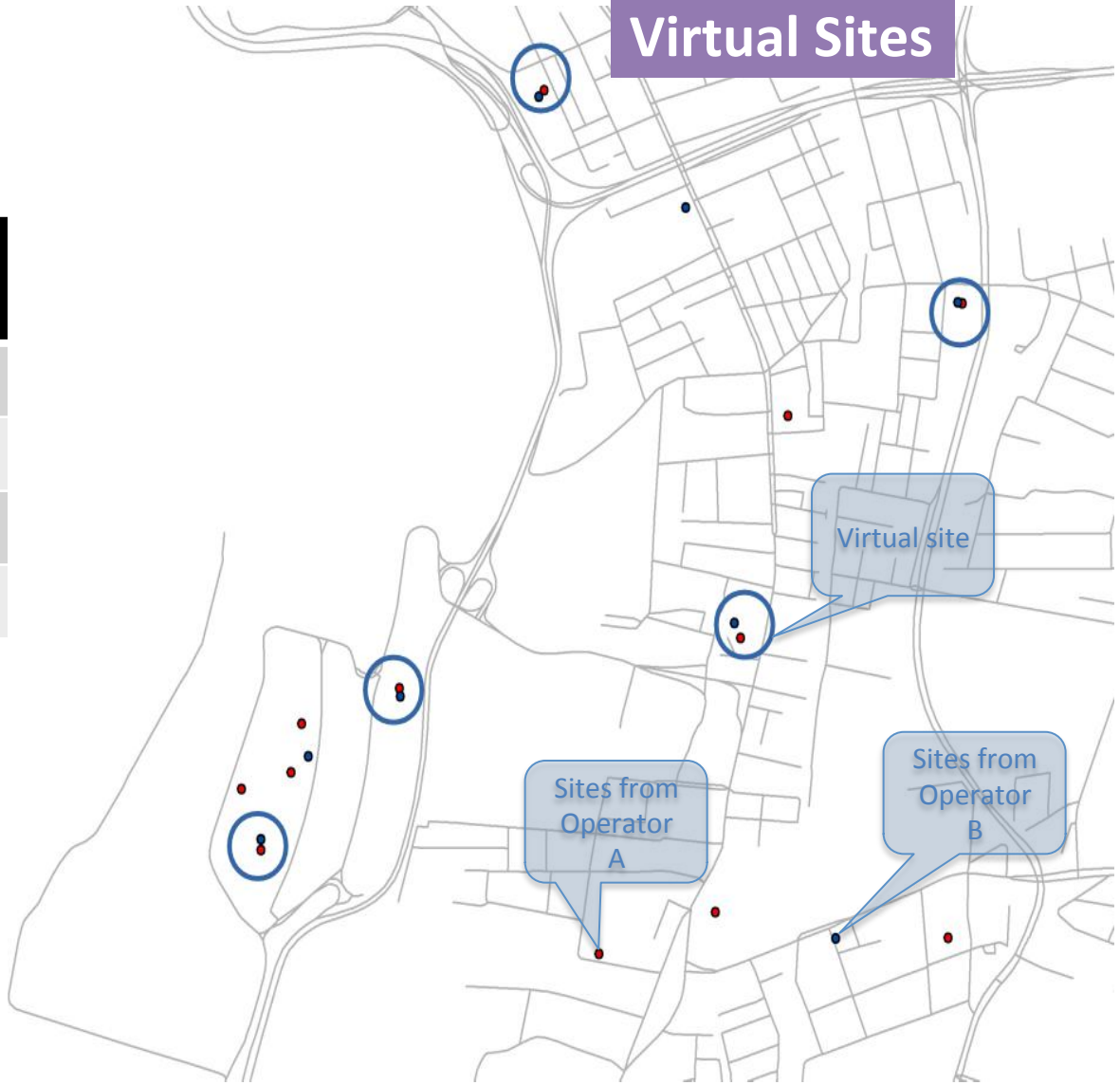
Other key feature considered in the study (not in the figure):
Support for relay nodes

Key parameters – Literature

Spectral efficiency per site class - ITU

Type of Site	Spectral efficiency range
Macro	2 - 4
Micro	2 - 5
Pico	3 - 6
Hot-spot	5 - 10

