

# DAB in Thailand

Network design and cost analysis

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## AGENDA

1. Network and system requirements
2. Transmission plan summary
3. Network options
4. Functional implications
5. Cost analysis
6. Conclusions

# Network and system requirements

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## High level requirements

- 95% of population coverage
- Accommodate the majority of existing FM services, approx. 4,000
- Target the lowest overall Total Cost of Ownership (TCO) while not compromising system efficiency
- The transmission plan includes National, Regional and Local services.

## The DAB system includes:

- Capex: Audio and PAD encoder systems, Head-end systems, Transmitters, Antenna systems, Monitoring systems, IP systems, GLUE
- Opex: Site costs, telecommunications costs, energy costs, operations costs (maintenance, monitoring and repairs)

# Network and system requirements

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## Network architectures

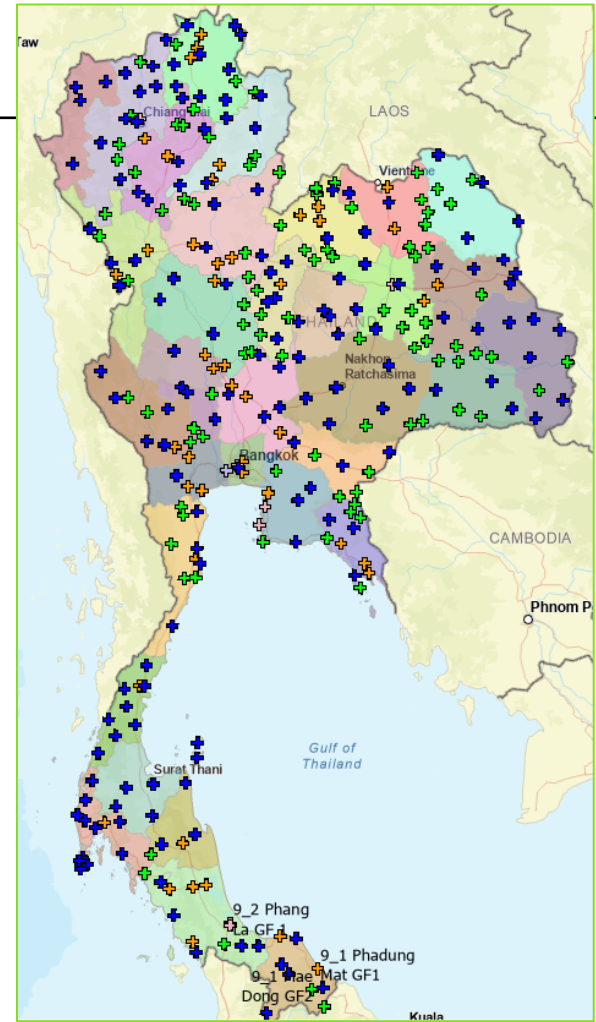
- Primary network layer scenarios studied

Layer	Number of ensembles		
	Scenario 1	Scenario 2	Scenario 3 (Baseline)
National	0	1	1
Regional	0	0	1
Local	3	2	1

- Scenario 3 is the baseline as it treats all layers equally
- Other scenarios are also studied when considering demand and rollout variations

