NBTC/ITU Workshop on Roadmap for Introduction of Digital Terrestrial Radio Services in Thailand

16 December 2014
The Sukosol Hotel, Bangkok, Thailand

AGENDA

08:30–09:00	Registration
09:00–09:30	**Opening Session** ▪ Welcome Remarks by Mr. Ioane Koroivuki, Regional Director, ITU Regional Office for Asia and the Pacific ▪ Welcome Remarks by Mr. Takorn Tantasith, Secretary General, Office of National Broadcasting and Telecommunications Commission ▪ Opening Remarks by Associate Professor Dr. Thawatchai Jittrapanun Commissioner of National Broadcasting and Telecommunications Commission
09:30–09:45	Group Photo and Coffee Break
09:45-11:15	**Session 1 : Transition from Analogue to Digital Terrestrial Radio Broadcasting** *Speaker: Mr. Peter Walop, ITU Consultant* ▪ Introduction to ITU/NBTC works on Roadmap Development Digital Terrestrial Radio Broadcasting Rollout in Thailand ▪ Digital Radio technologies and international update ▪ Roadmap for digital terrestrial radio broadcasting in Thailand
11:15–12:15	**Session 2 : DAB Global Developments** *Speaker: Dr. Les Sabel, ITU consultant* ▪ DAB+ Technology Overview ▪ World DAB+ progress update ▪ Business case for DAB+ ▪ Receiver profiles & types
12:15-13:30	▪ Lunch Break
13:30–15:00	**Session 3 : Digital Radio Options for Thailand** *Speaker: Mr. Peter Walop, ITU Consultant* ▪ Digital Radio Technologies & Frequency bands ▪ Digital Radio Service & Coverage Planning
15:00–15:15	Coffee Break
15:15–17:00	**Session 4 : DAB Network architecture and System Equipment** ▪ Proposed DAB system architectures ▪ Details of the DAB system equipment *by Dr. Les Sabel, ITU consultant* ▪ DAB Network investments and cost drivers *by Mr. Peter Walop , ITU Consultant*
17:00–17:15	**Closing Session** ▪ Closing Remarks by Ms.Supinya Klangnarong, Commissioner of National Broadcasting and Telecommunications Commission

Transition from Analogue to Digital Radio Broadcasting

An overview of trends

ITU/NBTC Workshop
16 December 2014

Peter Walop
International Telecommunication Union

Presentation Overview

1. **Roadmap for Digital Radio Broadcasting**
   - What is a roadmap?
   - Roadmap overview for Thailand
2. **Thai Radio Market & Abroad**
3. **Digital Radio System**
   - Radio is not TV
   - Transmission Systems

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ITU

- Founded in 1865
- Leading UN Special Agency for ICTs
- HQs in Switzerland

- Three sectors (ITU-T, ITU-D, and ITU-R)
- 4 Regional Offices & 7 Area Offices
- 192 Member States and 750 Sector Members

ITU-D

Established to help spread equitable, sustainable and affordable access to ICT.

ITU-T

ITU's standards-making efforts are its best-known – and oldest – activity.

ITU-R

Managing the international radio-frequency spectrum and satellite orbit resources

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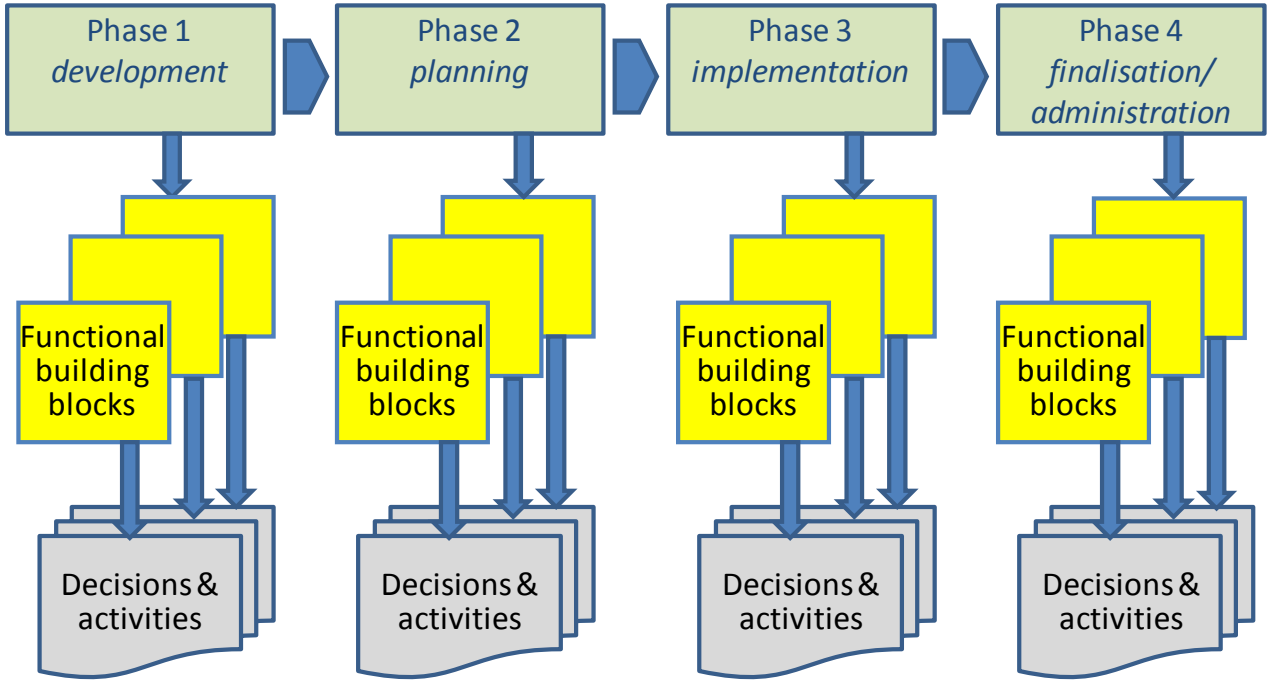
1. Roadmap for DRB

1. Roadmap for DRB – what is a Roadmap?



Source: ITU

- A Roadmap is comprehensive set of decisions and activities organised in a functional & time order
- A Roadmap is developed in a joined effort and provides:
  - Consensus on requirements & solutions
  - Help for coordinating activities
  - Help for forecasting timelines

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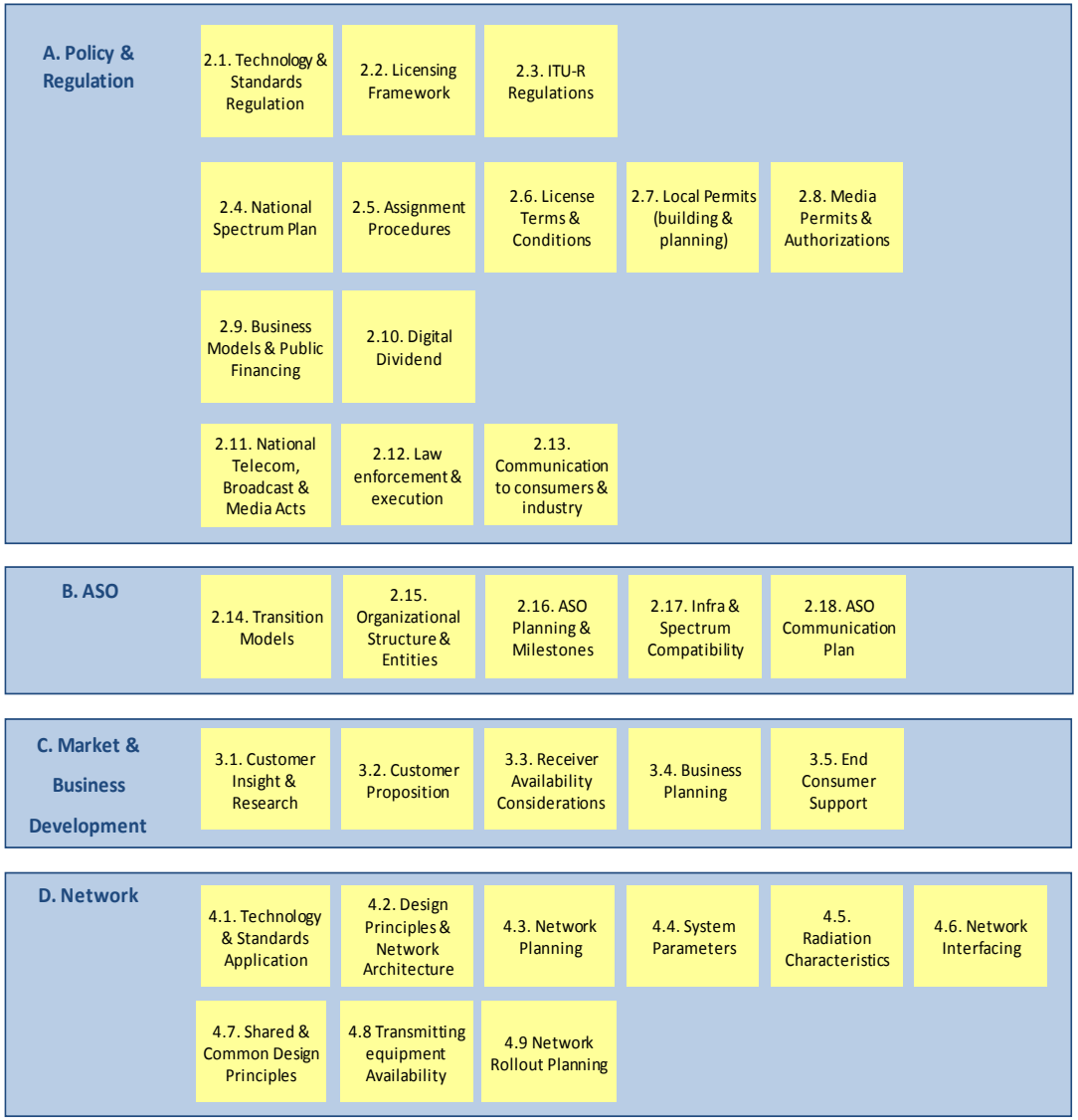
1. Roadmap for DRB – what is a Roadmap?



Source: ITU

- Roadmap functional framework:
  - 5 layers
  - Between 3 to 13 functional blocks per layer
- Functional blocks same as for TV but:
  - Market dynamics different
  - Applied Technologies different
  - No ASO/DD alternative allocations (yet)

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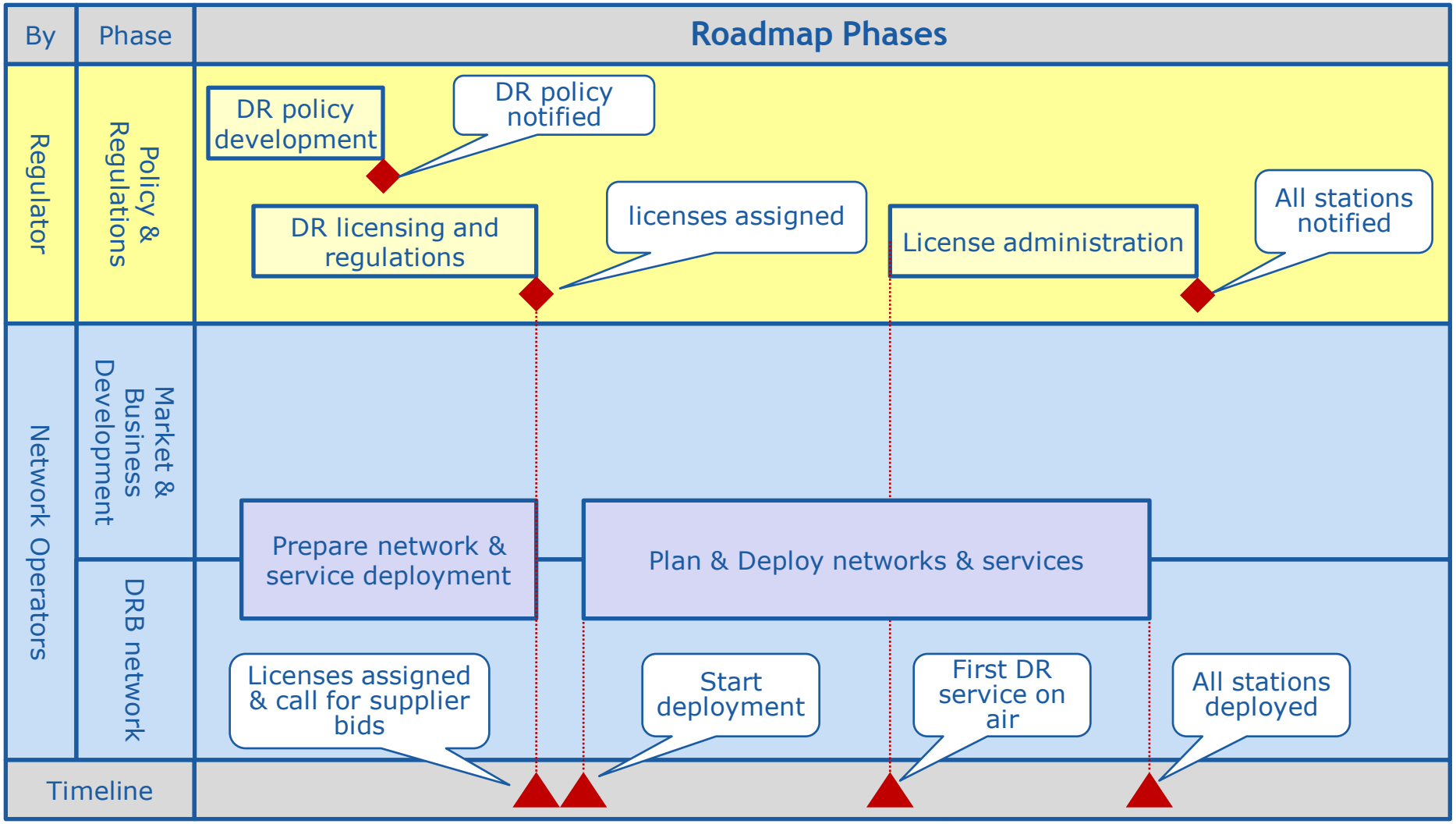
1. Roadmap for DRB – what is a Roadmap?



Source: ITU

1. Roadmap for DRB – Thai Roadmap overview

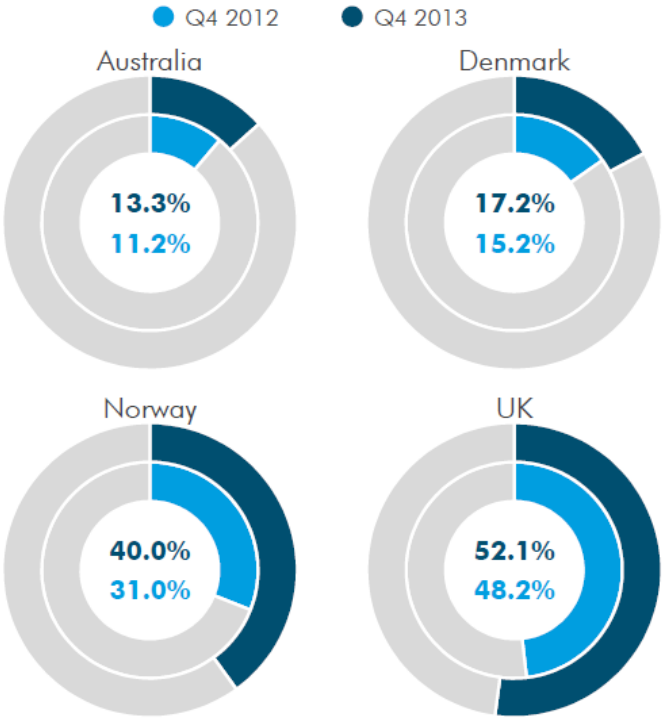
DR roadmap comprises Plan A and B for respectively short and long term

- Plan A is addressing the short term:
  - Launching Trial services in 2014
  - DAB+ in VHF Band III
  - 40-50 services in 10 most populated cities (with pop target of 40%)
  - Preparing and assigning regular licenses
- Plan B is addressing the long term:
  - Regular licensing at the moment when VHF Band III ASO is known (and DAB uptake is sufficient)
  - Matching demand and supply across all available platforms
  - Radio ASO (after BMP planning horizon 2012-16)

1. Roadmap for DRB – Thai Roadmap overview

Migrating to digital should include all platforms of digital listening

Digital Radio Listening (% of all listening)



Source: WorldDMB

- An all-platform view facilitates:
  - More possibilities to match supply and demand
  - 'Radio' ASO in the future

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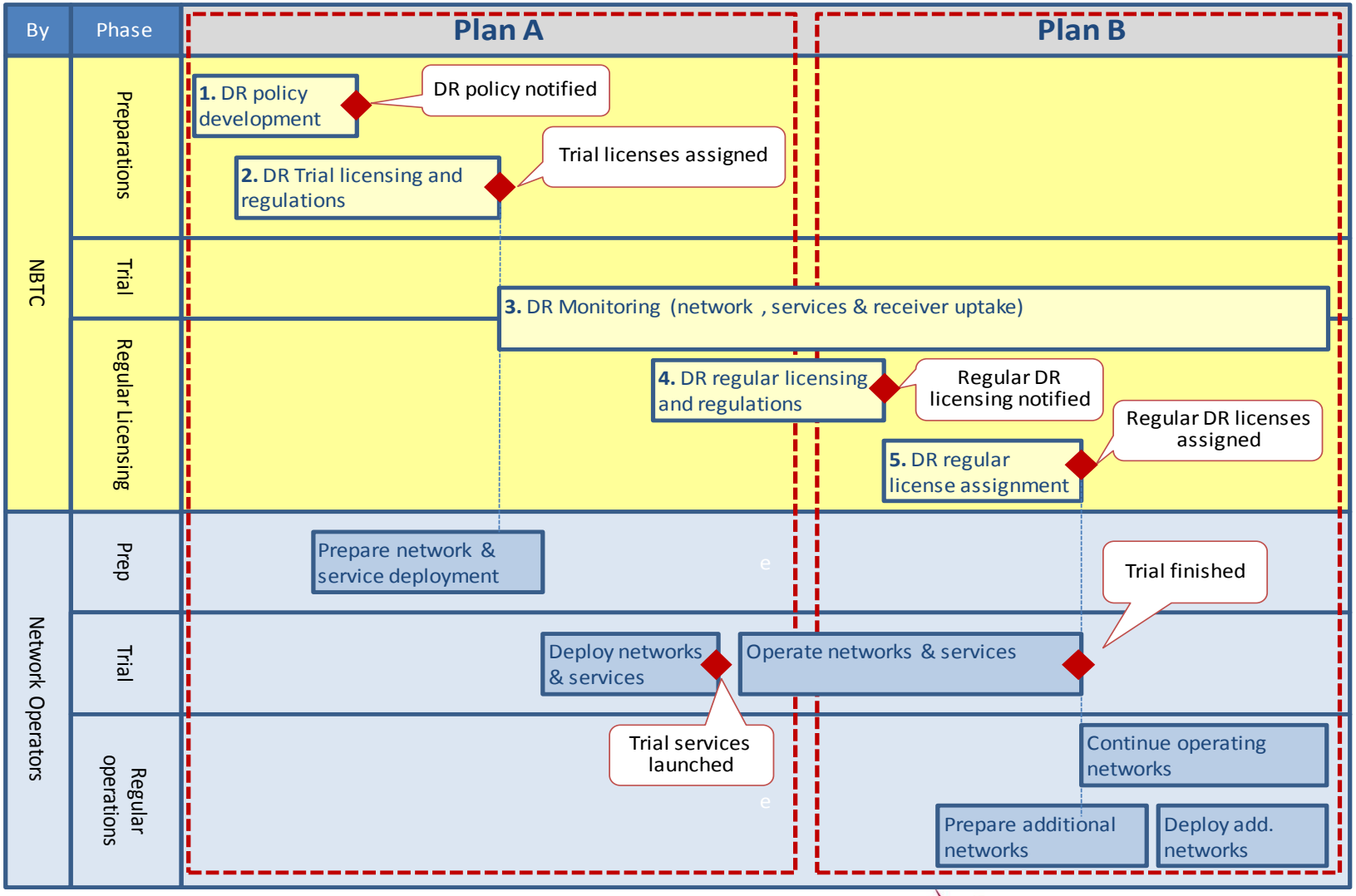
1. Roadmap for DRB – Thai Roadmap overview