Virtual Sites



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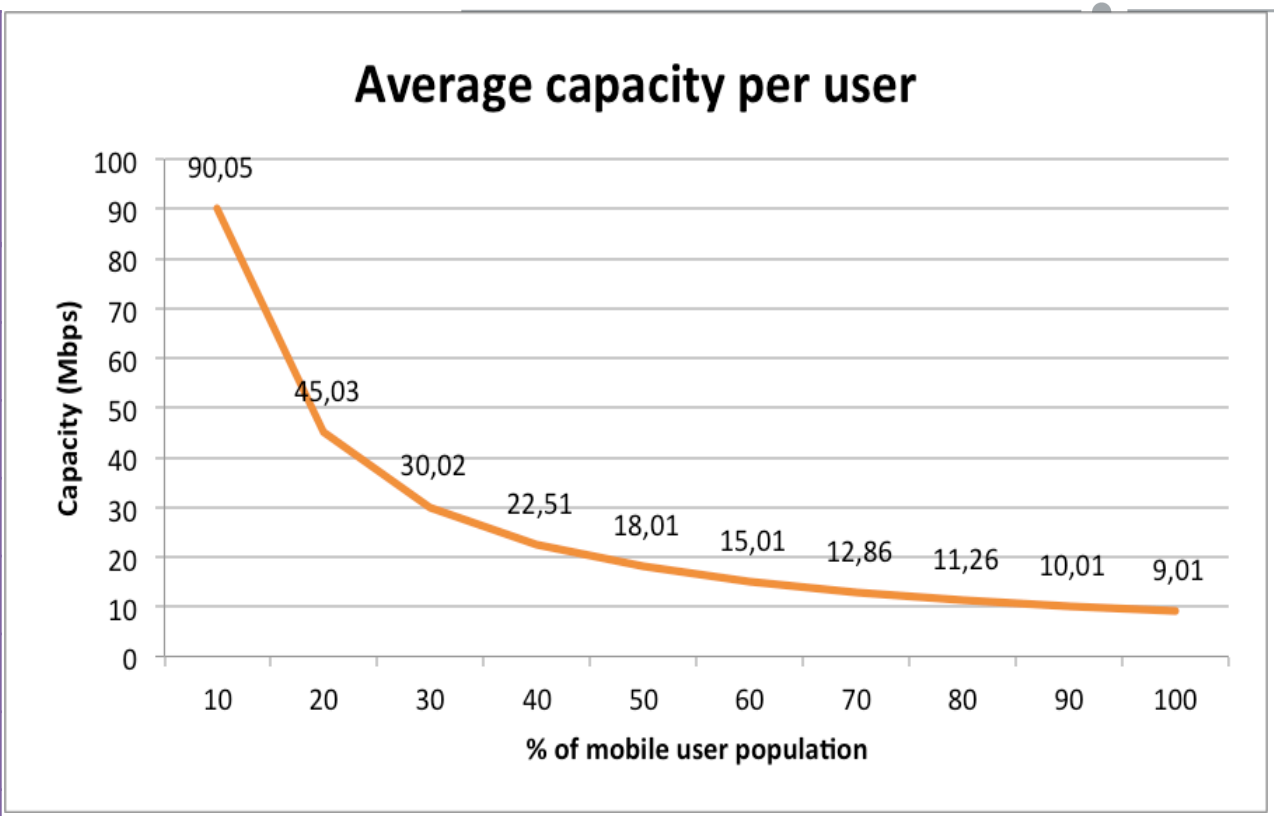
- Recommendations
- Extra slides - Other Important Findings (Not Part of Scope)

Model Parameters derived

Parameter	Value
Average Downlink activity factor	0.025
Busy hour DL activity factor	0.039
Frequency Reuse Factor	1.5
Spectral efficiency macro	3 (bps/Hz/Cell)
Spectral efficiency micro	4 (bps/Hz/Cell)
Spectral efficiency indoor hot spot	7.5 (bps/Hz/Cell)
Number of sectors	3
Number of potential mobile users in 2020	51,238,073

Average capacity per user

WOAN users (%)	Number of Users ('000)	Average capacity per user (Mbps)
10	5 190	**90,05**
20	10 248	**45,03**
30	15 371	**30,02**
40	20 495	**22,51**
50	25 619	**18,01**
60	30 742	**15,01**
70	35 867	**12,86**
80	40 990	**11,26**
90	46 718	**10,01**
100	51 908	**9,01**



Serving 100% of mobile users *implies* that all new users will be served by WOAN **AND** all current mobile data customers would have migrated to WOAN by 2020.