# Transmission plan summary

The plan includes 330 transmissions in 34 sub-regions and 10 regions



# DAB+ multiplexer network options

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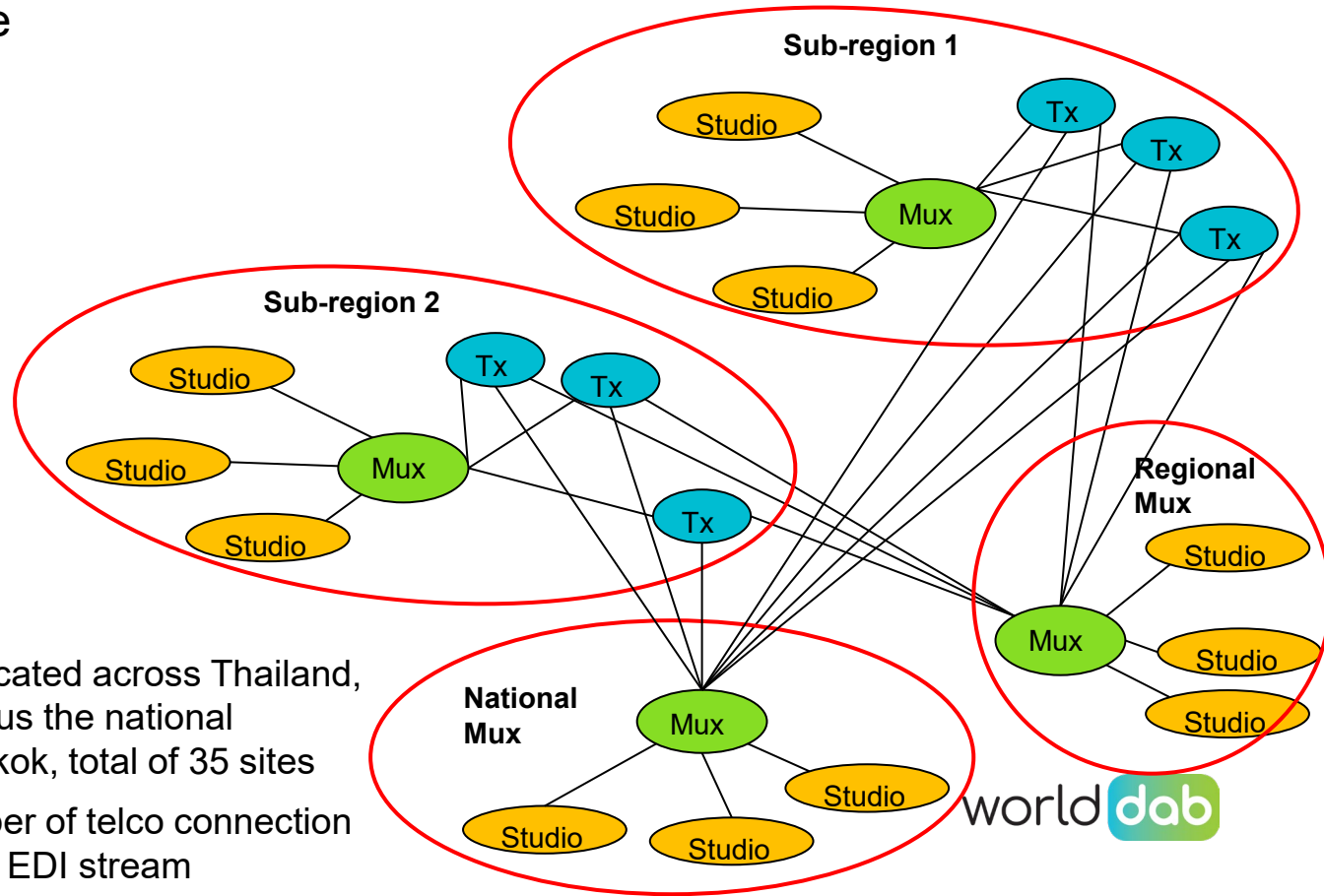
## Multiplexer system network architecture options

- Distributed
- Regional
- Centralised

# DAB+ multiplexer network options

## Distributed architecture

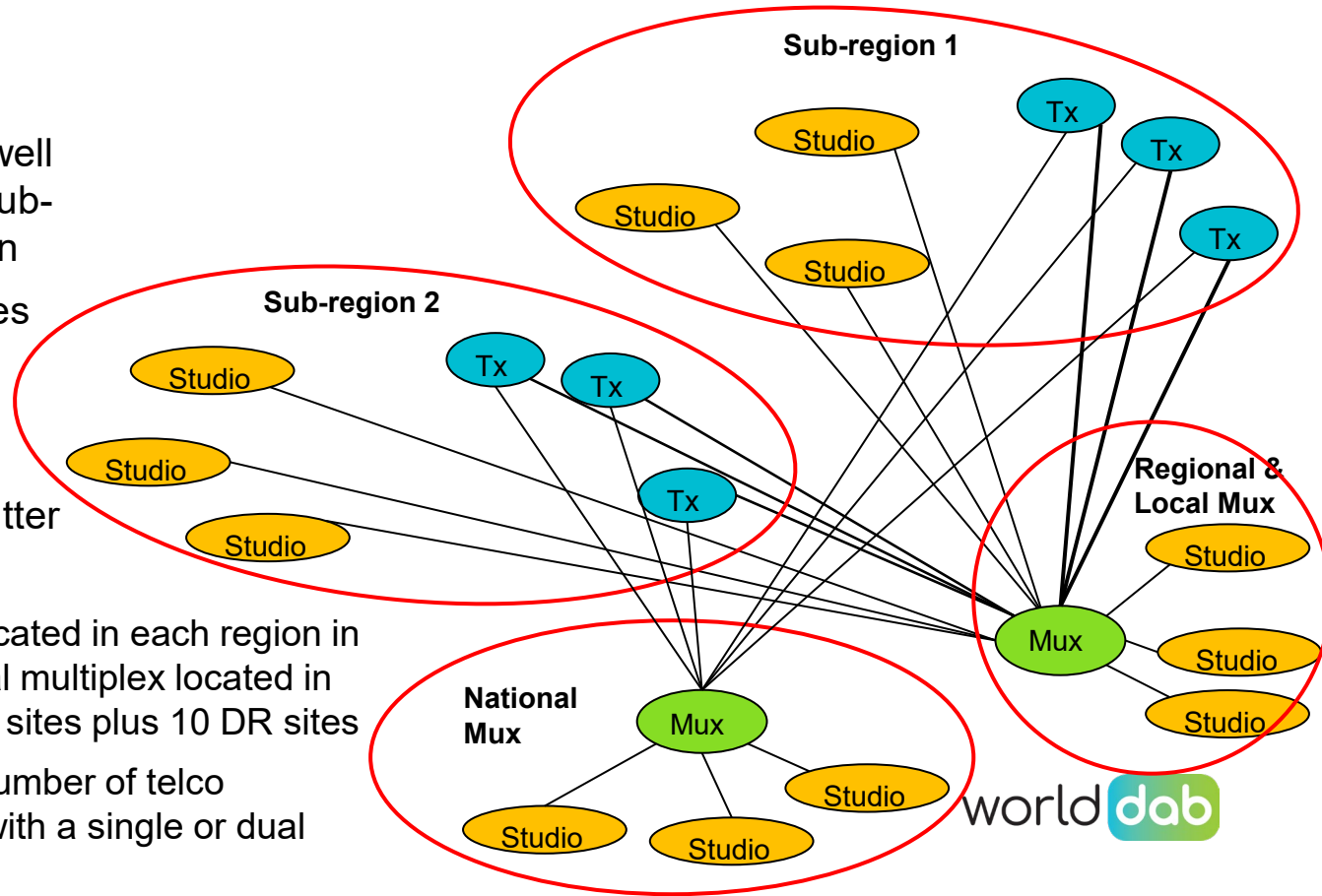
- Each local sub-region has its own multiplexer and multiplexer centre connected to all transmitter sites within the sub-region
- Each region has its own multiplexer connected to all transmitter sites within that region
- The national multiplexer connects to ALL transmitter sites
- Multiplexer centres are located across Thailand, one in each sub-region plus the national multiplexer located in Bangkok, total of 35 sites
- There will be a high number of telco connection routes, most with a single EDI stream