Source: ITU/NBTC

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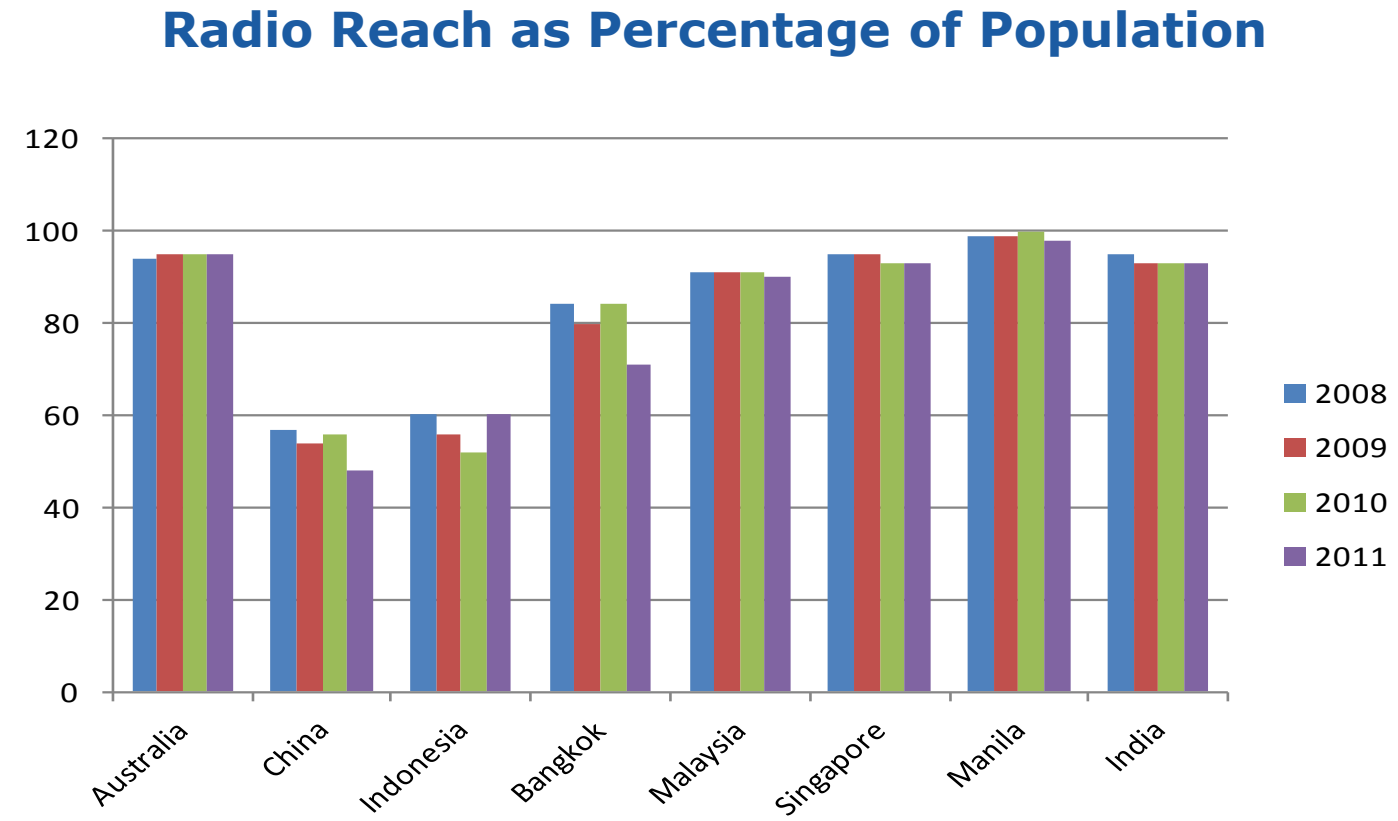
2. Thai Radio Market & Abroad

2. Thai Radio Market & Abroad

Thai radio trends in line with international trends



Source: AC Nielsen

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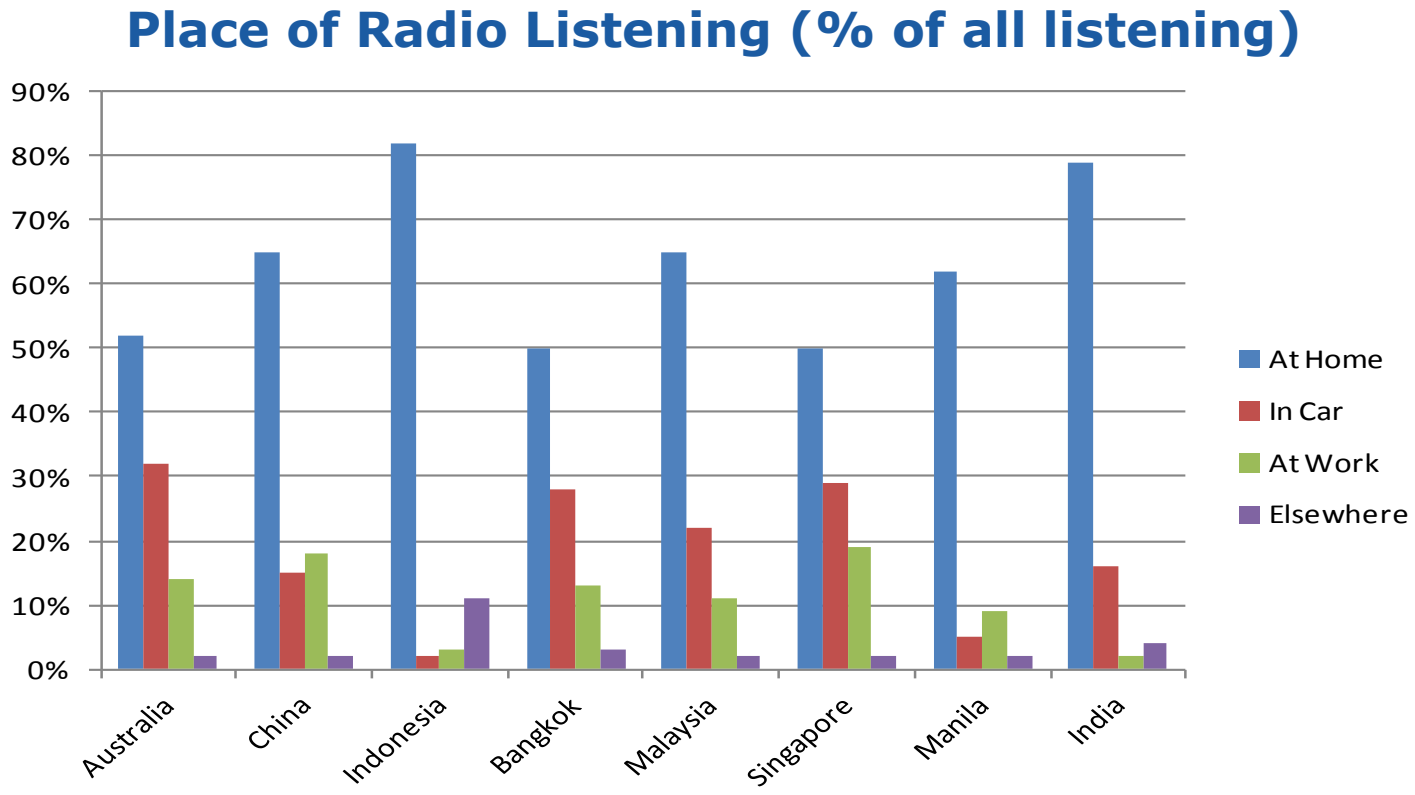
2. Thai Radio Market & Abroad

Most listening at home and work. Not in the car!



Source: AC Nielsen

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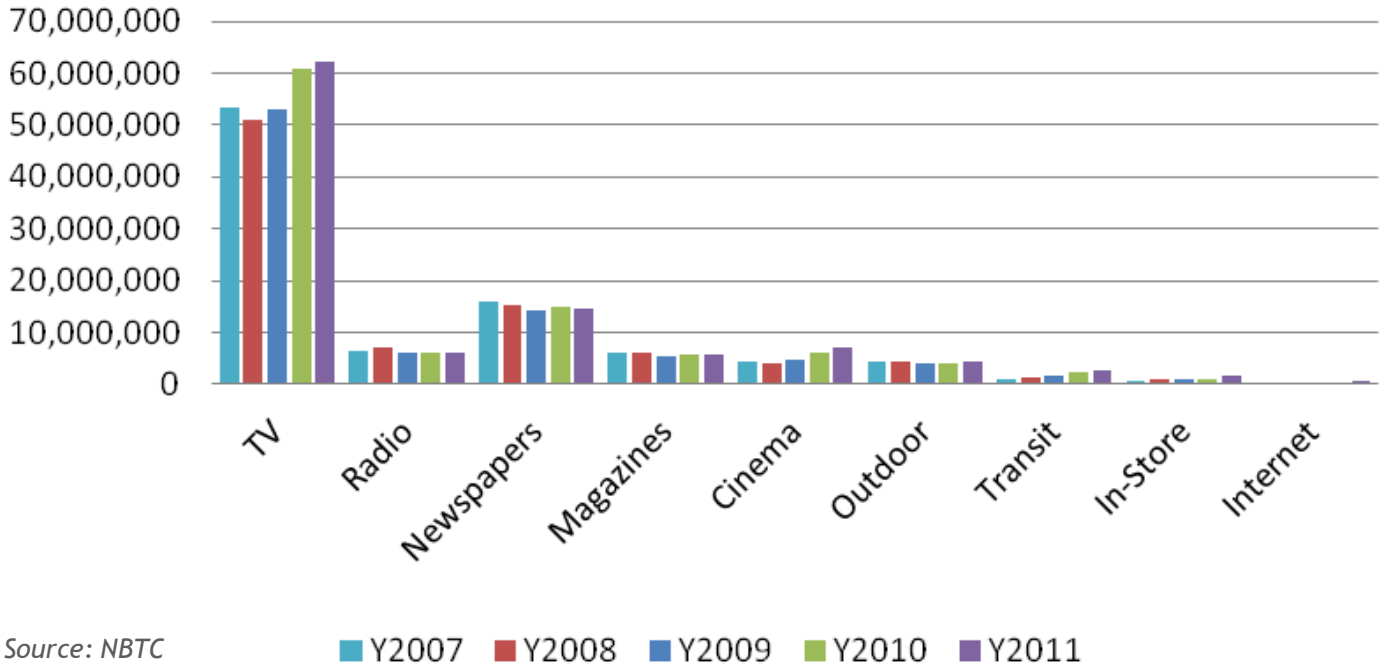
2. Thai Radio Market & Abroad

Stable trend in radio advertising income, no significant growth expected

Media Advertising over Years (in k THB)



Source: NBTC

- For 2013-2017 a CAGR of 3.3% expected
- 5.1% GDP growth expected in same period
- Shift to Internet advertising

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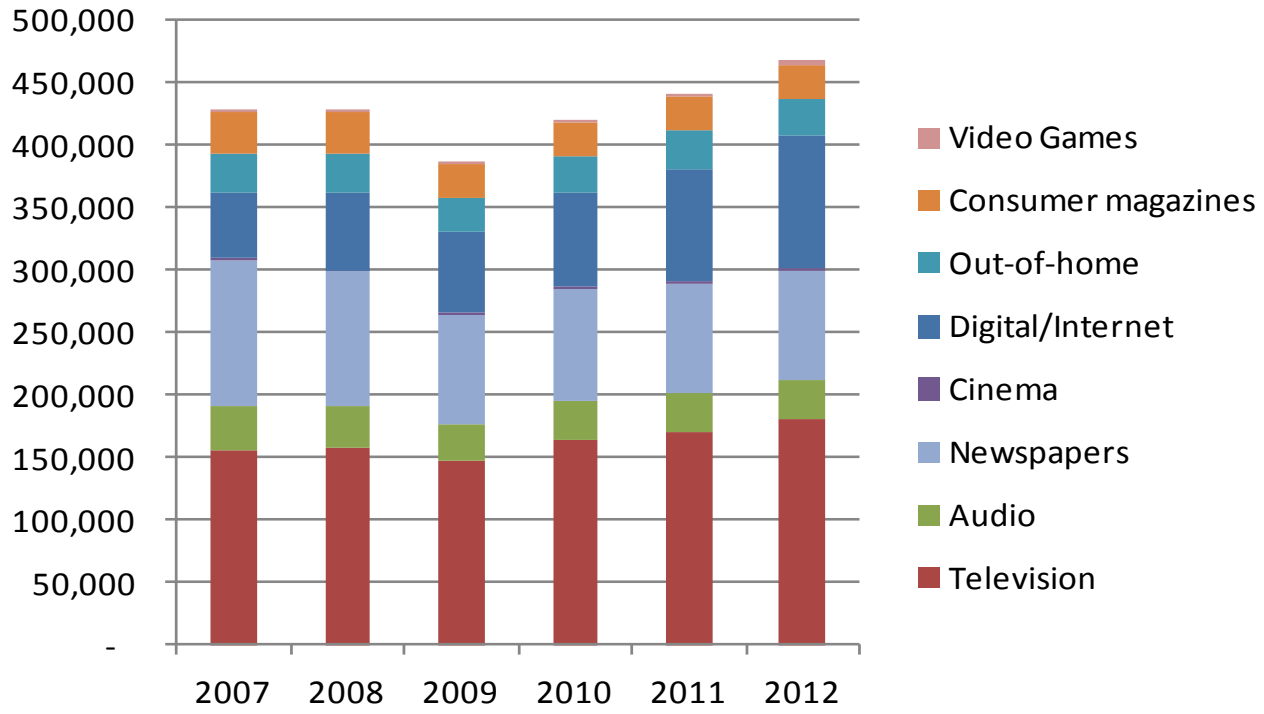
2. Thai Radio Market & Abroad

Global forecasts show stable radio Ad revenues and shift towards Internet advertising

Global Media ADEX (in million USD)



Source: McKinsey, 2013 Global Media report

- For 2013-2017 a CAGR of near 0% expected

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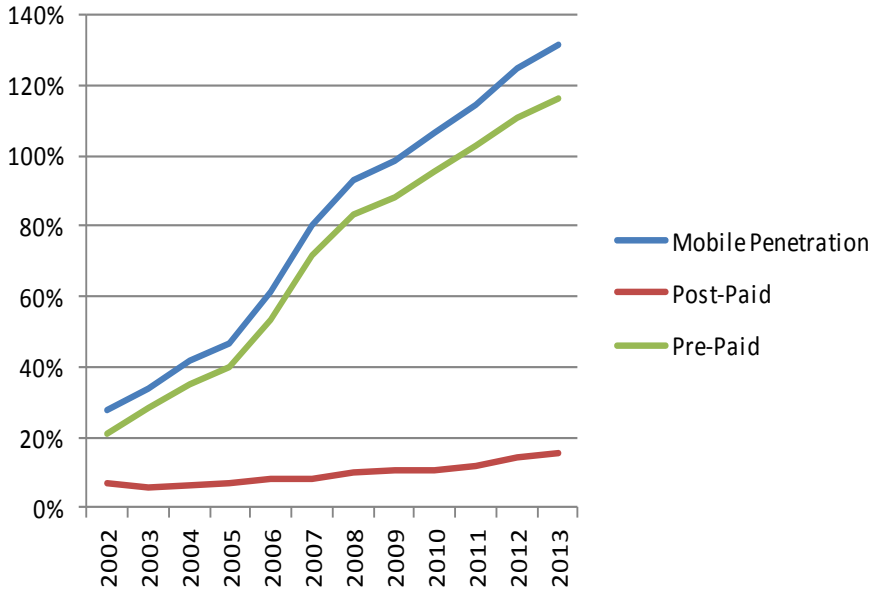
2. Thai Radio Market & Abroad

Mobile will be important for radio distribution as fixed broadband offers little..