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Challenges to migration of 100% of users

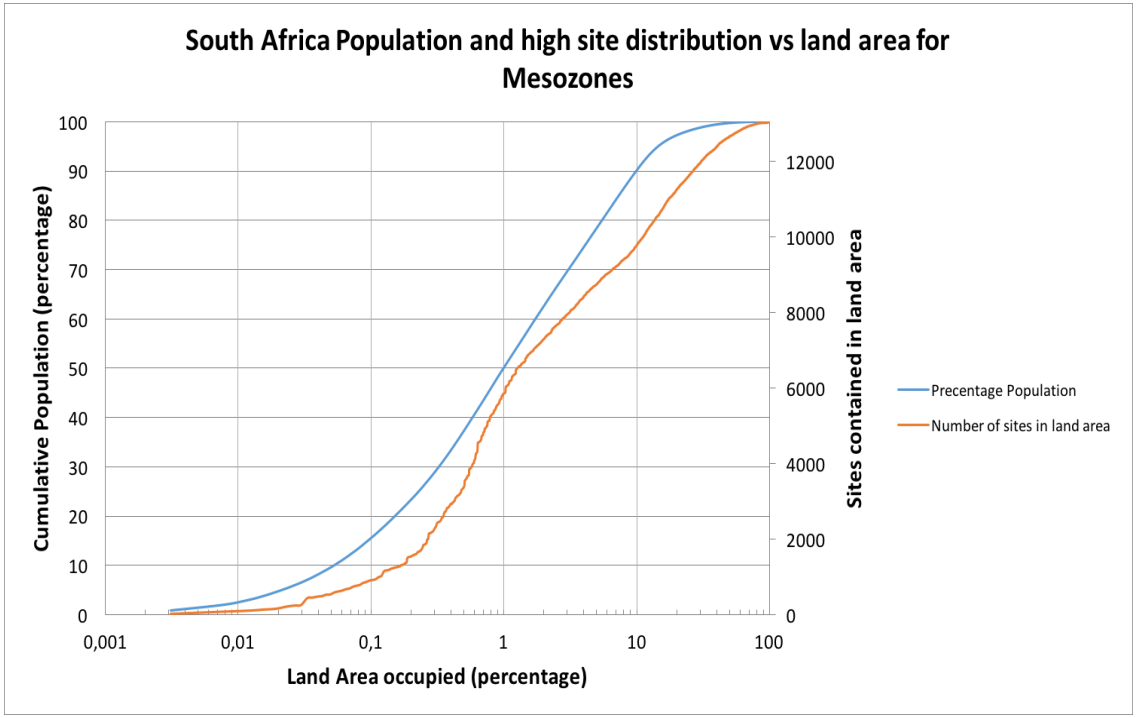
- Studies show that challenger operators** need to ensure four key success factors to take market share:
  - Master the basics
  - Bet on the future
  - Ensure a favorable regulatory context
  - Challenge the strategy

- For WOAN, whose key use cases are; (1) Achieve rural broadband targets, (2) Provide lower cost data and (3) Ease introduction of new service providers, this means
  - Rolling out nationwide network that deliver similar or better quality of service compared to incumbents with a clear roadmap to 5G
  - A strategy to migrate all smaller operators to roam on WOAN, attract all new operators to WOAN
  - Availability of user devices in the bands that are used by WOAN

***challenger operators are late entrant operators which entered into markets with there are two or more incumbents*

Challenges to rolling out nationwide network

- Site and backhaul sharing agreements with incumbents
  - This will fast track roll-out in 10% of land to serve 90% of population.
- To cover the remaining 10% of population, largely new sites need to be built to cover 90% of land.