# DAB+ multiplexer network options

## Regional architecture

- Each region hosts the regional multiplexer as well as multiplexers for the sub-regions within that region
- Regional multiplexer sites require a Disaster Recovery site
- The national multiplexer connects to ALL transmitter sites
- Multiplexer centres are located in each region in Thailand, plus the national multiplex located in Bangkok, total of 11 main sites plus 10 DR sites
- There will be a medium number of telco connection routes, most with a single or dual EDI stream

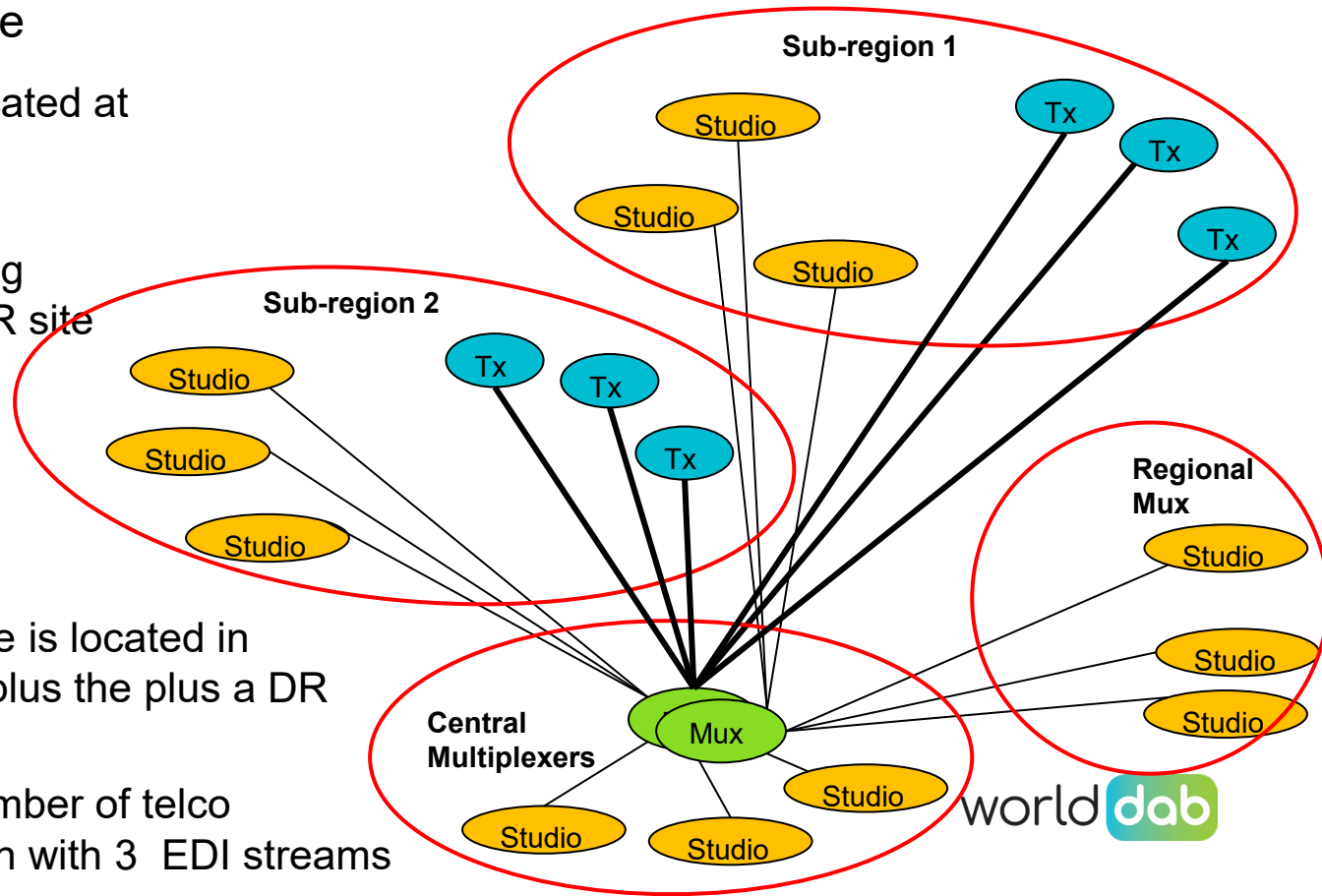




# DAB+ multiplexer network options

## Centralised architecture

- All multiplexers are located at a centralised main multiplexing centre
- The central multiplexing centre will require a DR site
- Main multiplexer centre is located in Bangkok in Thailand, plus the plus a DR site outside Bangkok
- There will be a low number of telco connection routes each with 3 EDI streams



# Functional implications

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- The cost of the network is the primary consideration when choosing the most appropriate architecture
- However, we need to address a number of Operational Considerations when both specifying the network constraints and selecting the network architecture
- We rate each architectural option as High (best), Medium (middle) and Low (worst)

Aspect	Centralised	Regional	Distributed
Functionality	H	M	M
Reliability	H	H	M
Flexibility	H	M	L
Maintainability	H	M	L
Operations	H	M	L
Security	M	M	M

- Overall the Centralised multiplexer network architecture has the most beneficial operational considerations
- The Distributed architecture provides some security and resilience capabilities due to the distributed nature of the sites

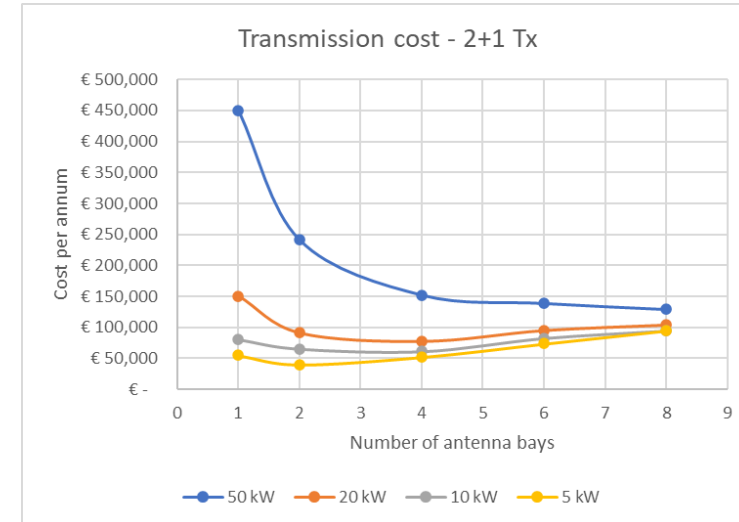
# Cost analysis


- Process

- Generation of broadcasters, multiplexer and transmission site templates
  - Determine the combination and transmitter power and antenna gain to minimise the transmission site TCO<sup>1</sup>
  - Parameterize the head-end requirements
    - Scenarios for the number of ensembles and services
- The TCO period – nominally 7 years

Baseline parameters are:

- Network layers = 1N + 1R + 1L
- Multiplexer systems shall be 1+1 redundant
- Transmitters shall be N+1 redundant
- IP systems shall be 1+1 redundant
- Centralised and Regional architectures shall have DR sites
- The DR sites do not have redundant mux and encoding systems
- Each ensemble contains 18 services (at 64 kbps)