Mobile uptake in Thailand



Source: NBTC

- 3 out 5 phones sold = smartphone
- Broadband penetration < 7% (2013) and leveling
- Last 5 years FX line penetration declined (7.2 to 6.2%)

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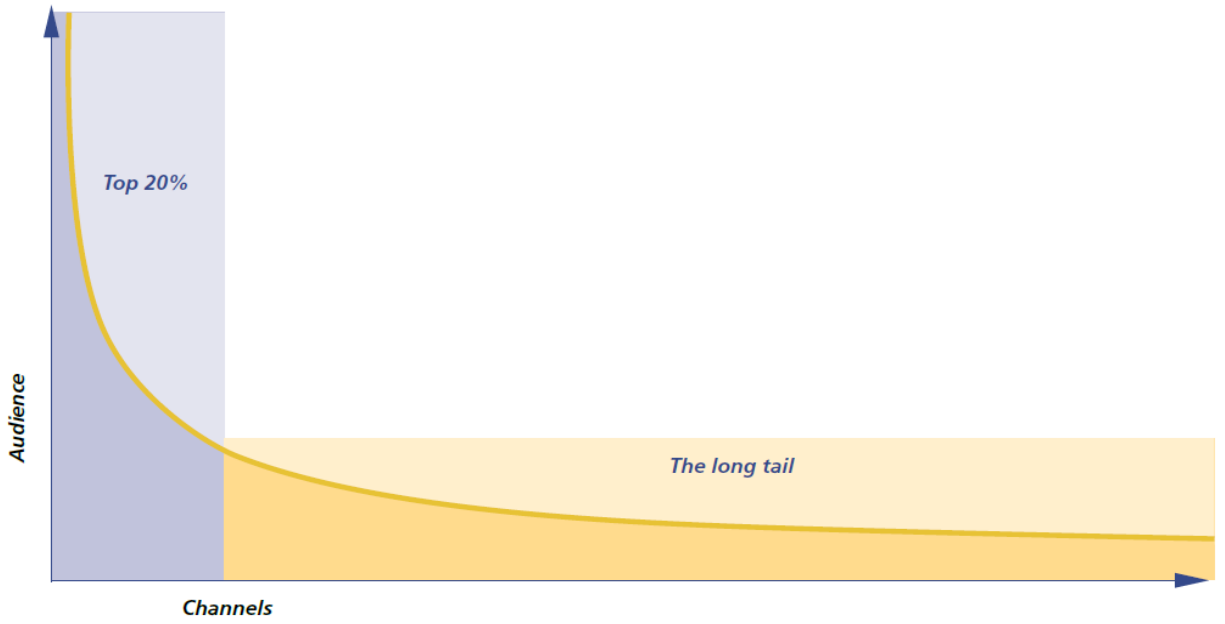
2. Thai Radio Market & Abroad

Income disparity extremely large between top 10 (in BKK) and the rest

Long Tail of Advertising Income per Service



Source: EBU

- BKK FM Top-10 stations take 3b of 5 b THB (60%)
- >7000 FM/AM services or broadcasters

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3. Digital Radio Systems

3. Digital Radio Systems – radio is not TV

Digital radio business case more challenging

- Installed base of analogue receivers much larger than for TV
- Analogue receivers have to be replaced
- Radio market is FTA → no receiver subsidies
- ARPU is much lower than for TV
- No 'Digital Dividend' for Radio ASO

- Business case much harder to make viable
- Simulcast period long
- Digital receiver retail prices are critical

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3. Digital Radio Systems – transmission systems

Selection of transmission system critical for receiver availability and price

System	VDO/ Image	On mob devices	On mob phones	Band	Commercial operations
DMB/DAB+	√	√	√	VHF III	√
DRM	√	√	√	LF, MF, SW, FM, VHF	√?
T-DMB	√	√	√	VHF III	√ part of TV
ISDB-Tsb		√	√	TV bands	√ part of TV
ISDB-Tmm	√	√	√	VHF III, etc	√ part of TV
HD/IBOC		√		MF, FM	√

Source: ITU

- TV systems lack 'Radio' functionality:
  - Roaming between FM/DRB
  - Mute when TA
- TV raster may be different

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3. Digital Radio Systems

No universal system and they all do 'the job'

- None of the 6 transmission systems are universally applied (in contrast with FM/AM)
- Technical performance of most systems the same
- DMB/DAB+ offers more capacity per multiplex → for the same number of services less OPEX & CAPEX
- In selecting the standard the following aspects should be considered:
  - Available frequency bands (in Thailand)
  - Service offering (incl. #of services, audio quality, PAD functionality & enhanced services)
  - Receiver requirements

DAB Global Developments

ITU/NBTC Workshop
16 December 2014

Dr. Les Sabel
International Telecommunication Union

Overview

DAB+ Technology Overview

World DAB+ progress update

Business case for DAB+

Receiver profiles & types

Next Steps

S-Comm Technologies acknowledges input to this presentation from previous presentations and sources including WorldDMB, CRA and S-Comm Technologies

DAB+ Technology Overview - Part 1

Core Technology

Welcome to the DAB Family of Standards

One family provides the most cost effective delivery of digital radio and mobile TV

The DAB Family of Standards

The Eureka Family of Standards

- DAB : 1995 Original audio with PAD and data services standard
- T-DMB : 2006 Added video services for Mobile TV and enhanced data streaming
- DAB+ : 2007 Enhanced audio service efficiency

Why DAB+?

One family provides the most cost effective delivery of digital radio and mobile TV

- 2.5 times more audio services than DAB due to the use of HE AAC+ v2
- Slightly better coverage – 1 to 2dB better than DAB – better FEC coding
- More flexibility for Programme Associated Data delivery
- PAD content has much stronger error protection

DAB Standards

For detailed description of the DAB+ system refer to the following ETSI standards documents

- EN 300 401 Main document
- TR 101 496-1, -2, -3 Guidelines of use and operation
- TS 102 563 Transport of AAC audio

See http://www.worlddab.org
or
http://www.etsi.org/standards

DAB+ Features

DAB+ Features – Audio - Room for Lots of Services

Choose the station from a list

No more need to remember the station's frequency!!!

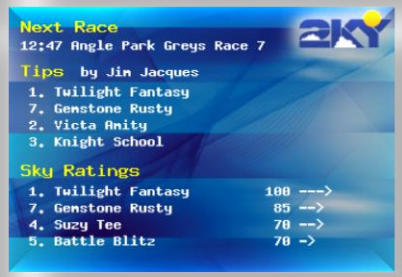
Station list

PAD – Scrolling Text (Dynamic Label Segment)

- Straight forward, effective
- Limited to 128 characters per text segment
- All DAB+ receivers have DLS
- Good receivers should have options to vary scroll speed

PAD – SlideShow (SLS)

- Further strengthens the audio message
- Standalone advertising during song items
- Promotion of station activities, e.g. OB's
- Traffic and weather reports
- Race / betting and stock market information
- Local news, happenings, community events



Data Services

Electronic Programme Guide (EPG)

Now called : Service and Programme Information (SPI)

Very useful tool for promotion of programs, talent, competitions

Especially useful for multilingual national broadcasters with scheduled programme slots

Is flexible, can be station, network or ensemble based

Data Services - Other

Traffic e.g. TMC and TPEG can provide up to the moment information on
- current traffic flow and congestion
- fuel locations and prices
- parking

Journaline
- Hierarchical categorised text service

Custom Applications

Broadcast Features

Announcement Support
- Ability to command the receiver to deliver a different service
  - Traffic Announcements
  - News and Weather announcements
- User controlled / enabled

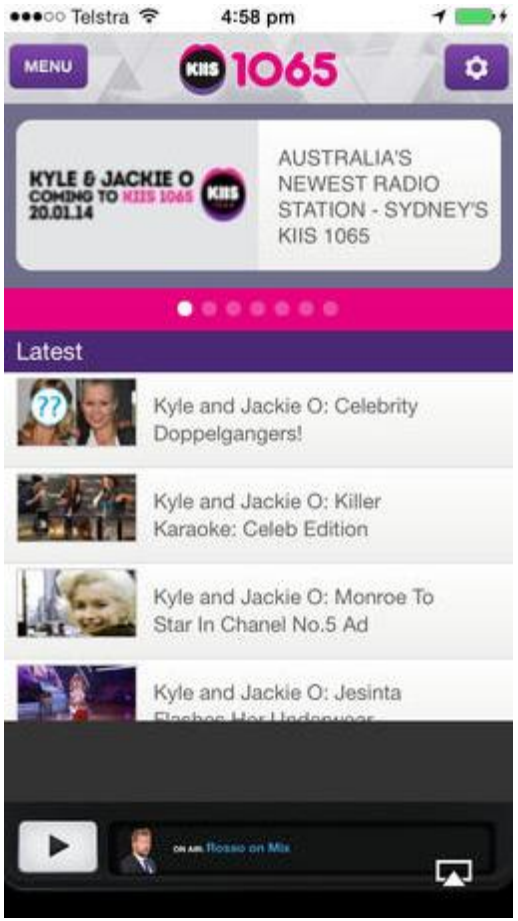
Emergency Warning System
- Ability to wake up receivers which are in standby
- Uses Announcements to force the receiver onto the Emergency Warning Channel
- Increasing activity to implement a common system

Service Linking and Following
- Provides link information between services and ensembles
- Receiver changes services under predefined reception conditions
- User controlled / enabled

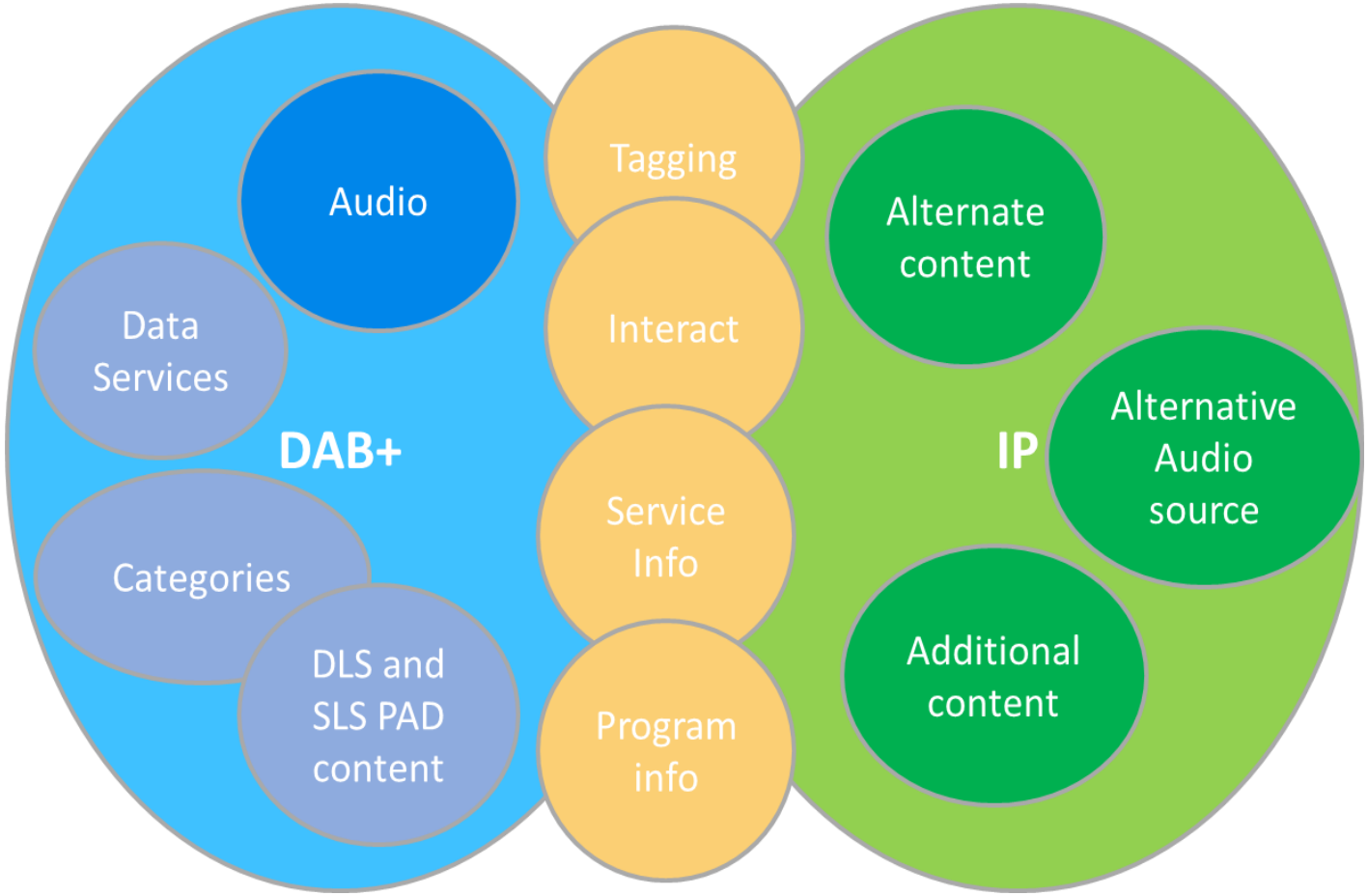
DAB+ Technology Overview – Part 2

Hybrid DAB+ Digital Radio

Broadcasters have invested in streamed radio services...



DAB+ Hybrid Radio Ecosystem

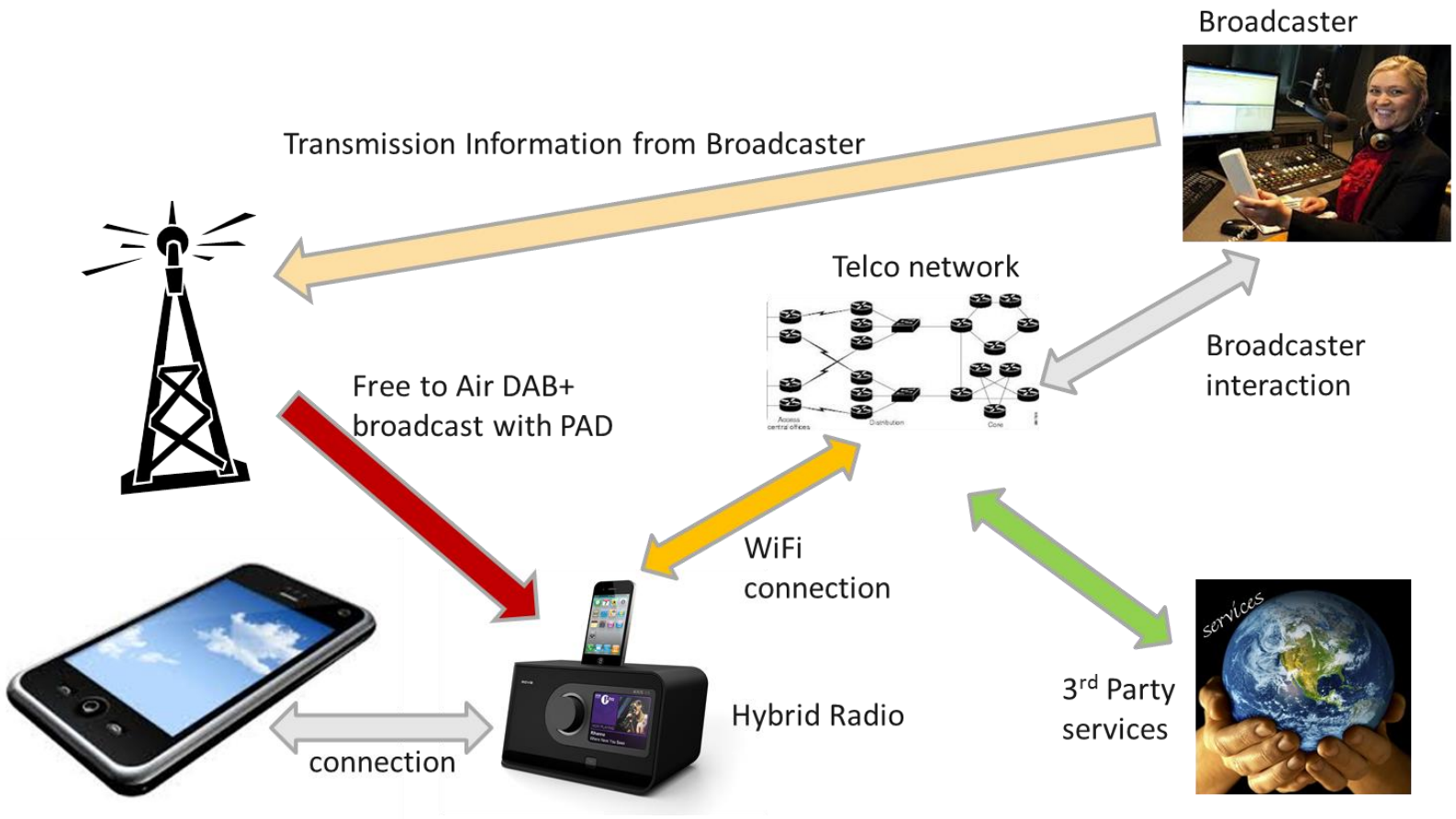


Hybrid Radio was very well received overall, especially by the younger and more tech savvy users

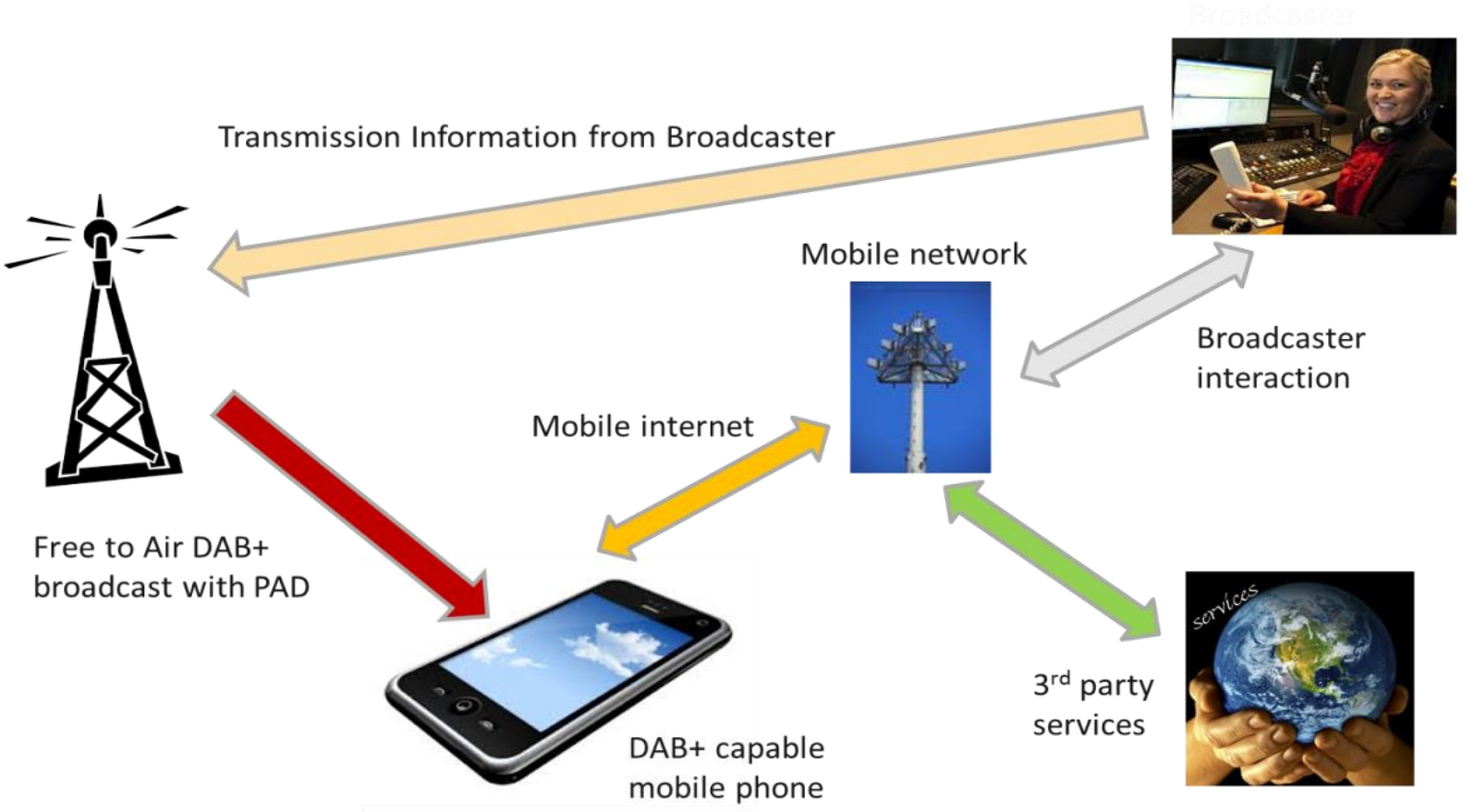
Base : All survey respondents : UK 16-64 Internet users, smartphone owners, weekly radio listeners (1,009)

Hybrid Radio has also the potential to increase general radio listening among all listeners

DAB+ Hybrid Radio



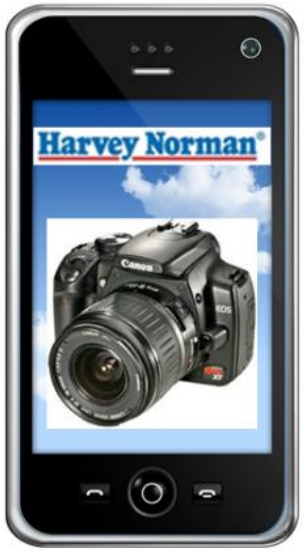
DAB+ Hybrid Radio



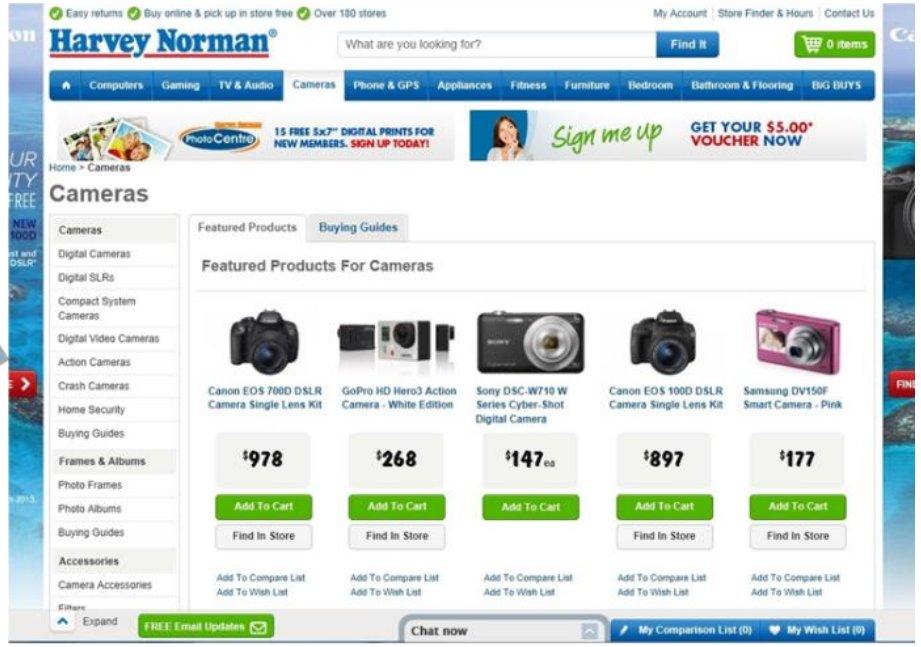
DAB+ Hybrid Radio – Service Discovery

Explore new content and services through hyperlinks

DAB+ Hybrid Radio – Instant shopping!