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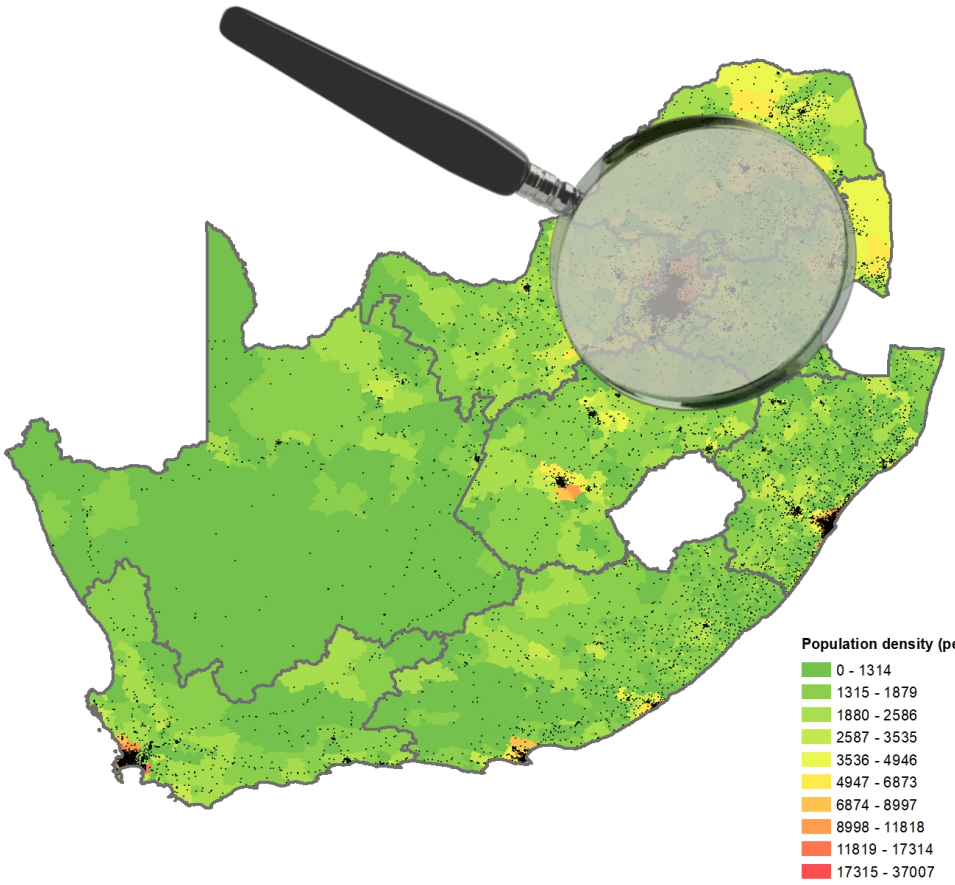
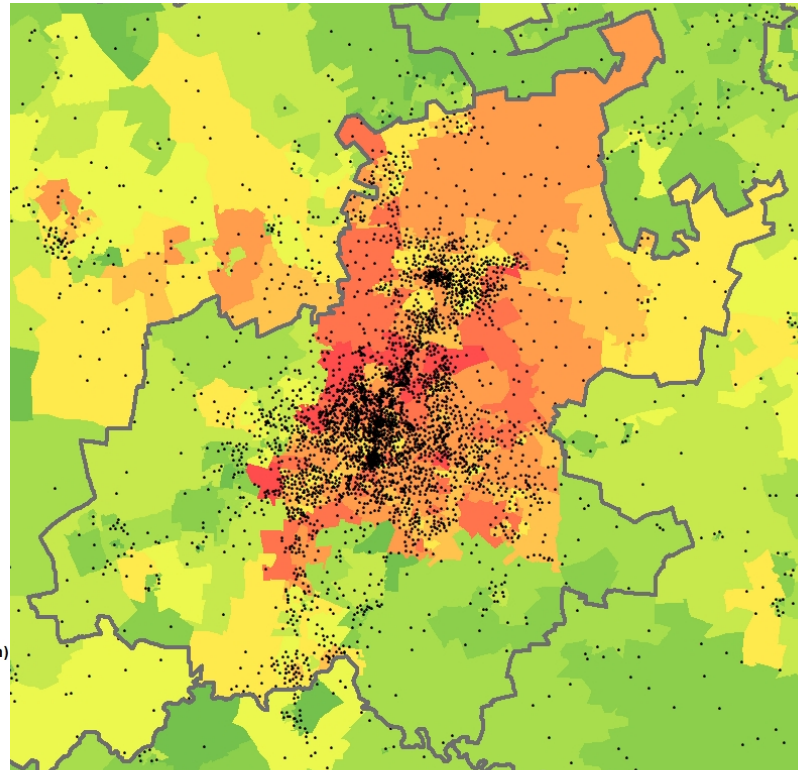
Challenges to rolling out nationwide network





Majority of sites are in the Metros

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Challenge to migrate users to new network

- Incumbent already have latest technology networks (LTE-Advanced)
- Incumbents already have these popular bands:
  - 1800 MHz (Band 3)
  - 2100 MHz (Band 1)
  - 900 MHz (Band 8)
  - 2300 MHz (Band 40)
  - 2600 MHz (Band 38)