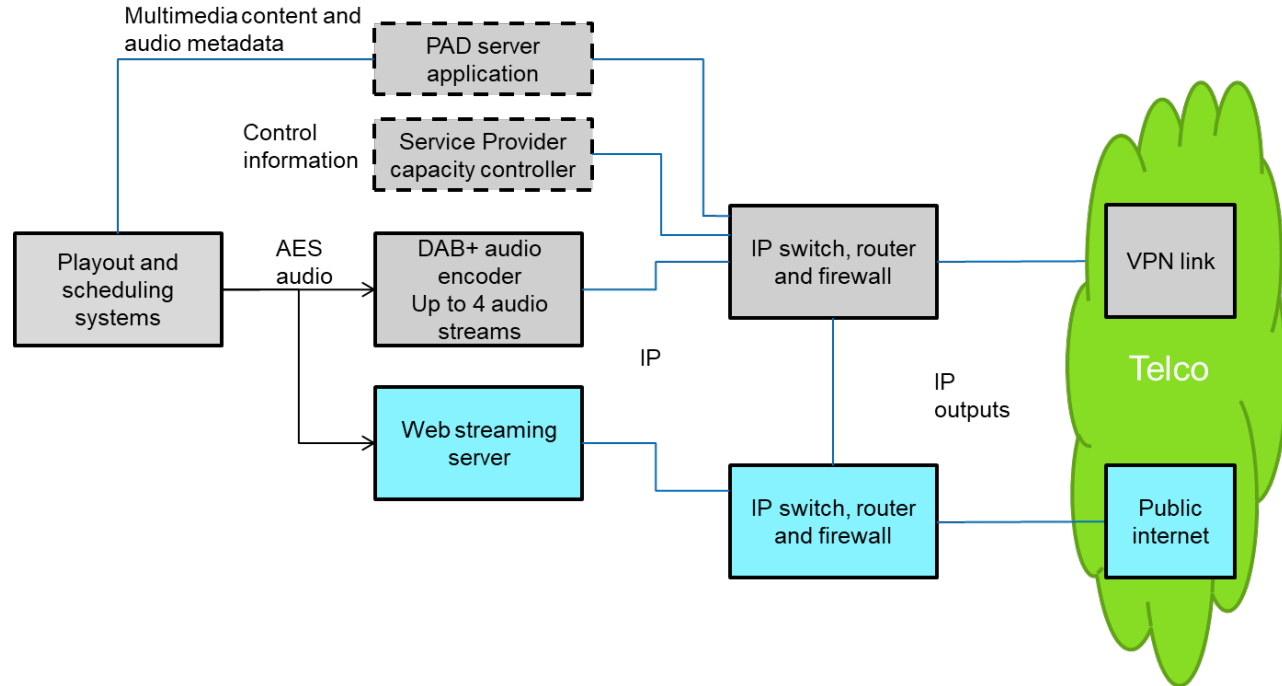


<sup>1</sup> See the WorldDAB ebook “Establishing DAB+ Digital Broadcast Radio”   
<https://www.worlddab.org/resources/establishing-dab-plus-ebook>

# Cost analysis

## Site templates – Broadcaster site

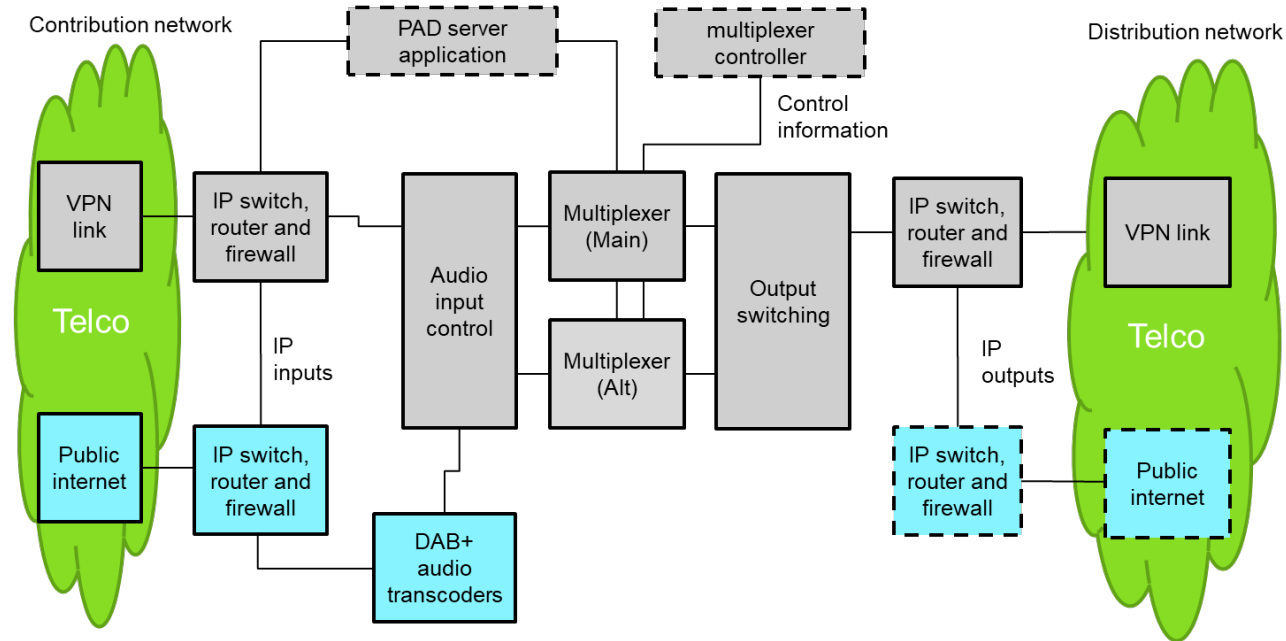
- The broadcaster equipment is the same for all network architectures
- The core equipment is shown in grey
- Optional PAD server and Service controller have dashed outline
- The redundant systems are shown in blue