Screen tap

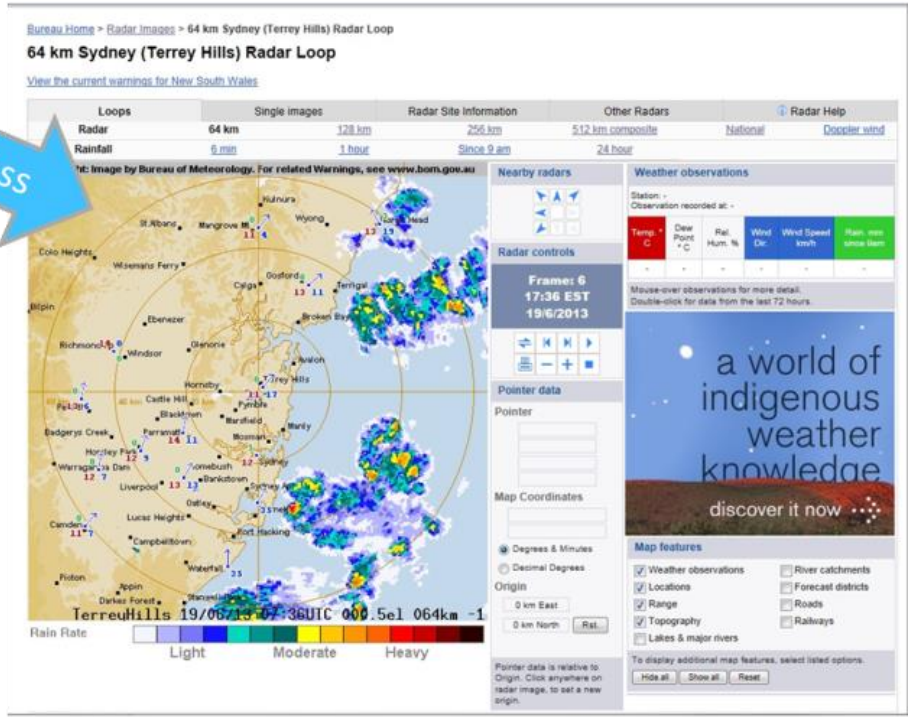


DAB+ Hybrid Radio – Engagement and measurement

Screen tap

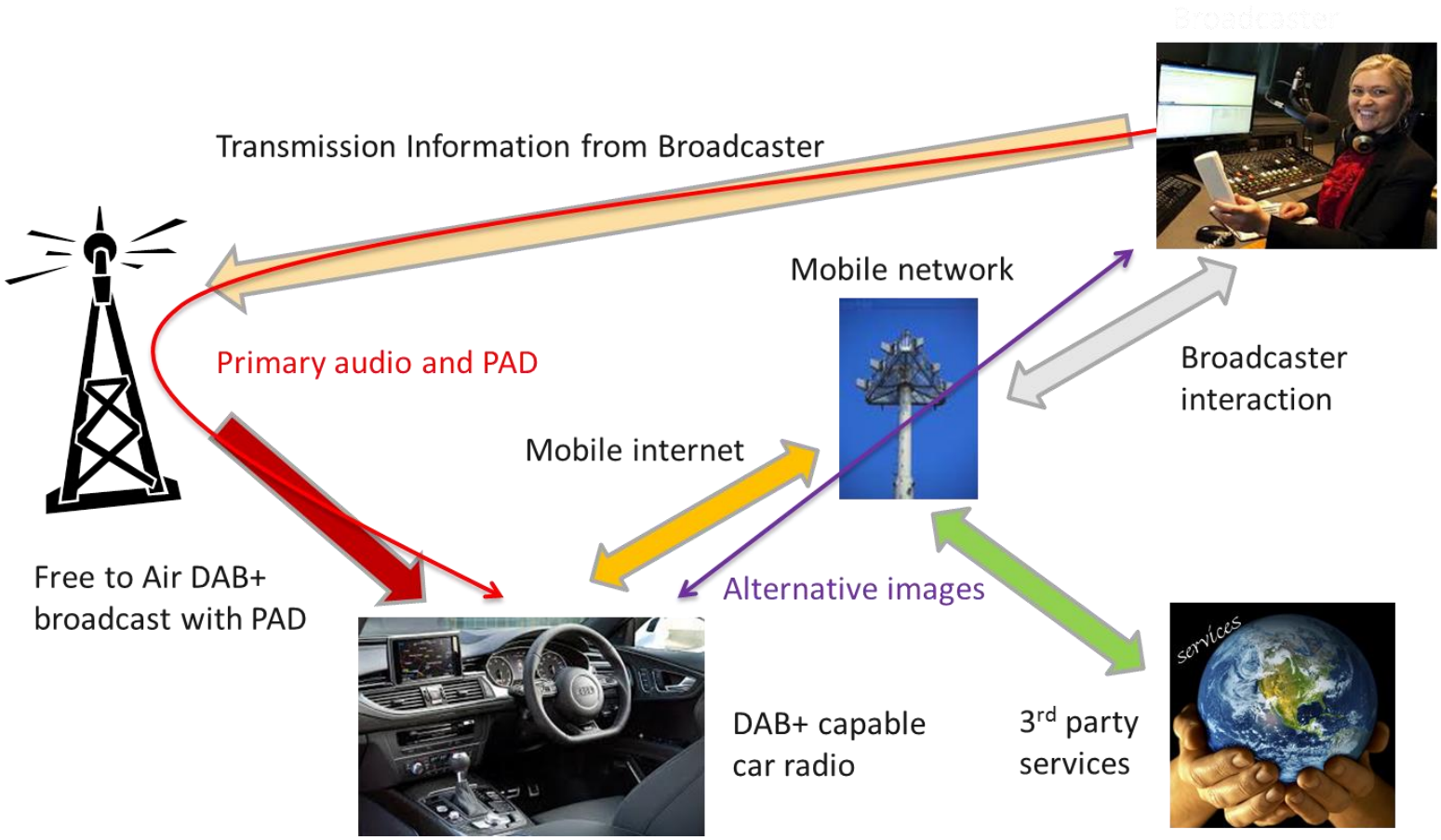
DAB+ Hybrid Radio – More information

Button press

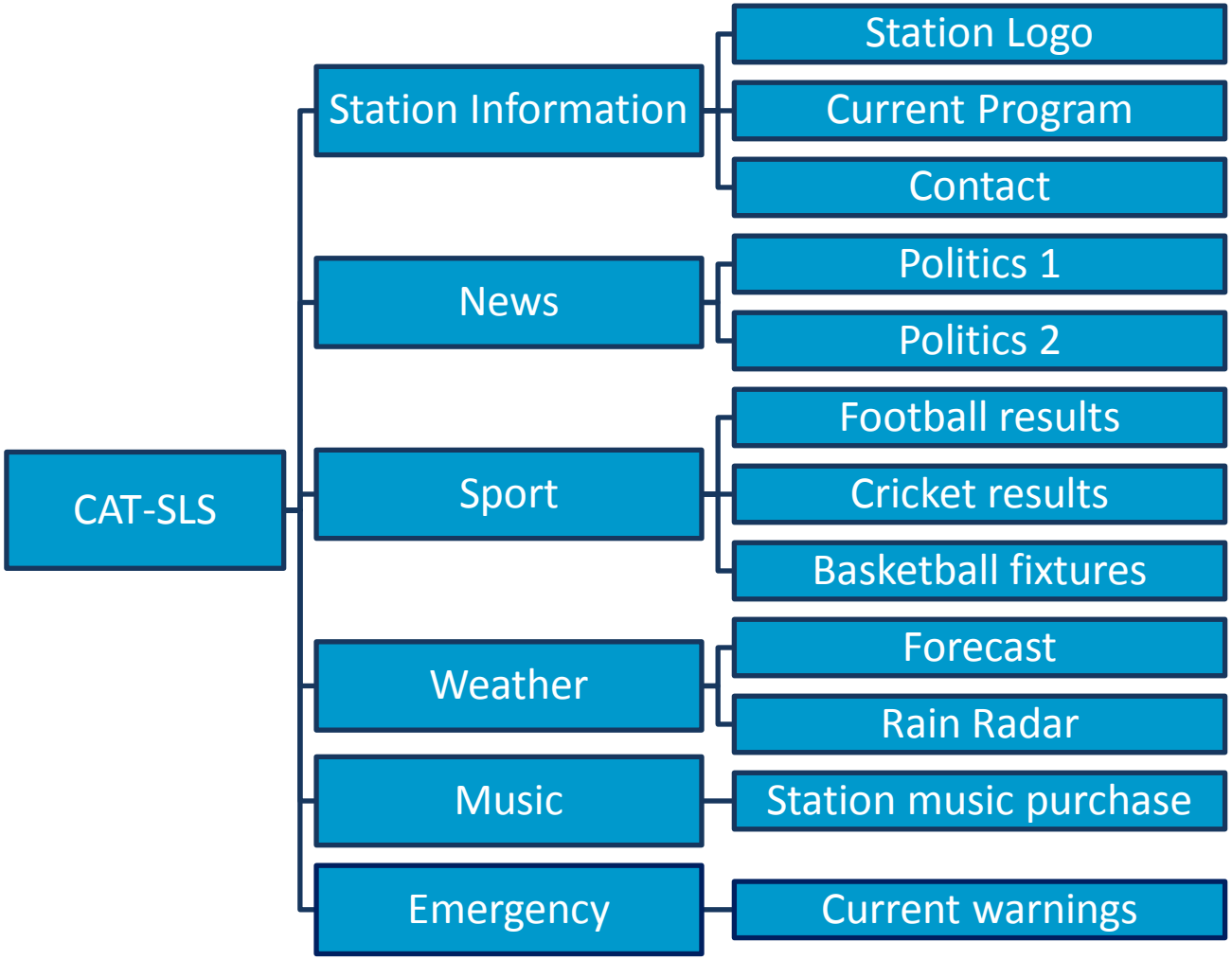


Accessing a website from a URL delivered associated with the information provided

DAB+ Hybrid Radio – Alternative content

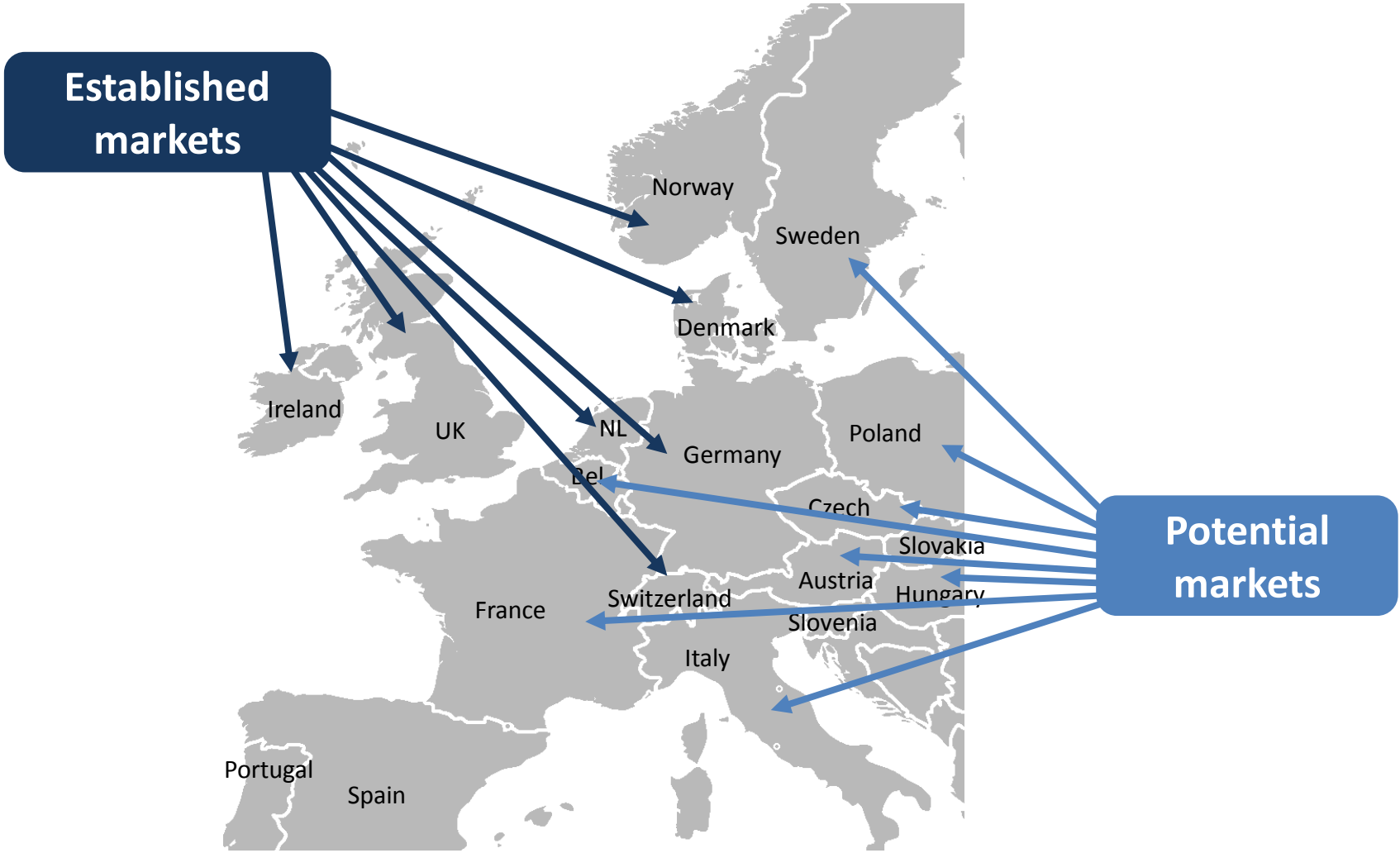


DAB+ Hybrid Radio – Categorisation



World DAB+ progress update

Europe : Several potential markets



Europe : Analogue Switch Off

In Asia Pacific, a similar process is rapidly under way

Vietnam: DAB+ trial in 2013, workshops 2014

Thailand: DAB+ trial planned for 2015

Malaysia: DAB+ trials on air

Indonesia: DAB+ trial on air in Jakarta, Workshop 2014

China: DAB in Beijing & Shanghai

South Korea: DAB/DMB 60m considering DAB+

Hong Kong: DAB+ launch 2011

NZ: DAB+ trial on air Auckland

Australia: DAB+ launched July 2009

DAB+ Digital Radio in Australia

DAB+ launched 2009

- five major cities + 2 trial cities
- 64% population coverage

1.9m devices sold (400k p.a.)

Radio listening on digital device

- Over 3 million people each week
- Over 24% of all listening
- 1.3m DAB+ listeners more than on internet
- 400 plus different DAB+ receivers on sale – from $29
- Text, Graphics on all stations – inc 37 DAB+ Only Stations

Automotive Industry in Australia

- 20 major vehicle manufacturers now offer DAB+ in vehicles
- Other brands expected to launch in coming months
- CRA best practice paper for automotive task force and manufacturers/OEMs
- 125,000 new cars sold with DAB+

Business Case

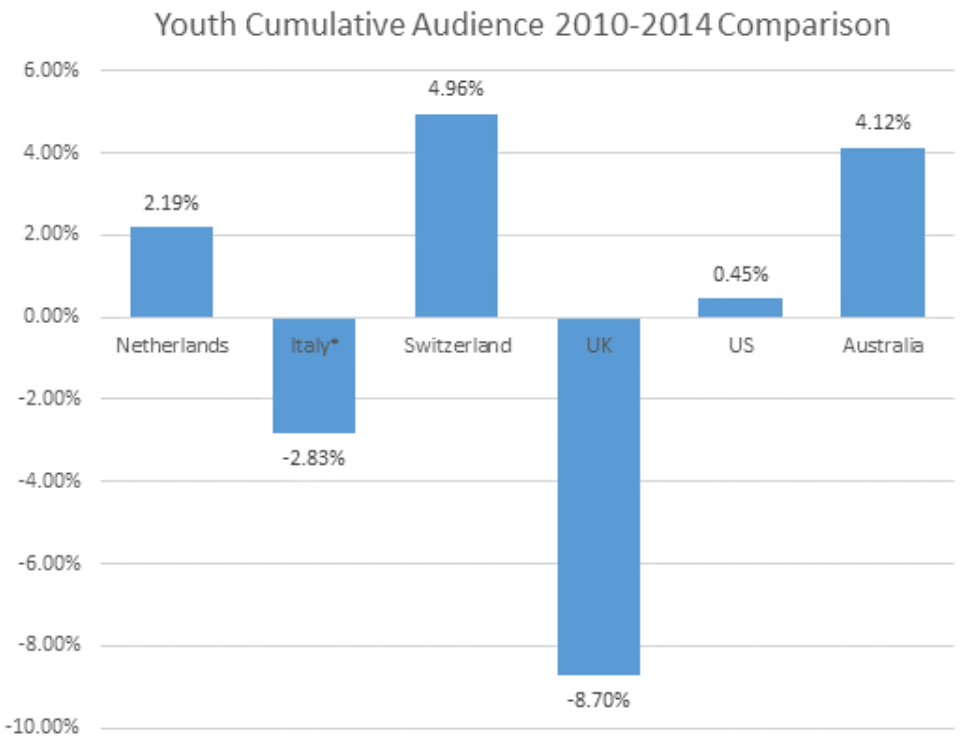
The competitive landscape for radio is changing

Online music services

- **Digital music services**
- **Smart devices**
- **Competition for FM radio**

Younger audiences are listening less??