LTE FDD	
1800 MHz band 3	5,426 devices
2600 MHz band 7	5,042 devices
2100 MHz band 1	4,364 devices
800 MHz band 20	3,135 devices
800/1800/2600 tri-band	2,983 devices
850 MHz band 5	2,522 devices
AWS band 4	2,310 devices
900 MHz band 8	2,247 devices
1900 MHz band 2	2,067 devices
700 MHz band 17	1,741 devices
700 MHz band 13	877 devices
APT700 band 28	741 devices
700 MHz band 12	654 devices
1900 MHz band 25	393 devices

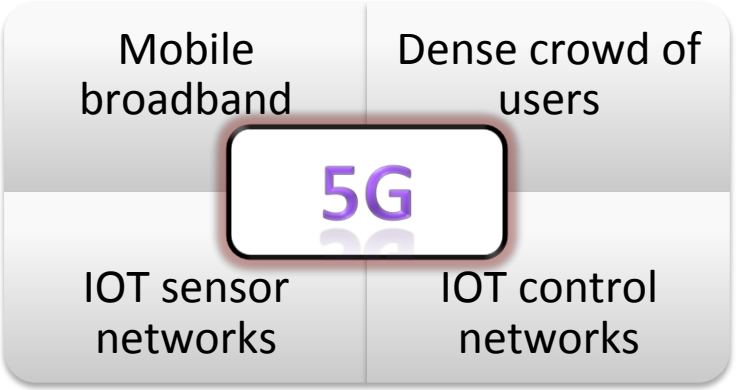
LTE TDD	
2300 MHz band 40	2,608 devices
2600 MHz band 38	2,065 devices
2600 MHz band 41	1,886 devices
1900 MHz band 39	1,558 devices
3500 MHz band 42	130 devices
3600 MHz band 43	98 devices

- There are more user devices in the bands where they have the networks

These numbers have substantially increased since completion of the report in September 2017, however the order in popularity has not changed.

Opportunity for new network

- To stimulate lower cost manufacturing of user devices in the bands in which it operates
- Uptake commitment of 30% by the incumbents
- Policy support for early access to spectrum to build next generation networks, including **Low mobility large cell (LMLC)** configuration for 5G technology



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Summary of observations

- It would not be possible for WOAN to migrate all mobile data customers in the current generation of technology (LTE-Advanced)
- A percentage of target users need to be determined; studies show that an operator needs at least 15% to be viable
- WOAN has an opportunity and policy support to drive the adoption of upcoming 5G technology
- WOAN has an opportunity to drive manufacturing of affordable devices in its bands of operation