# Cost analysis

## Site templates – Multiplexer site - Main

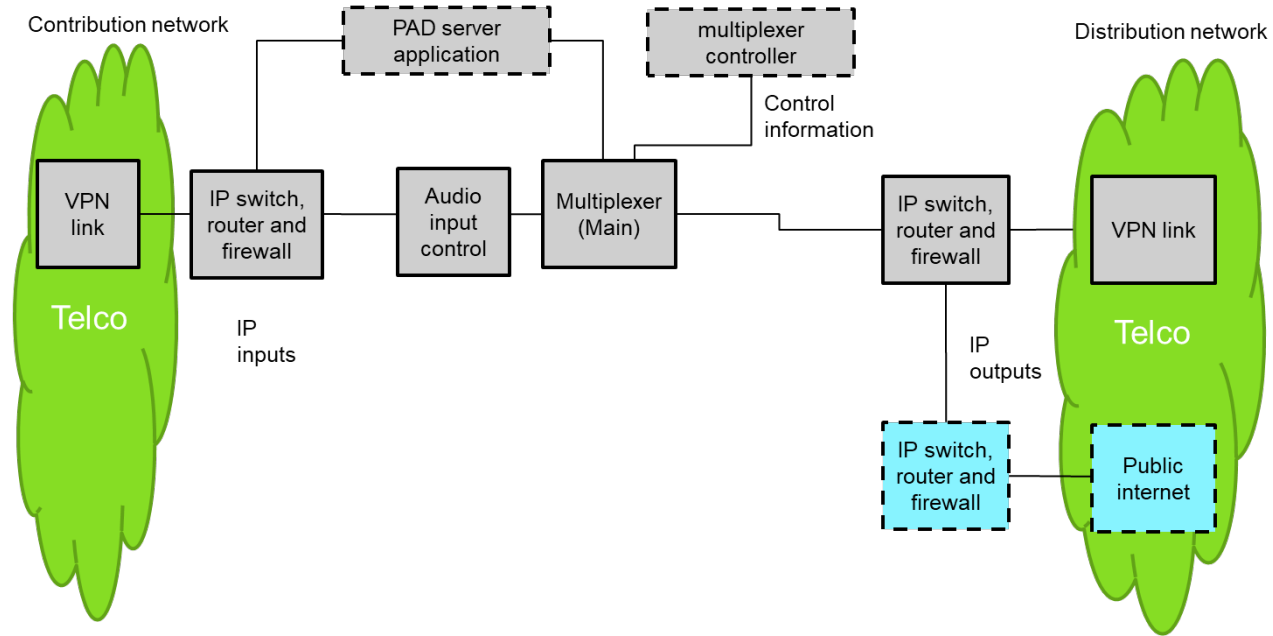
- Generalised flow diagram
- Vendor dependent
- Architecture dependent
- Applies to all architectures



# Cost analysis

## Site templates – Multiplexer site - Disaster Recovery

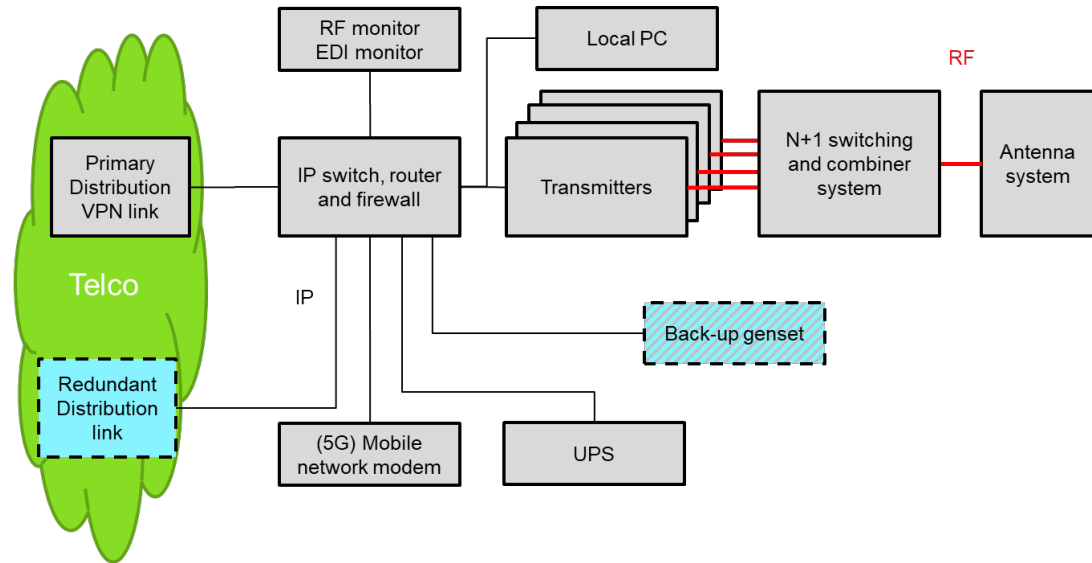
- Only used for Centralised and Regional architectures
- No Alt multiplexer
- No Audio transcoders – relies only on the studio encoders