Changes in youth per capita listening hours, 2010-14[1]



GfK Netherlands Radio Ratings Jan -Aug 2010, 2014 All People 10-24, GfK Italy Radio Ratings 2012, 2014 All People 14-24, GfK Switzerland Radio Ratings 2010, 2014 All People 15-24, RAJAR Radio Ratings Q3 2010, 2014 All People 15-24, Nielsen US Radio Ratings Q3, 2010, 2014, All People 12-24, GfK Radio Ratings Australia S1-8 2010, S1-6 2014 All people 10-24,

In many markets, FM spectrum is full

- Overloaded airwaves
- No capacity for new services
- Difficult to innovate
- DAB+ on Band III a fresh new start

FM v DAB+ costs

DAB+ offers significant efficiency savings

Based on:

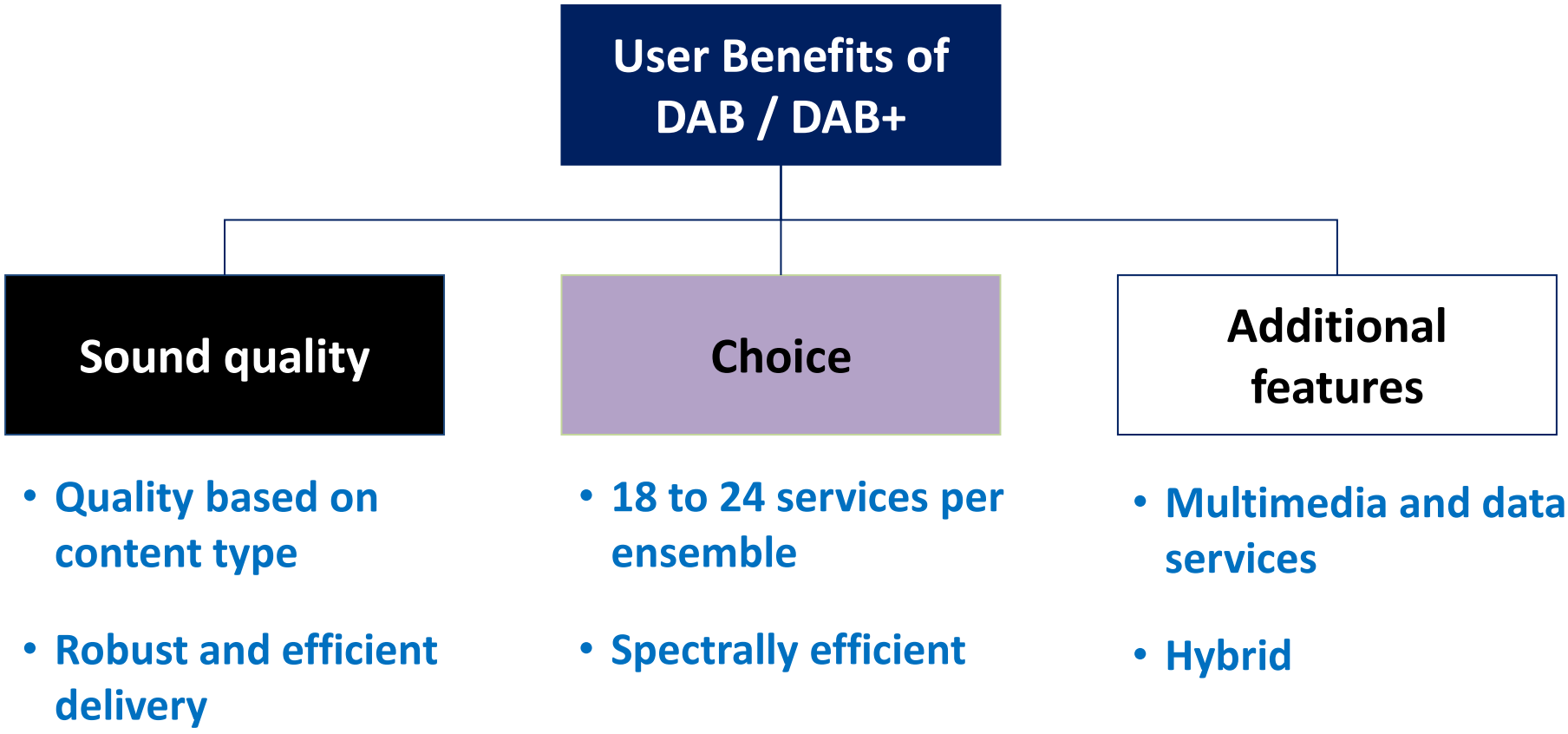
18 DAB+ services per ensemble
2.5kW transmitter / 25kW ERP

9 FM (or AM) services
10kW peak transmitter / 100kW ERP

Excludes costs for telco, insurance, legal, operations

	Transmitter	FM			DAB+		
	Situation	**Owned**	**Regional site**	**Metro site**	**Owned**	**Regional site**	**Metro site**
	Number of transmitters	**9**			**1**		
,000 USD	**Capex: Cost of transmitters**	**450**			**80**		
,000 USD **pa**	**Opex**	9 FM services			18 DAB+ services		
	Power	81.5			8		
	Cooling	22.5			5		
	Space	45	315	675	5	35	75
	Maintenance	45			50		
,000 USD **pa**	**Total Opex all sites**	**192.5**	**462.5**	**823**	**68**	**98**	**128**
Annual cost per FM site		**21.4**	**51.4**	**91.4**			
Ratio one FM / 2 DAB+		**2.83**	**4.72**	**6.43**			

Digital radio offers solutions



DAB+ Receivers

The market is ready

over 400 consumer devices available

Prices from $25

The market is ready

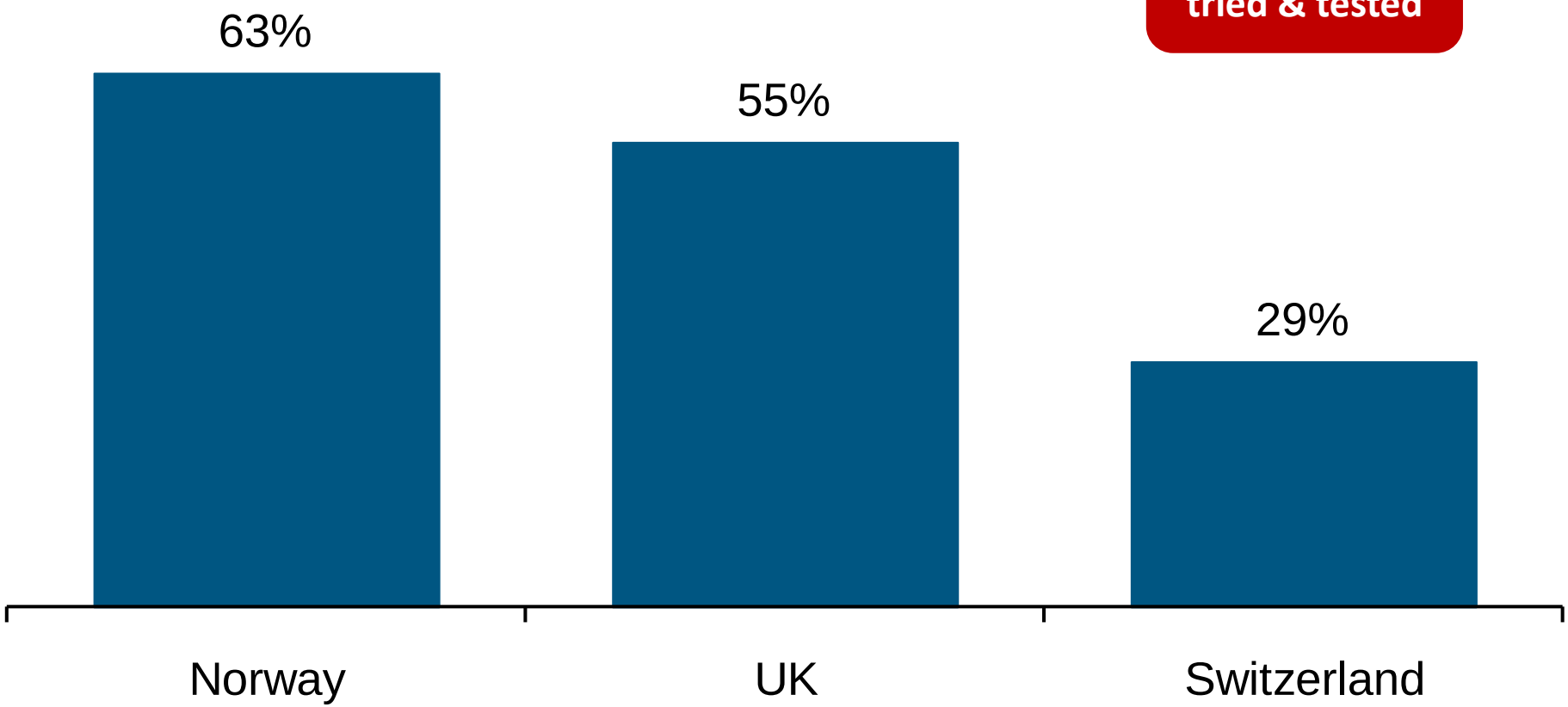
All varieties of receivers

The automotive sector is ready

DAB in new cars becoming the norm

% of new cars with DAB digital radio

Technology - tried & tested



Source: Digitalradio Norge, DRUK, MCDT

DAB+ and Smartphones

- An Australian study into the ability of mobile networks to cope with radio audiences streaming has shown
  - If all radio was listened to on 3G or 4G networks – the capacity for other uses would be severely impacted
  - Even 4G in broadcast mode would not provide the solution
  - The cost of building out every telco network is prohibitive – people would not want to pay for radio
- This study supports the Swedish and German studies
- CRA works with broadcasters in Europe to encourage handset makers to incorporate DAB+

DAB+ Receiver Profiles

	Portable	Vehicle
Profile 1: Standard Radio Receiver	Band III DAB+ 1 Service decoding Basic display DLS	TPEG TMC FM Service Following DAB Service Following
Profile 2: Rich Media Radio Receiver	4 service decoding Colour screen and SLS DL+ SPI Journaline BWS	TPEG TMC FM Service Following DAB Service Following
Profile 3: Multimedia Receiver	H.264 video decoding BSAC audio SLS+ Packet data	

The road is long…..

Broadcasting Unions calling for international approach

EBU

EBU recommendations

- Digital broadcast backbone[1]
- Devices to offer analogue & digital[2]
  - consumer
  - automotive
  - smartphones
- Harmonisation across Europe

- **Harmonisation: create scale / accelerate market development**
- **Key requirement of manufacturers**
  - **automotive**
  - **consumer receivers**
- **Digital broadcast the best way to make radio "fit for purpose" in 21st Century**

Note: (1) Recommendation R138 https://tech.ebu.ch/docs/r/r138.pdf
(2) Euro-chip / smart radio initiative: http://www3.ebu.ch/cms/fr/sites/ebu/contents/programming/radio/digital-radio/welcome-page/about-euro-chip.html

DAB+ Next Steps – Engagement

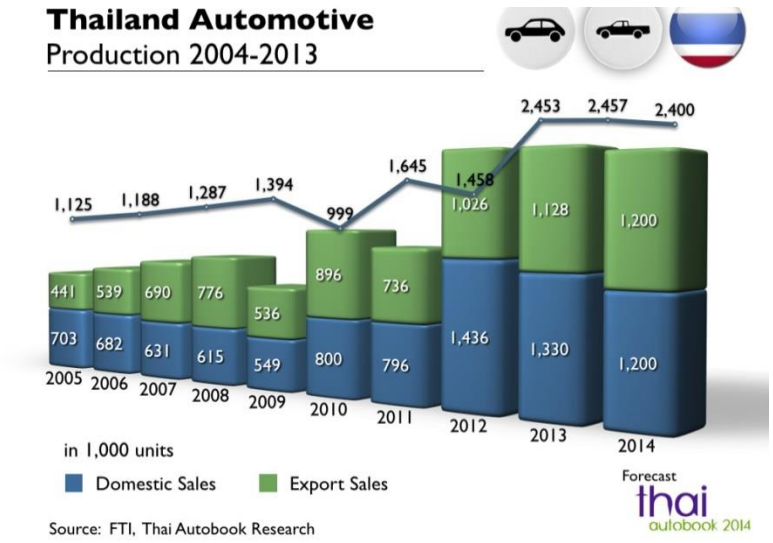
Government and Regulators

Suppliers

Advertisers

Retailers

Automotive



The future

Thank You

les.sabel@scommtech.com.au

Digital Radio Options for Thailand

Services and Frequency Planning

ITU/NBTC Workshop

16 December 2014

Peter Walop

International Telecommunication Union

Presentation Overview

1. **Frequency & systems options**
   - National Spectrum Plan (NSP)
   - System options
2. **DRB services & planning**
   - Multiplex loading
   - Plan targets & results
   - Reaping synergies
   - Local service planning

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1. Frequency & systems options

1. Frequency & System options – NSP

VHF Band III only option at present for DR introduction

Band reference	Alternative service name	Frequency Range	Options for Thailand
LF Band	AM Long Wave	30 to 300 kHz	None at present
MF Band	AM Medium Wave	526.5-1606.5 kHz	Limited at present
HF Band	AM Short Wave	3 to 26 MHz	None for coverage in Thailand[22]
VHF Band I	Television Band I	47 to 68 MHz	Not tried. Good potential.
VHF Band II	FM Radio Band	87 to 108 MHz	Very Limited to None at present.
VHF Band III	Television Band III	174 to 230 MHz	Limited, but Good
UHF Band IV/V	Television Band IV/V	470 to 854 MHz	Very Limited
UHF L-Band	L-Band	1452 to 1492 MHz	Limited to Very Limited
Source: ITU project			

1. Frequency & System options – system options

Only DAB+ and DRM are realistic options for Thailand (for Trial)

Technology/ System	Radio	VDO/ Image	Radio On Mobile Devices	On Mobile phones/ Devices	Frequency Band
DMB (DAB, DAB+)	Yes	Yes	Yes	Yes	VHF III
DRM (DRM30, DRM+)	Yes	Yes	Yes	Yes	LF, MF, Shortwave, FM, VHF
T-DMB	Yes	Yes	Yes	Yes	VHF III
ISDB-T $_{SB}$	Yes	-	Yes	Yes	TV bands
ISDB-T $_{MM}$	Yes	Yes	Yes	Yes	VHF III, etc.
HD-Radio (IBOC)	Yes	-	Yes	-	MF, FM
Source: ITU Project					

- 4 transmission standards for VHF Band III (DAB+, DRM, ISDB-T, T-DMB):
  - ISDB-T & T-DMB radio services are part of TV multiplex
  - Thailand has opted for DVB-T2 → ISDB-T/T-DMB no option → only DAB+ and DRM are options for DR

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1. Frequency & System options – system options

DAB+ receivers commercial available with a wide product range and lowest prices

- A wide diversity of commercially available DAB(+) receivers
  - For all Profiles, including Multimedia Receivers
  - Prices range from 1,000 to 19,000 THB
- No/limited commercially available DRM receivers:
  - Indian DRM-30 project may change situation
  - DRM multiplex has relatively limited bandwidth (→ more transmitters for same # of services

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2. DRB services & planning

2. DRB services & planning – multiplex loading

Step 1: available multiplex capacity

Parameter	Digital Radio System: DAB+ Typical operating parameters	Digital Radio System: DAB+ Maximum permissible
Typical stream bitrate (kbps) at protection level 3, code rate = 1/2	1152kbps	576 – 1728 from level 1 to level 5
Typical Number of audio only services	18	63
Typical service channel rate (kbps)	32 – 80	Up to 192
Channel bandwidth (kHz)	1712	1712
Modulation / FEC coding	DQPSK Convolutional / Reed-Solomon	DQPSK Convolutional / Reed-Solomon
Typical operation	DQPSK / R=1/2	-
Robustness	Excellent	-

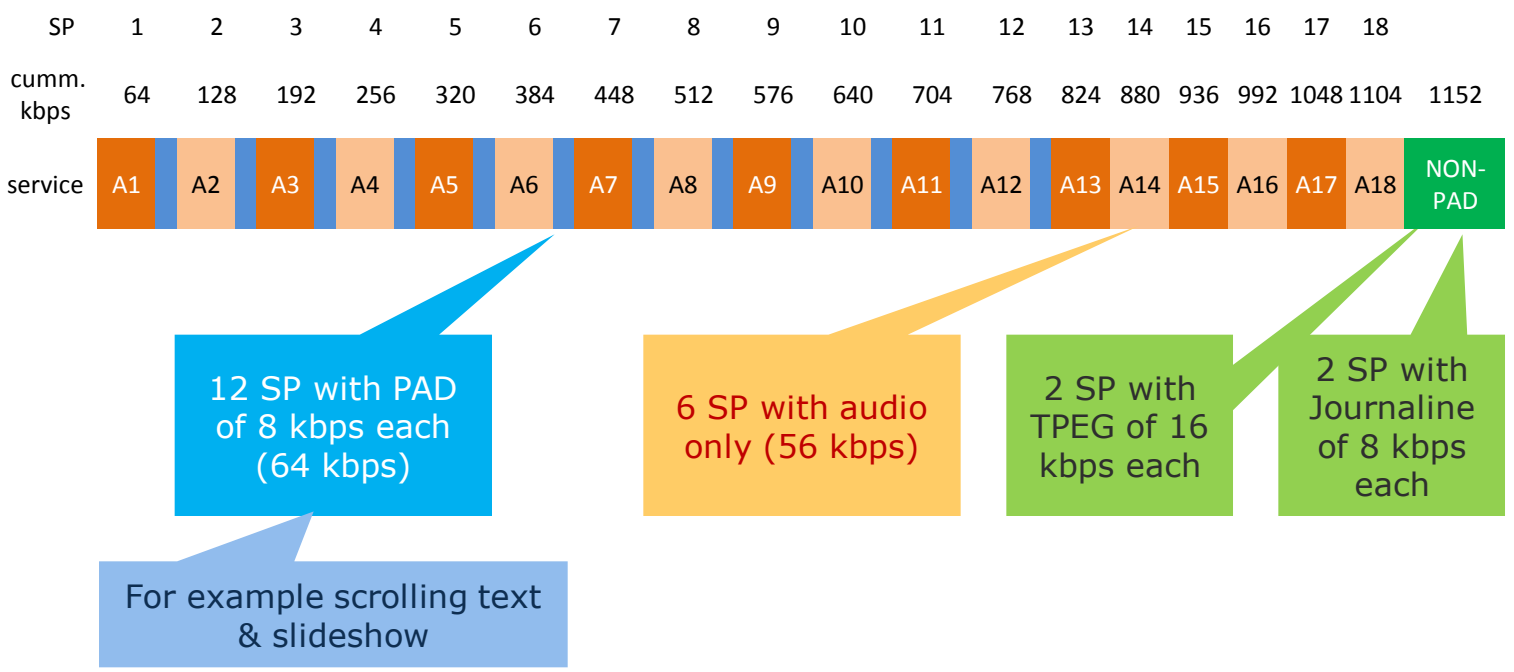
2. DRB services & planning – multiplex loading

Step 2: capacity per service

No	Service / Quality Objective	Service payload bit rates	Implemented figures	Recommended
1.	High quality 2 channel stereo sound	64-96 kbps	88kbps	64 kbps
2.	Good quality 2 channel stereo sound	48/56/64/72 kbps	56-64 kbps	40-48 kbps
3.	Limited quality 2 channel stereo sound	32-48 kbps	-	-
4.	5.1 channel surround sound	64 -128 kbps, depending on the content	-	64 -128 kbps depending on the content
5.	PAD data service	10 % of above	-	10 % of above