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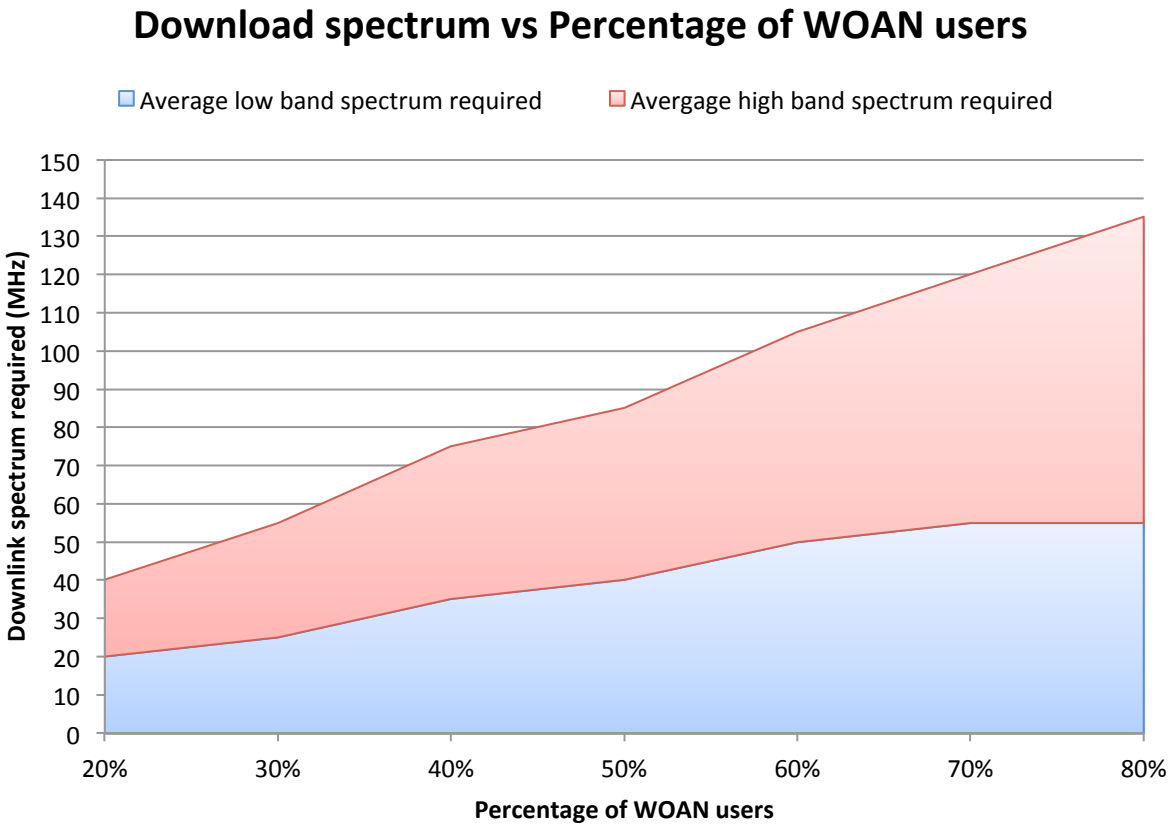
Spectral efficiency micro	4 (bps/Hz/Cell)
Spectral efficiency indoor hot spot	7.5 (bps/Hz/Cell)
Number of sectors	3
Percentage mobile users using WOAN	20% - 80%
Number of potential mobile users in 2020	51,238,073

Spectrum required to meet demand

WOAN users (%)	Number of Users ('000)	Downlink spectrum required (MHz)
20%	10 248	**40**
30%	15 371	**55**
40%	20 495	**75**
50%	25 619	**85**
60%	30 742	**105**
70%	35 867	**120**
80%	40 990	**135**



Determining the target number of users (or percentage of total users) will determine the amount of spectrum required.

- Study maybe required to determine this number.

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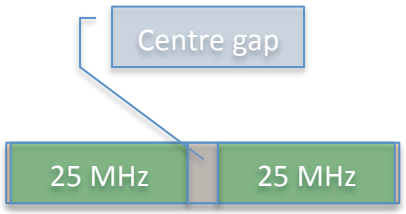
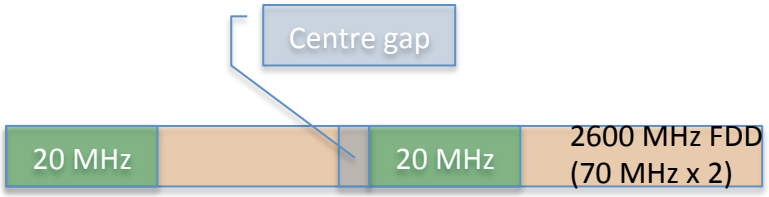
Summary of key recommendations

- The department should consider setting aside only a portion of spectrum in these bands for WOAN and the remaining to other licensees.
- The department should consider 20% of possible user population in 2020 as a baseline to ensure viability of WOAN.
- The following spectrum combinations should be set-aside for WOAN as a minimum. These satisfy the baseline user population as well as provide enough capacity for high-end users of WOAN:
  - 2 x 25 MHz of 800 band (Band 20);
  - 2 x 20 MHz of 2600 FDD band (Band 7); and
  - 25 MHz of 2600 TDD band (Band 38).



800 MHz FDD
(25 MHz x 2)



2600 MHz FDD
(70 MHz x 2)

2600 MHz TDD
(25 MHz)

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Recommendations – Additional studies (1/2)

- A detailed market study to forecast the market size of WOAN beyond 2020 and up to 2030. This will enable the department to take early decision on the licensing of spectrum for 5G.
- Experimentation with different spectrum assignment combinations for new mobile broadband spectrum bands to ensure that the emerging broadband needs are catered for and that new technologies, such as 5G are adopted as early as possible. This would include recalculation of WOAN spectrum needs beyond the year 2020 or at any point when the key assumptions change.