# Cost analysis

## Site templates – Transmitter site

- The diagram applies to all transmitter suite types
- The number of transmitters is equal to the number of ensembles + 1 for redundancy

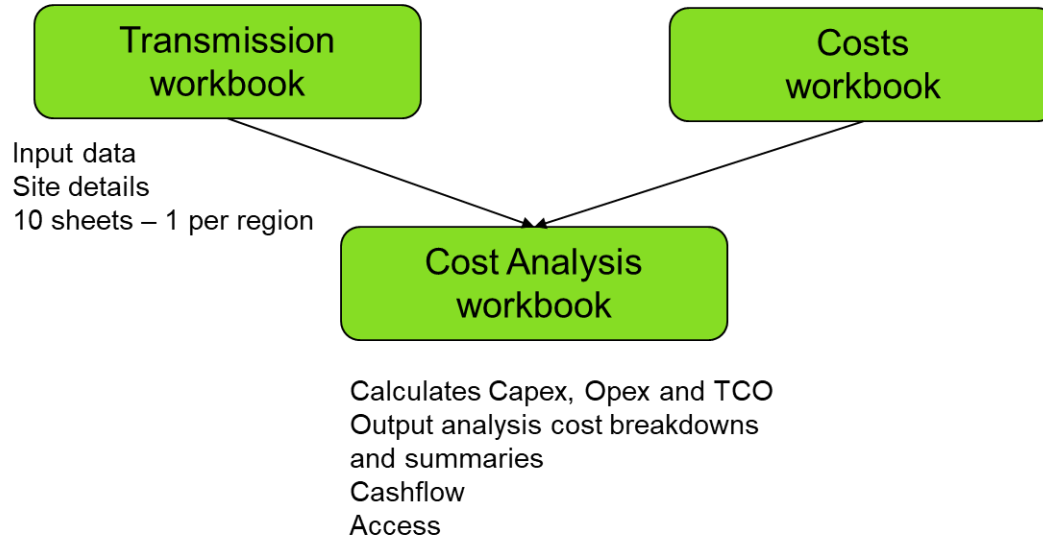


# Cost analysis

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## Capex, Opex and TCO

- The calculations are performed in a Microsoft Excel workbook / spreadsheet
- The analysis takes input from
  - transmission site details workbook
  - Vendor costs workbook – with budgetary quotations from reputable companies





# Cost analysis

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- Analysis
  - TCO results are shown as % relative to the lowest being 100%

Cost	Architecture		
	Distributed	Regional	Centralised
% TCO (7 years)	101.7	101.5	100.0
% Multiplexer network Capex	7.9	7.6	6.3
% Multiplexer network Opex	9.5	13.6	9.3

- The Centralised architecture is the most cost effective
- The multiplexer network requires less than 8 % of the total Capex
- The multiplexer network requires less than 10% of total Opex
- The transmission sites dominate both Capex and Opex

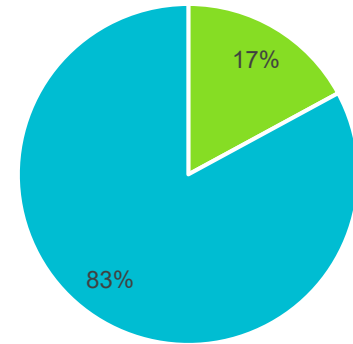
# Cost analysis

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## Results - Centralised

- Overall comparison of Capex and Opex over the TCO amortisation period (7 years)
  - Opex = 71%
  - Capex = 29%
- If we make the TCO amortisation period 14 years
  - Opex = 83%
  - Capex = 17%