2. DRB services & planning – multiplex loading

Step 3: loading the multiplex



- Many loadings possible which can vary daily
- Number of Service licenses and capacity per license determines multiplex load

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2. DRB services & planning – plan targets & results

Two frequency planning scenarios & targets

Frequency Plan completed

Plan A

Plan B

Frequency Planning in progress

	Scenario 1	Scenario 2
Description	All VHF Band III on air (and protected)	All digital situation – ASO VHF Band III
Pop coverage target	10 +1 city	95%, including 11 cities
# national MUX	3	4
# national audio services	3x(18 or 9)=54 to 27 (1)	4x(18 or 9)=72 to 36
# local MUX	None	4
# local services	None	72 to 36 in 39 local areas
# regional MUX	None	None
# regional services	None	None

Plan A FP results:

- 3 cities not possible due to ATV adjacent channel interference
- BKK TX site serves 4 cities
- 4 other TX sites cover other cites
- Total pop coverage = 8-15%
- Blocks 7 B,C,D and 8 B,C,D

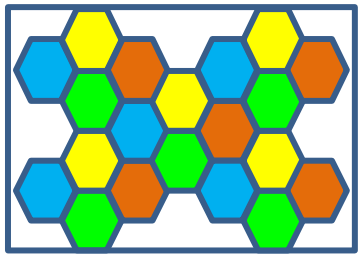
2. DRB services & planning – plan targets & results

Further planning work will show required spectrum

- Planning shows targets are demanding:
  - Scenario 1: avoiding adjacent channel interference
  - Scenario 2: number of blocks for national and local layer -> 2 in FP (Trial) and 7 (t.b.c) blocks (for nat. & loc.)
- Further planning work will show blocks for each local layer

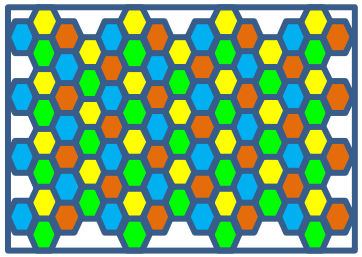
Target (scenario 3)	# blocks
4 national layers	8
4 local layers	28
total	**36**
Available	**32-3=29**

1 layer = 4 blocks



20 areas

1 layer = 4 blocks



100 areas

= SFN or single site

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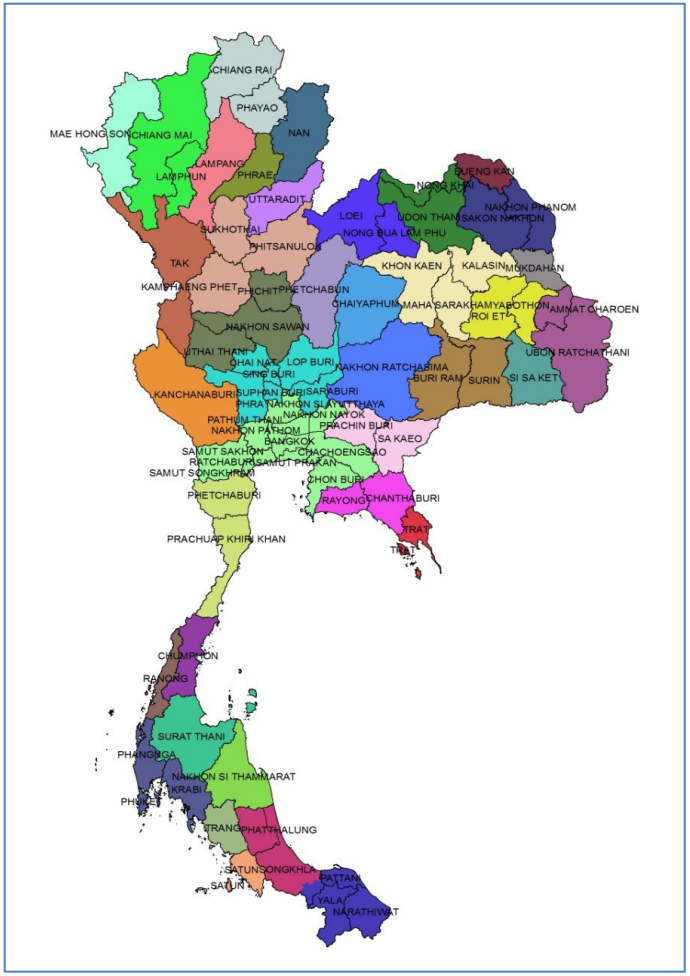
2. DRB services & planning – reaping synergies

Synergies between DTTB and DRB

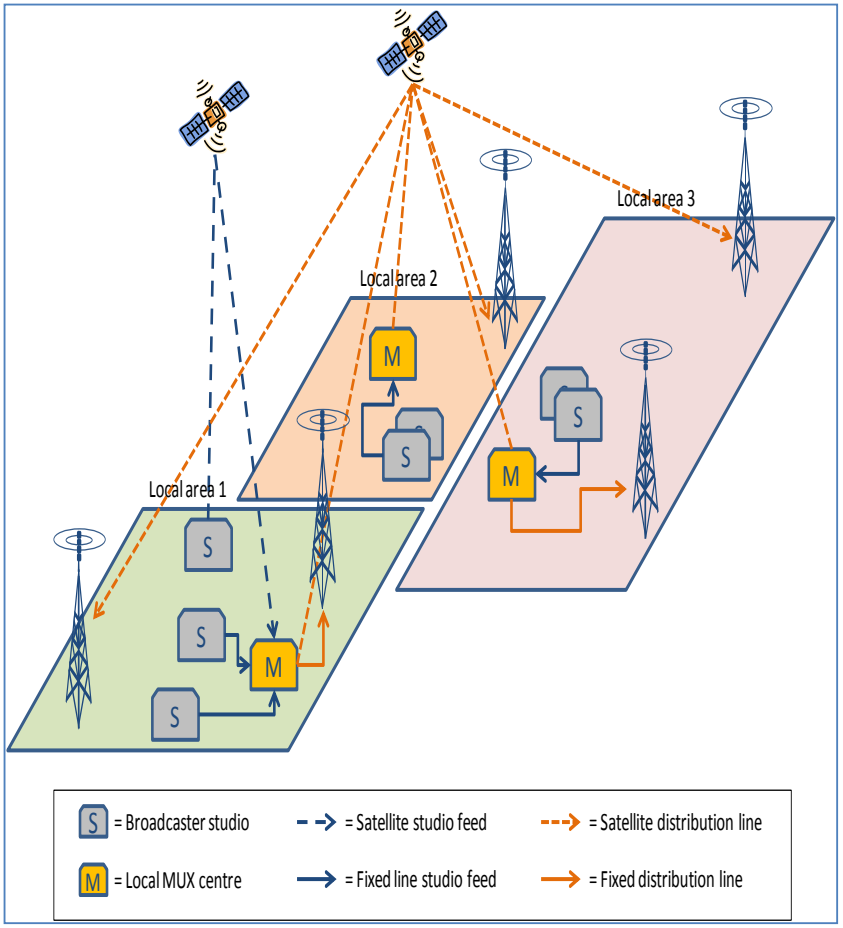
- DTTB network deployment before DRB
- 39 DTTB Local areas will be defined
- DRB Local areas should be the same because:
  - Communication / consumer confusion
  - Infrastructure / facility sharing between DTTB and DRB networks



2. DRB services & planning – reaping synergies

Facility sharing reduces DRB cost levels

- Facility sharing between DTTB / DRB:
  - Combined DTTB / DRB NOs
  - Sharing agreements
- Reducing DRB cost levels by sharing:
  - Distribution links
  - Site facilities
  - Fixed line studio feeds
  - Tower sharing



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2. DRB services & planning – local service planning

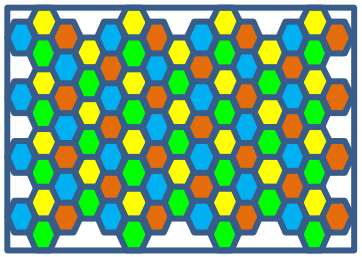
Size of DRB Local areas drive FP and costs

- Economic viability:
  - Smaller areas limit DRB earning capacity
  - Smaller broadcasters can still access market by Point of Service (PoS) pricing
- Frequency inefficiency:
  - Smaller areas lead to spectrum inefficiencies
  - Planning targets are spectrum demanding
- Deployment costs:
  - Smaller areas will require lower ERPs and more sites

Local area pop	#
< 1m	15

Local area size	#	PI diameter (10 kW ERP)
~ 25 – 80 km	10	~ 60 km

1 layer = 4 blocks



100 areas

= SFN or single site

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DAB Network Architectures and Equipment