Recommendations – Additional studies (2/2)

- A technical study to determine spectral efficiency at five-year intervals as the technology improves.
- Studies that investigate the deployment models and alternative technologies to for delivering broadband to the sparely populated areas of the country. Analysis of data from 2011 census, indicates 90% of the country's population live in 10% of the land. LTE-Advanced technology, as is the case with the previous generation of mobile broadband technologies, is not well suited to serve sparsely populated areas and thus create a challenge to extend the network to cover the remaining 10% of the population.

Thank you

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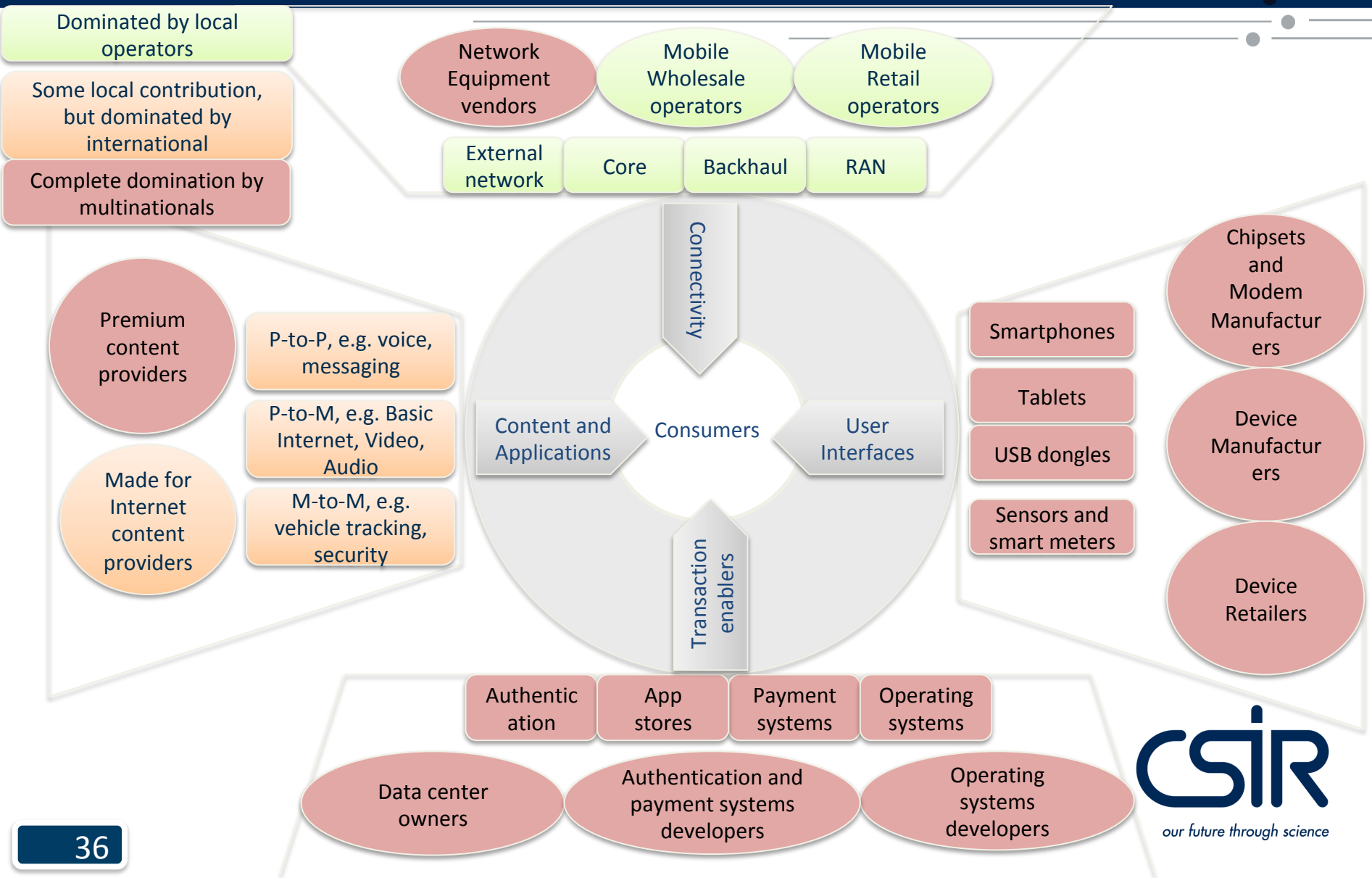
Mobile Data ecosystem – contribution by local industry



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