Centralised architecture - Capex v Opex - 7 years



■ Period Capex ■ Period Opex

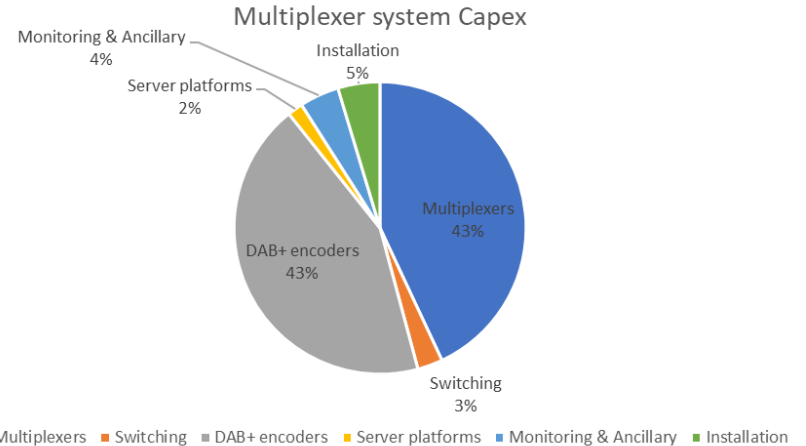
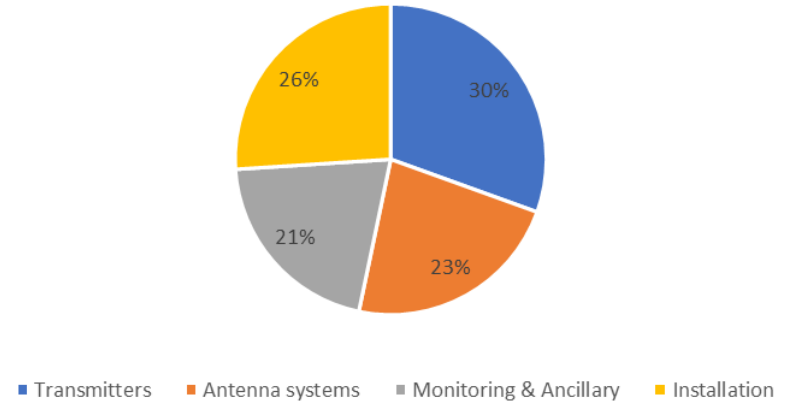
It is very important to ensure that Opex costs such as site access, Telco and Operations are minimised through the use of the most appropriate systems choices and operating procedures

# Cost analysis

## Results – Centralised - Capex analysis

- Tx sites
  - Transmitters – 30%
  - Antenna systems = 23%
    - Total = 53% of Tx sites and 48% of all Capex
  - Installation – 26%
    - possible focus area for Capex reduction
- Emux sites
  - Multiplexing systems – 43%
  - Encoders – 43%

Transmitter site Capex

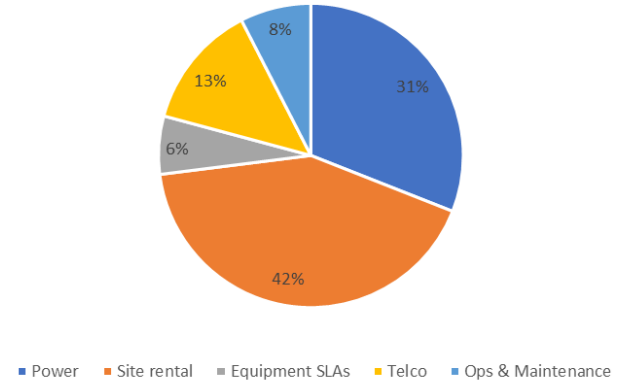


# Cost analysis

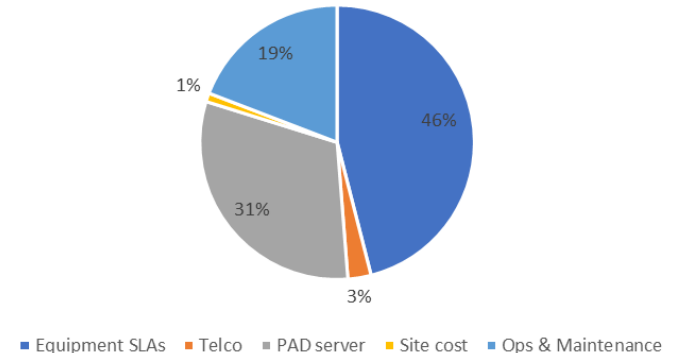
## Results – Centralised – Opex analysis

- Tx site
  - Site rental – 42%
    - a good target for Opex reduction
  - Power – 31%
    - The reason why we optimise the antenna
  - Telco – 13%
    - May be optimistic
- Emux
  - Service Level Agreements – 46%
    - Seems very high given Centralised systems
  - PAD systems – 31%
    - Seems very high for functionality gained
  - Ops and maintenance – 19%
    - Needs further investigation

Transmitter site Opex



Emux Opex



## Observations and conclusions

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- The analysis indicates that the CAPEX difference between the 3 options was small and was dominated (90%) by the transmission site equipment
- Opex costs are around 34% per annum of the Capex cost
  - Dominated by Tx site access fees, Energy and Telco costs
- Opex costs need to be carefully obtained due to their long term impact
- The Centralised network architecture option has the most positive operational aspects
- The Distributed option has the highest level of local control, but also the highest long term Opex
- When stakeholders work together they can produce new opportunities

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# Thank you

*For further information, please contact:*

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