ITU/NBTC Workshop
16 December 2014

Dr. Les Sabel
International Telecommunication Union

Overview

DAB+ Network Structures

Redundancy

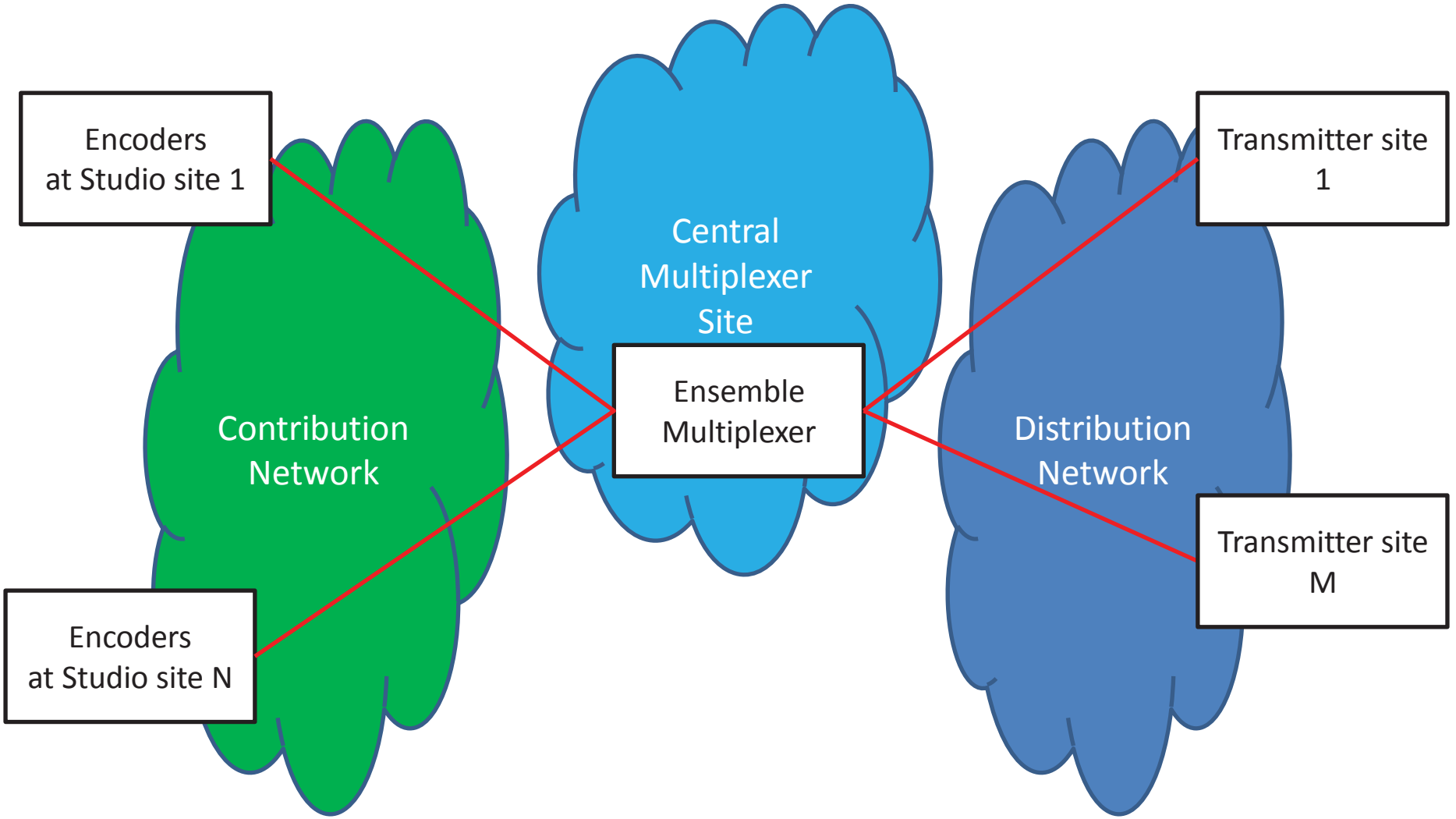
Proposed Network Architectures

Ancillary Equipment

Next Steps

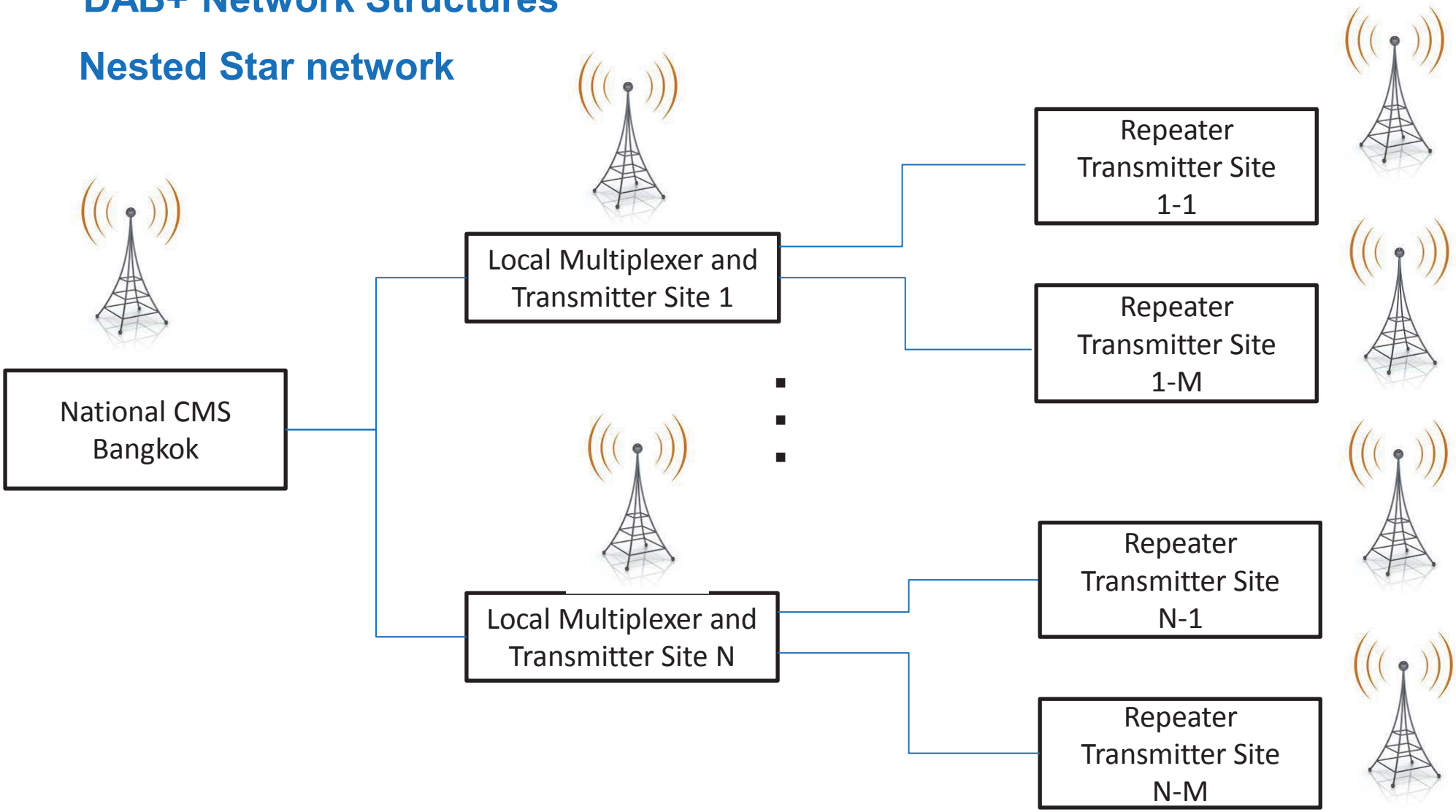
DAB+ Network Structures

DAB+ Network Structures



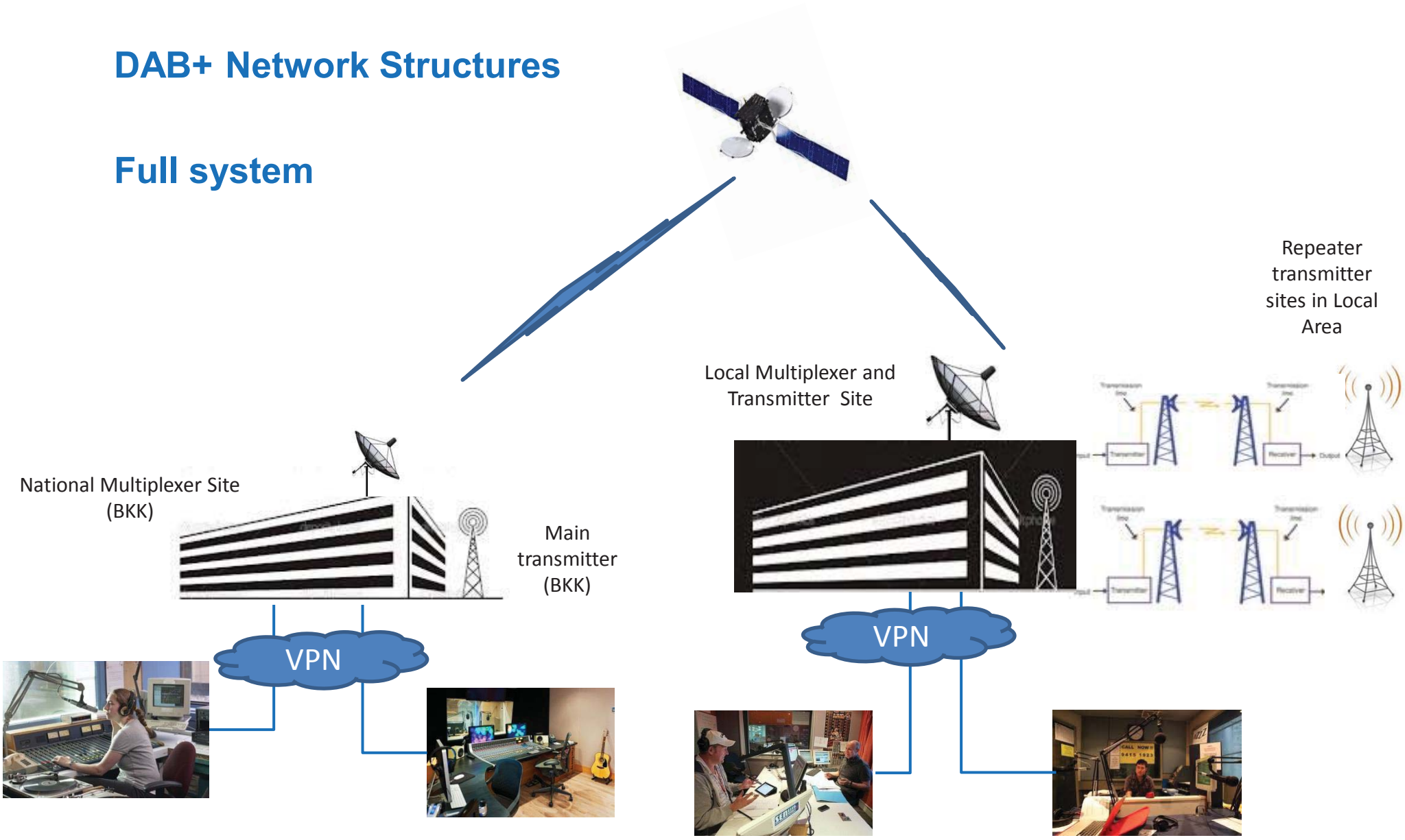
DAB+ Network Structures

Nested Star network



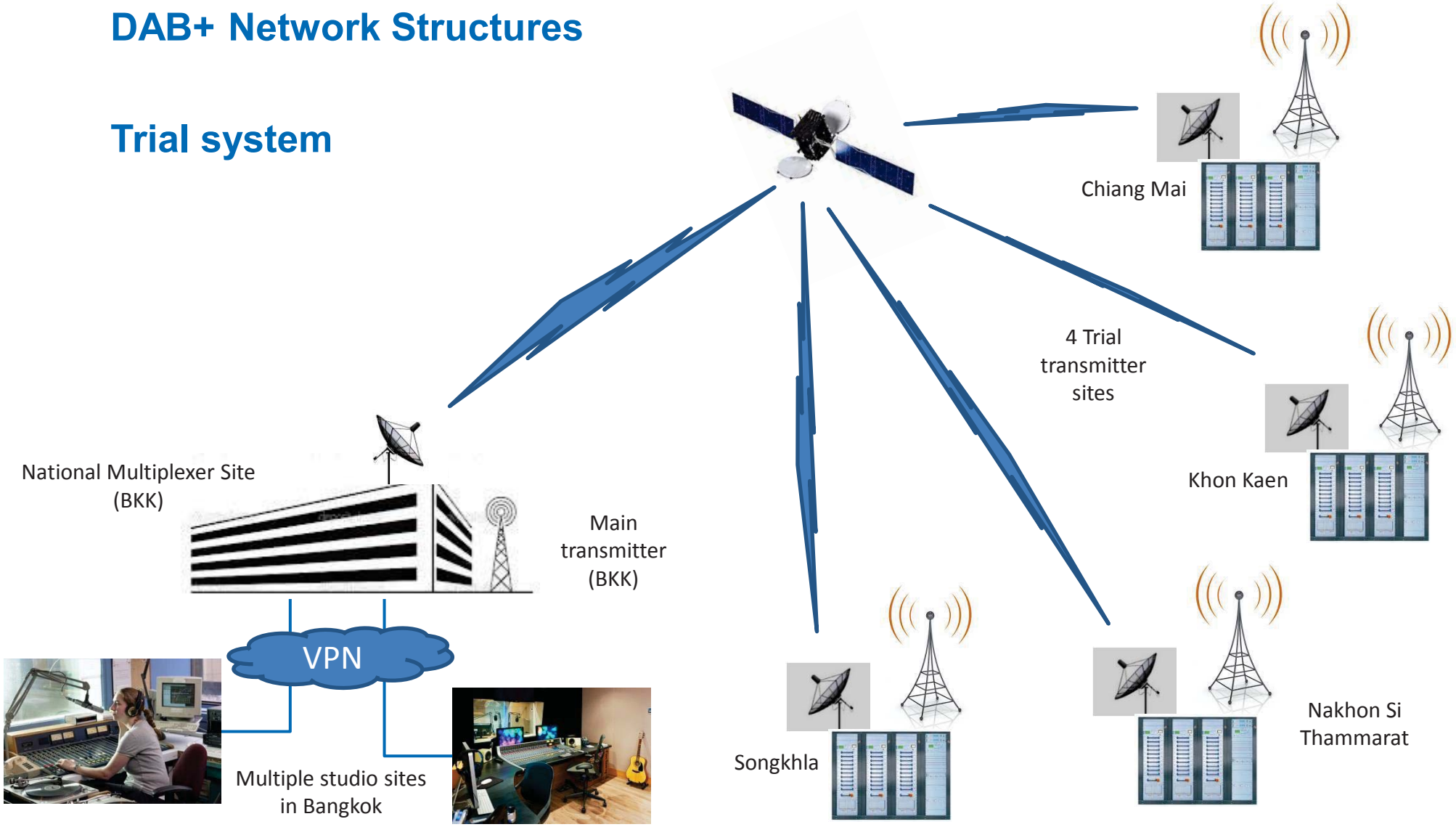
DAB+ Network Structures

Full system



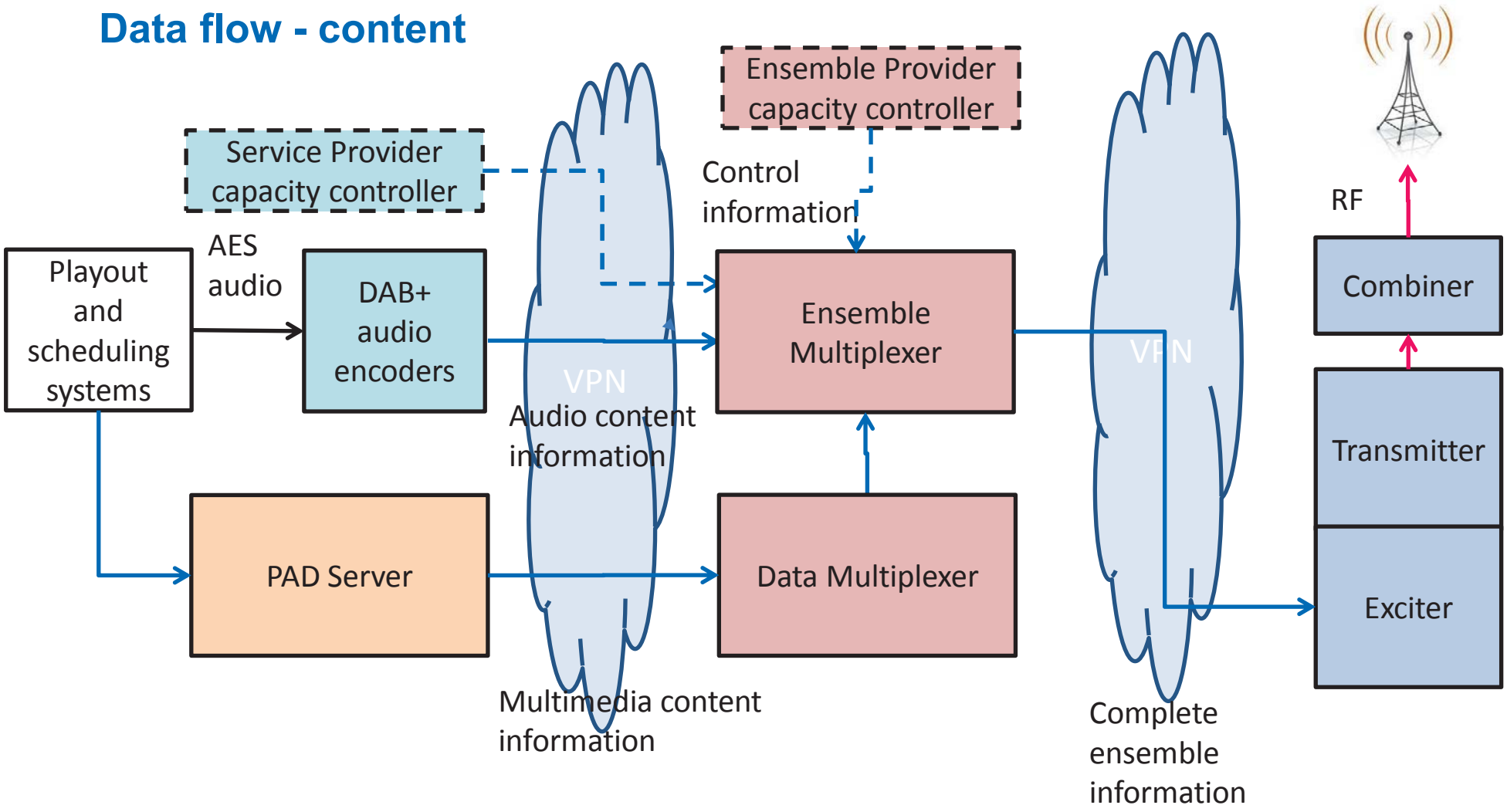
DAB+ Network Structures

Trial system

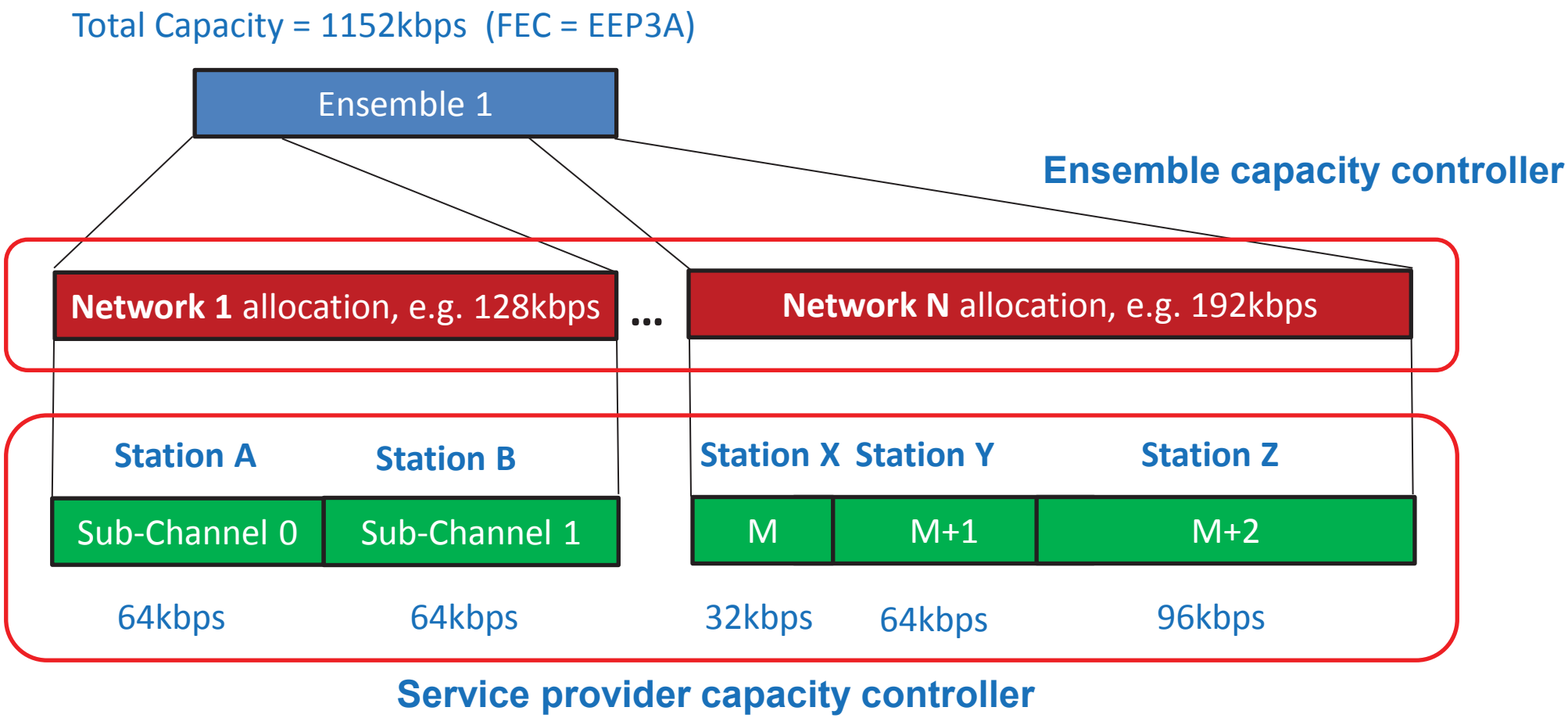


DAB+ Network Structures

Data flow - content

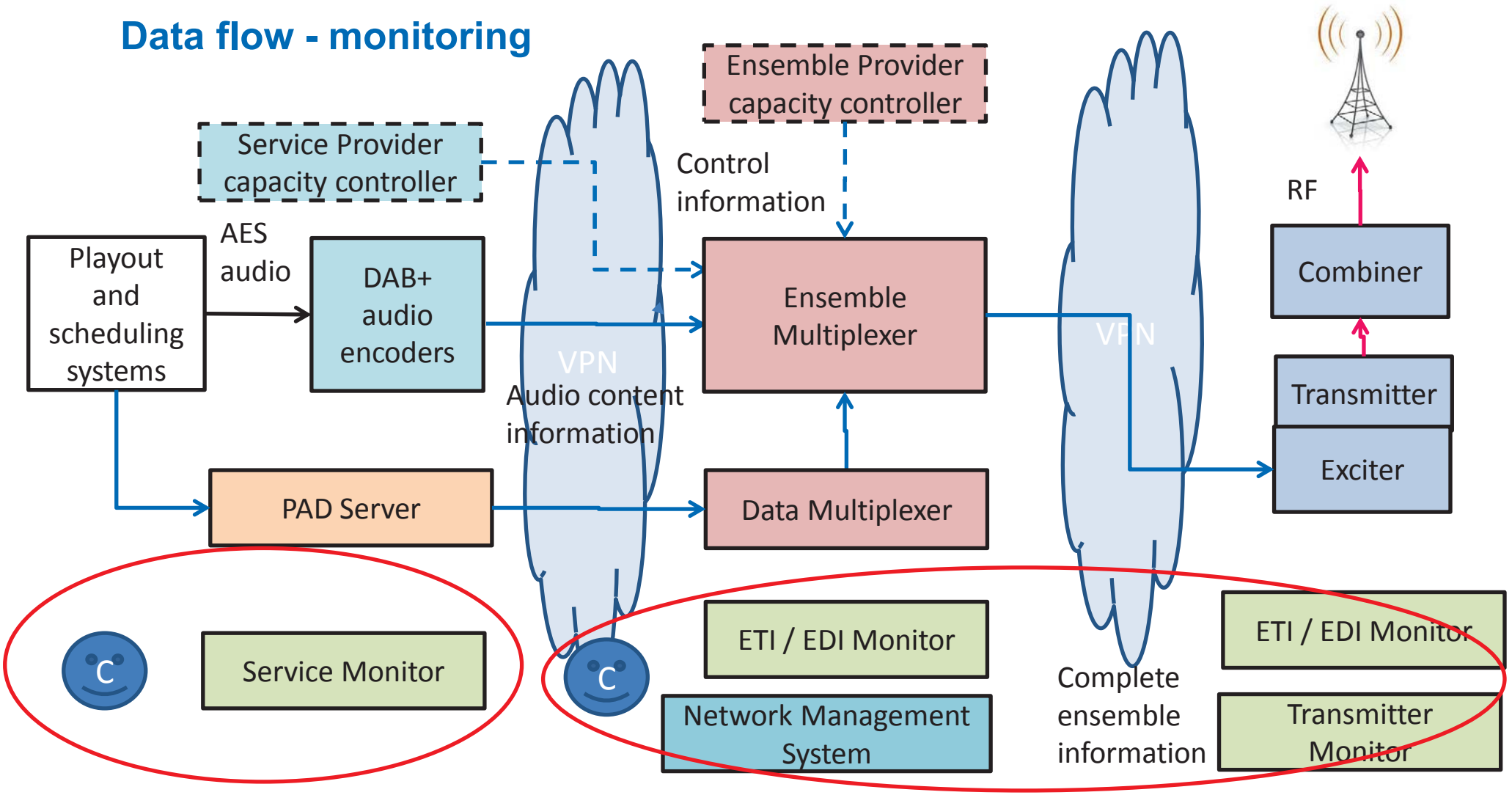


DAB+ Network Structures – Capacity control

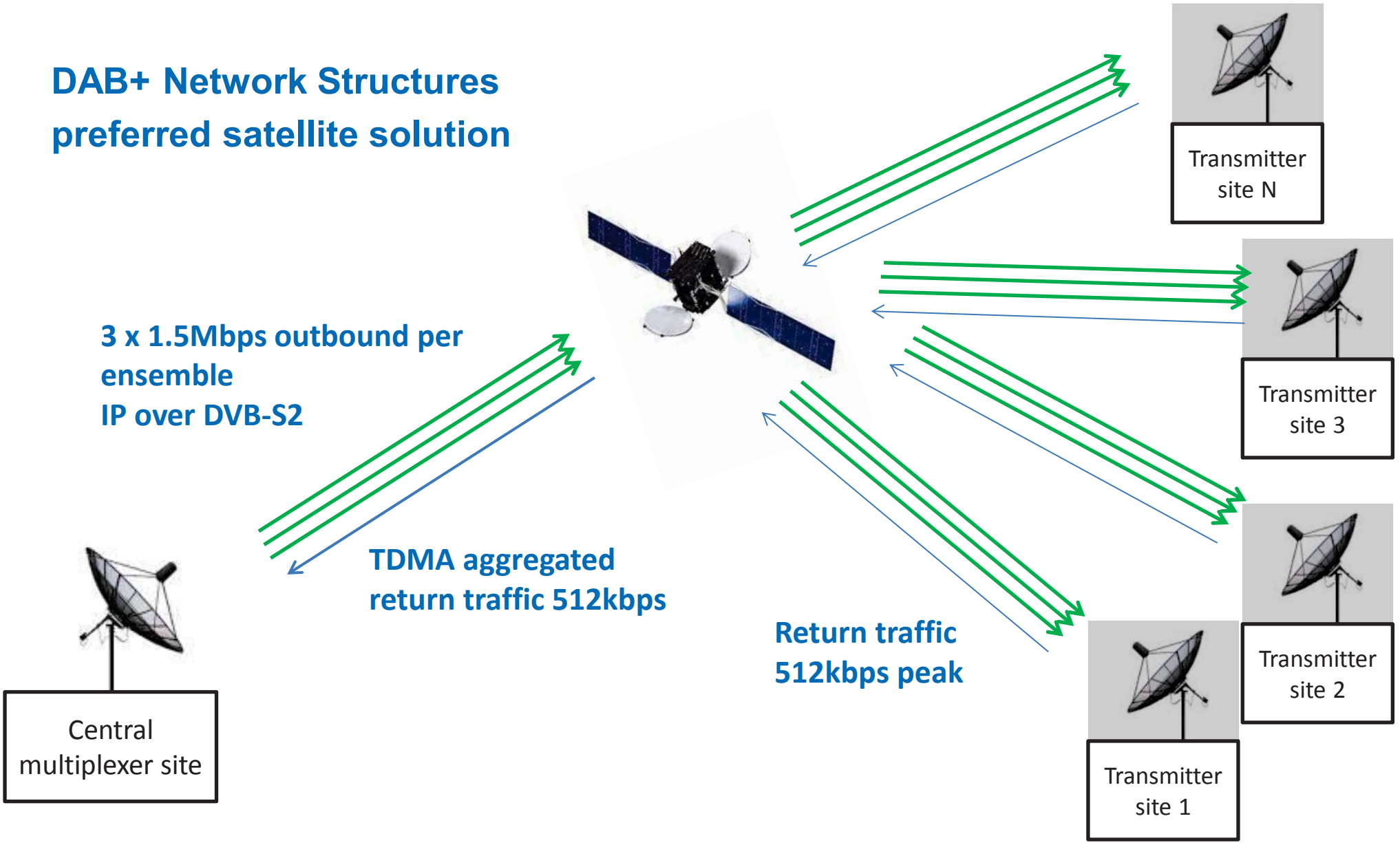


DAB+ Network Structures

Data flow - monitoring



DAB+ Network Structures
preferred satellite solution



DAB+ Network Structures

Architectures are proposed for the three main site types

- Studio Site
- Central Multiplexing Site (CMS)
- Transmitter Site

The architecture for each site type is reused at all sites with minimal variations

The contribution and distribution networks will generally be very similar with only slight variations in both contribution and distribution based on local conditions

Redundancy

Redundancy

Purpose

- Minimise service interruptions
  - Equipment failures
  - Equipment servicing and maintenance

Cost Benefit

- Increases as the listening population increases
- Redundancy can be added in stages to spread Capex over time
- Need a minimum amount to counter potential long periods of outage

Types

- None
- N+1
- 1+1

Redundancy

Equipment options	Audio Service Interruption					
	Failure			Maintenance		
	None	N+1	1+1	None	N+1	1+1
• Studio						
• Encoders	Y	Y	N	Y	N	N
• Service Controller	N	N	N	N	N	N
• Studio to EMUX link	Y	-	N	Y	-	N
• PAD Server	N	N	N	N	N	N
• Multiplexer Sites						
• Ensemble Multiplexer	Y	-	N	Y	-	N
• Ensemble Controller	N	N	N	N	N	N
• Data Multiplexer	N	N	N	N	N	N
• NTP server	Y	-	N	Y	-	N
• NMS	N	N	N	N	N	N

Redundancy

Equipment options

- Transmitter site
  - Distribution Links
  - Transmitters
    - Exciter
    - PA
  - Combiner
  - Antenna system
  - Monitors

Audio Service Interruption					
Failure			Maintenance		
None	N+1	1+1	None	N+1	1+1
Y	Y	N	Y	N	N
Y	-	N	Y	-	N
Y	Y	N	Y	N	N
Y	-	-	Y	-	-
Y	-	N	Y	-	N
N	N	N	N	N	N

Ancillary Equipment

Ancillary Equipment

- Essential for system operation
- Used to ‘glue’ the primary system components together
- Provides support functions
- Has a critical influence on system performance

Critical items

- NTP server
- IP switches and routers
- UPS

Ancillary Equipment

Don’t forget….

- Power systems back up
- Lightning protection and grounding
- MSTS for system access and control

Measurement tools

- Field measurements and analysis
- Monitors – RF transmitter, ETI/EDI
- Network Management System

Next Steps

The road is long…..

Next Steps

- An assessment of the system cost has been undertaken
- Given agreement to proceed the budget needs to be examined to determine the level of redundancy possible
- It is recommended to construct with an architecture as close to the full system as possible to allow maximum systems and operations learning
- A detailed analysis of the coverage area and interference analysis is required to design the optimum transmission power and pattern ensure maximum population coverage
- The full system design should be undertaken including processes in the operation redundant systems – there maybe some system enhancements required

Next Steps

- Site arrangements for equipment positioning
- Tower access and antenna positioning
- Operations planning – management, monitoring and maintenance
- Equipment tendering and purchase
- Factory and Site Acceptance Test plans
- Trials test plans
  - Testing different FEC rates
  - Testing On-Channel Repeater capabilities (additional equipment)
  - Testing SFN operation (additional equipment)
  - Tuning coverage analysis and modelling tools
- Engage with the industry

The future

Thank You

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DAB Network Architecture

Investments and cost drivers

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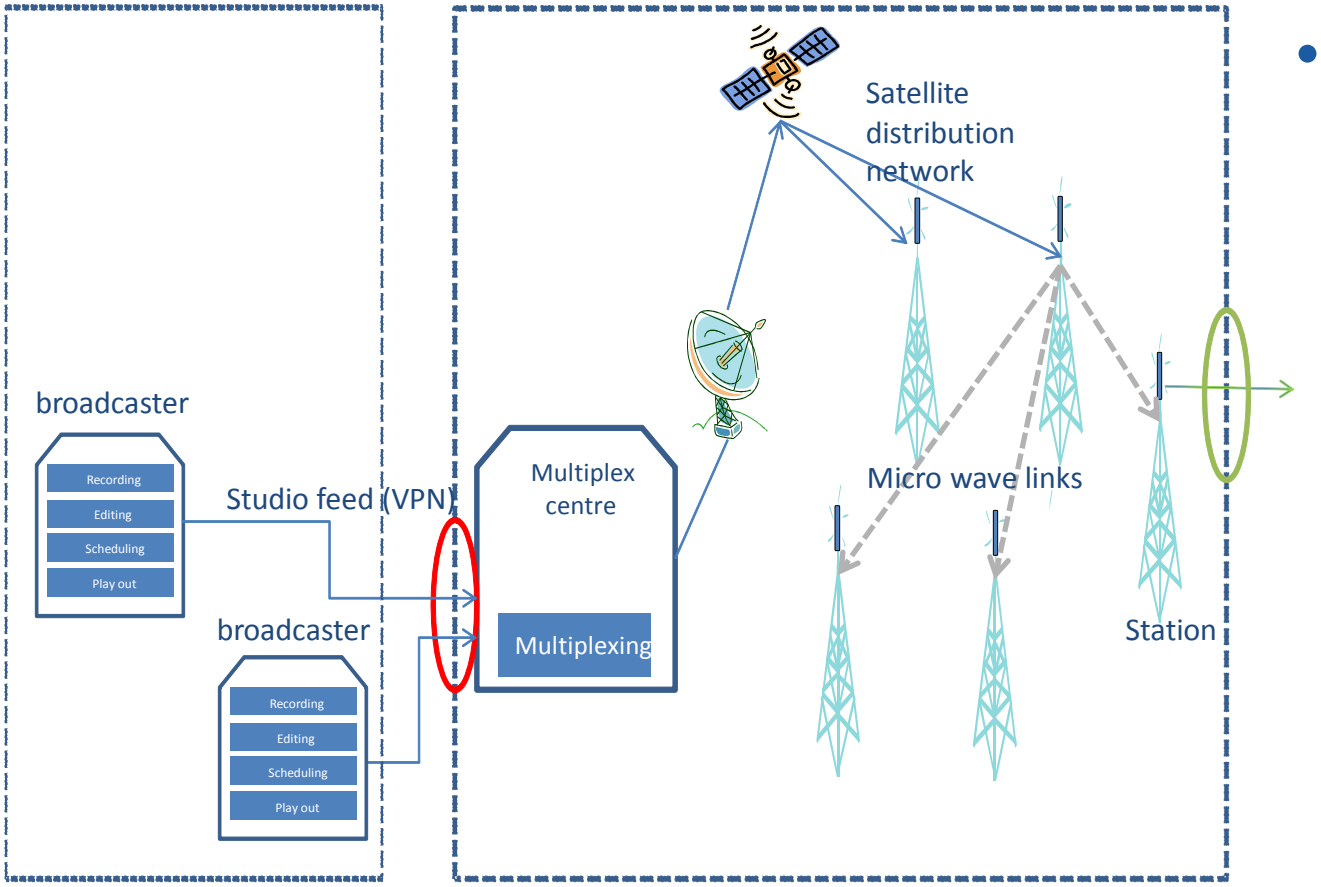
Presentation Overview

1. **Introduction**
   - Scope
   - LRIC
   - Cost drivers
2. **CAPEX**
3. **OPEX**

1. Introduction

1. Introduction – scope



- In scope:
  - Encoding in studio
  - Studio feeds
  - Encoding & multiplexing of studio feeds
  - Distribution of DAB+ compliant services
  - Transmission

1. Introduction – Long Run Incremental Costs

$$LRIC\ of\ the\ minimum\ service = \frac{(\text{Cost of providing the minimum service} - \text{Cost without the minimum service})}{\text{Total number of services in the network/multiplex}}$$

- The cost of the (minimum) service comprises:
  - Capital expenditure (CAPEX) and Operating expenditure (OPEX) directly relevant to the provision of (minimum) service;
  - Reasonable (??) return on capital, calculated on the basis of weighted average cost of capital (WACC);
  - Common cost relevant to the business operation but cannot be directly or indirectly allocated to minimum service – mark-up model (EPMU)
- WACC can vary from 10% - 25% depending on the risk profile
  - Country and industry specific
  - Market structure and offer
  - Size of operations/company

1. Introduction – cost drivers

- For any terrestrial broadcast network the technical cost drivers are:
  1. Network topology = Number of sites and power (ERP) per site
  2. Number of multiplexes
  3. Level of redundancy
- In terms of service offering these drivers are:
  1. Population and geographical coverage
  2. Number of services, type and quality of service
  3. Service availability/reliability
- Service requirements should be matched with:
  - Business case (at industry level and per market player)
  - Finance capacity (risk profile)
  - Service deployment phases/timing of investments

2. CAPEX

2. CAPEX – scenarios

DAB CAPEX Dashboard

		Pop coverage	
Forecast	Theoretical	95%	61,750,000
Total # sites	502		
Number of National MUX (layer)	4		
Number of Local MUX (layer)	4		
Number of Local areas	39		
Number of audio services in national ensemble	9		
Number of audio services in local ensemble	18		
% greenfield sites	40%		

	National	Local
Redundant encoder	yes	yes
Redundant multiplexer	yes	yes
Redundant distribution	no	
Redundant transmitter	yes	

Source: ITU

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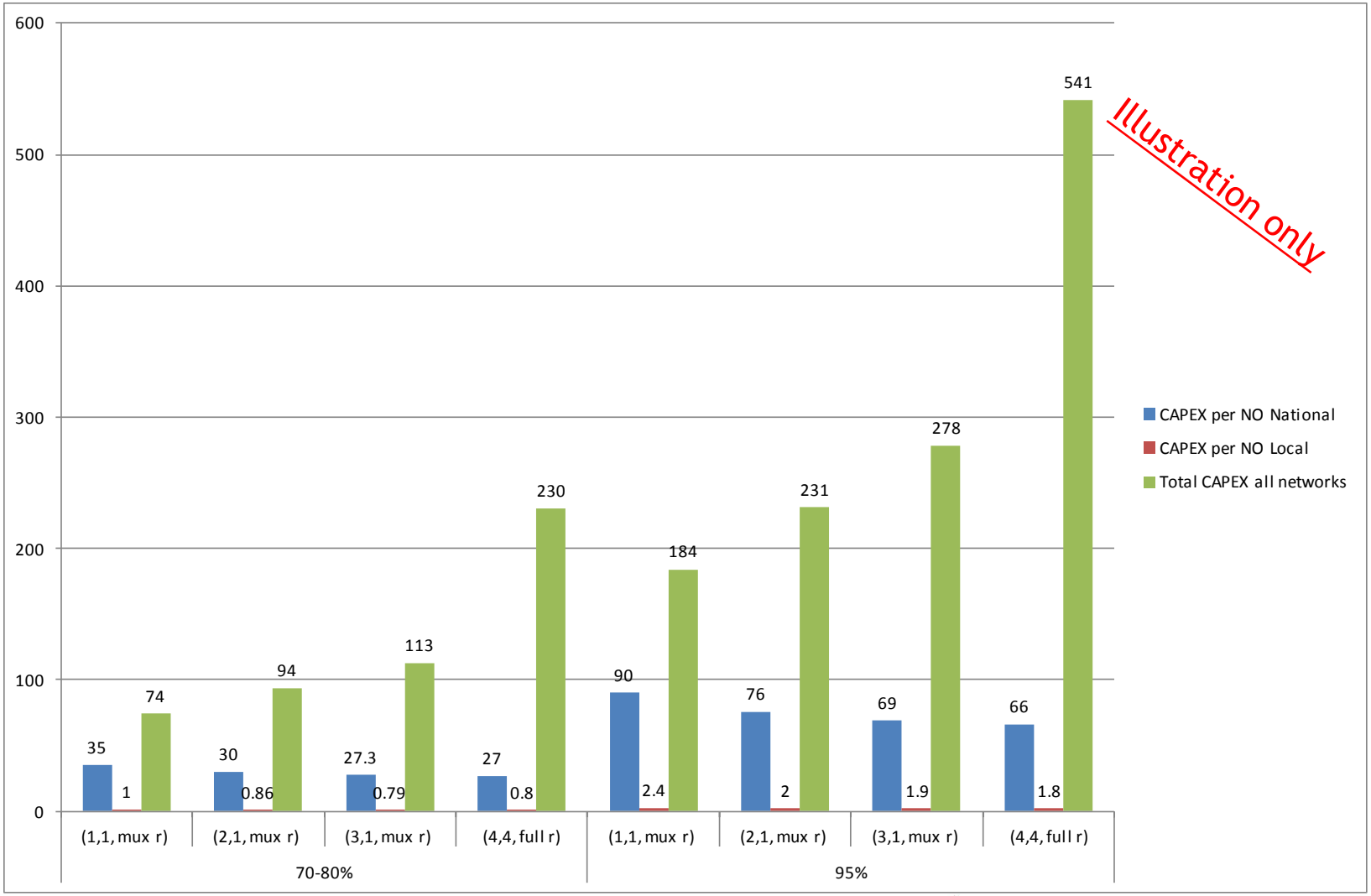
2. CAPEX – network operator (in m$)



Source: ITU

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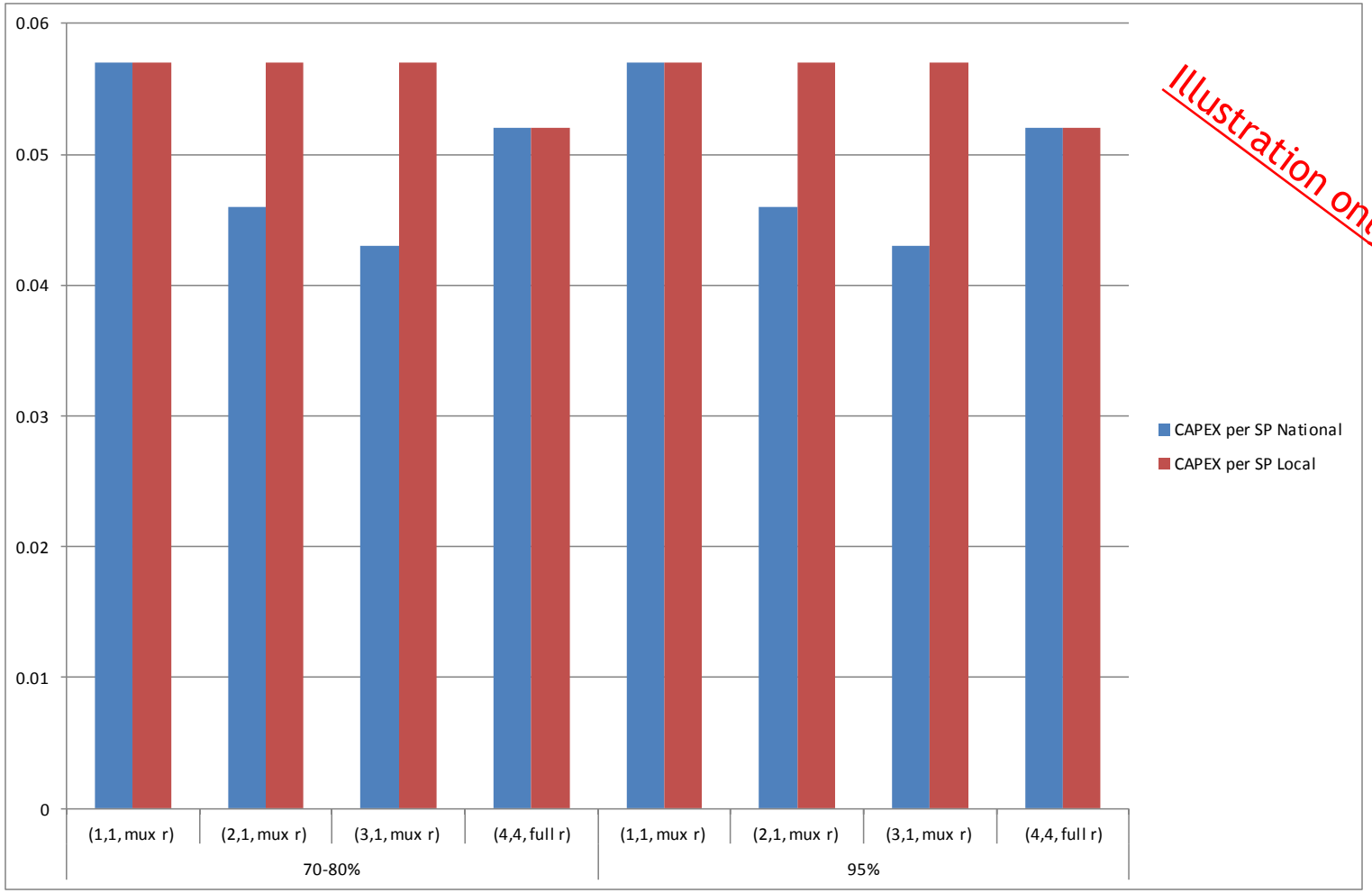
2. CAPEX – service provider (in m$)



Source: ITU

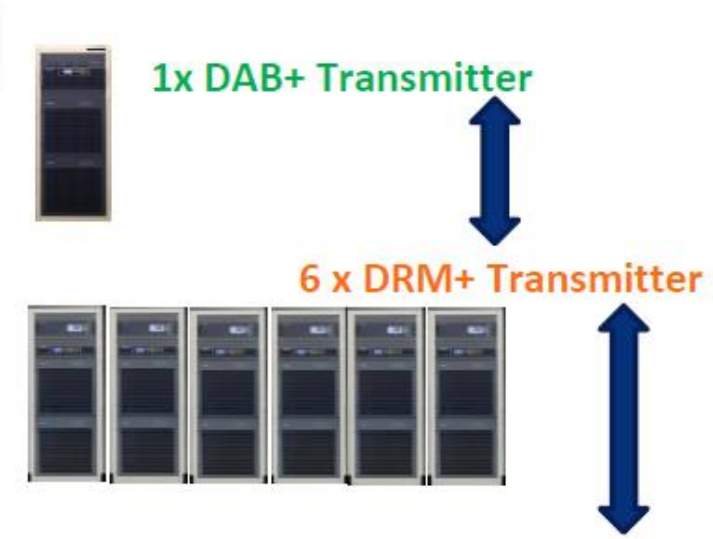
3. OPEX

3. OPEX – categories

- OPEX can comprise the following costs categories (design dependent):
  - Distribution (satellite transponder rental)
  - Energy (feeding TX and cooling)
  - Floor and tower space (of Facility license holder)
  - Service & maintenance costs (including spares, staff & contracts)
  - License fees (NBTC)
- OPEX is periodical cash-out and has a different risk profile for investors

3. OPEX – example

- 18 radio services/same coverage – energy savings



Transmitter	FM	DRM+	DAB+
Power	10 kW	1 kW rms	2,5 kW rms
Efficiency	72%	40 %	40%
Energy consumption per Transmitter	13,9 kW	2,5 kW	6,25 kW
Transmitters	18	6	1
Energy all Transmitters	250 kW	15 kW	6,25 kW
Annual cost of energy	328.500	20.000	8.000

Source: Harris Broadcast