DAB+ Digital Radio

Network Planning

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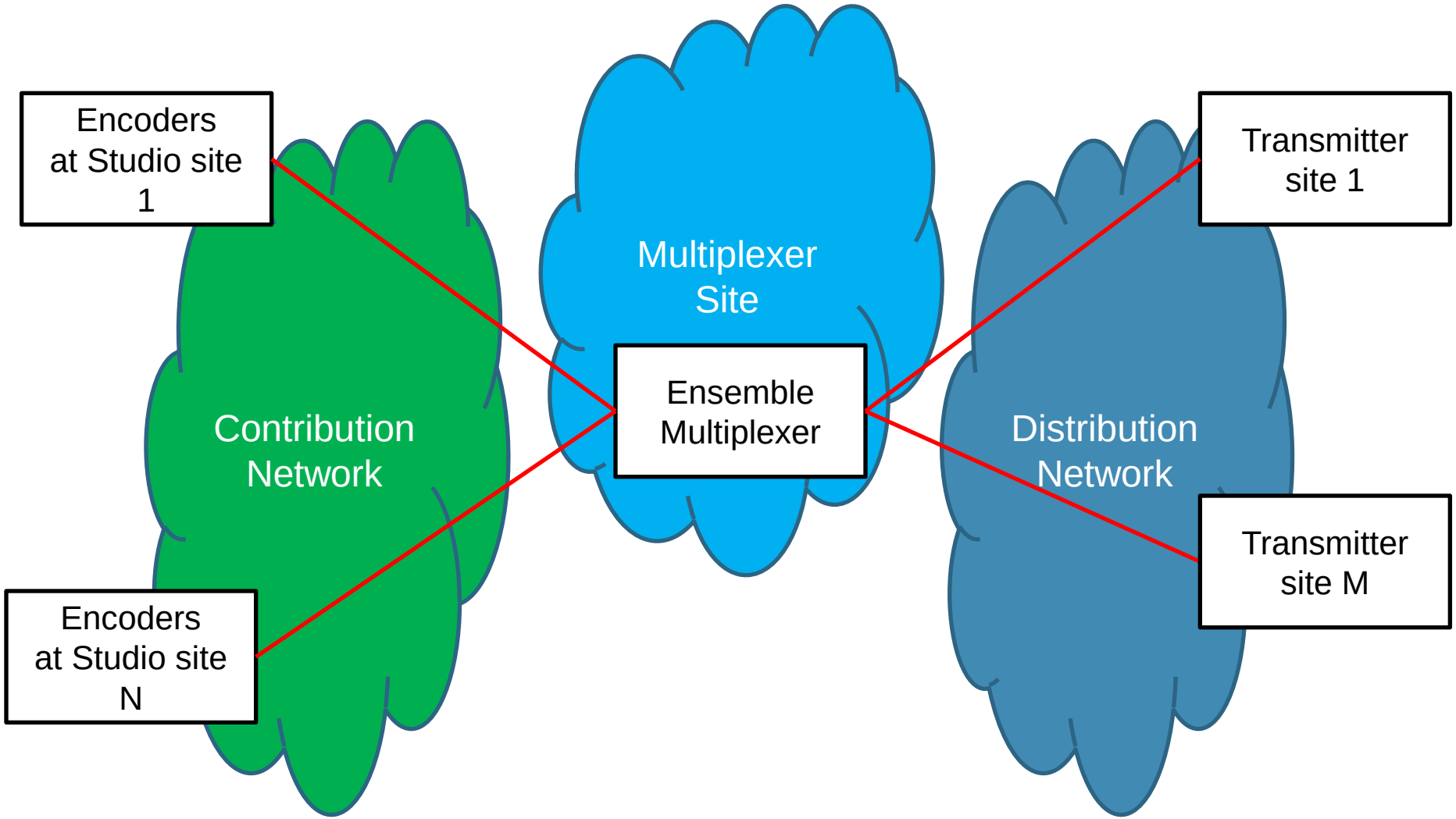
Network Planning: Contents

1. System requirements
2. Network types
3. Equipment location options
4. Cost benefit analysis

Network Planning: System requirements



Network Planning: System requirements

Delivery Requirements

Where

- Locations - terrain impacts, connectivity options

When

- Rollout schedule – what, where, when

Quality

- Uptime – typically 99.97% - 3 hours per year down time!!
- Error resilience – automatic recovery from errors
- Redundancy – at a cost effective price
- Disaster recovery – how to ensure the business survives

Cost

- Options – now vs later

Network Planning: System requirements

Delivery Requirements

What - content

- Contribution
  - Multiple services typically at 64kbps from multiple sites
- Distribution
  - Transmitter at different location to multiplexer?

What – control and monitoring

- Control
  - Forward commands can be delivered to multiple sites with only the addresses system responding
  - IP can be used for direct point-to-point actions
- Monitoring
  - Each site will report its status and health to one or more network management centres
  - May be some local and well as main central monitoring site depending on network type and ownership

Network Planning: Network types

Network Types

Star

- Often cheapest solution
- Not flexible
- Good for single site or area operations

Mesh

- Provides inbuilt redundancy and hence increased reliability
- Is flexible
- Good for multisite operations which share content, especially across multiple sites

Mixed

- Built to optimise cost
- Reliability as required
- Target content distribution according to business needs
- Expand / adjust as required

Network Planning: Equipment Location

Network design is based on minimum cost of ownership

The biggest Opex cost is generally SPACE!

- Main transmission tower and hall
- Repeater sites
- Connectivity

Often on-going LEASE arrangements

- Towers are expensive to build (in most countries)
- In cities there is often no space for new ‘green fields’ developments
- Telcos provide connectivity at the MAXIMUM cost bearable to the customer

Sites are the most important consideration

- Coverage first!
- Tower location options?
- Connectivity options

An ideal scenario

- High transmitter site at low cost!
- Line-of-site from studio to transmitter

Network Planning: Equipment Location

Isolated Star

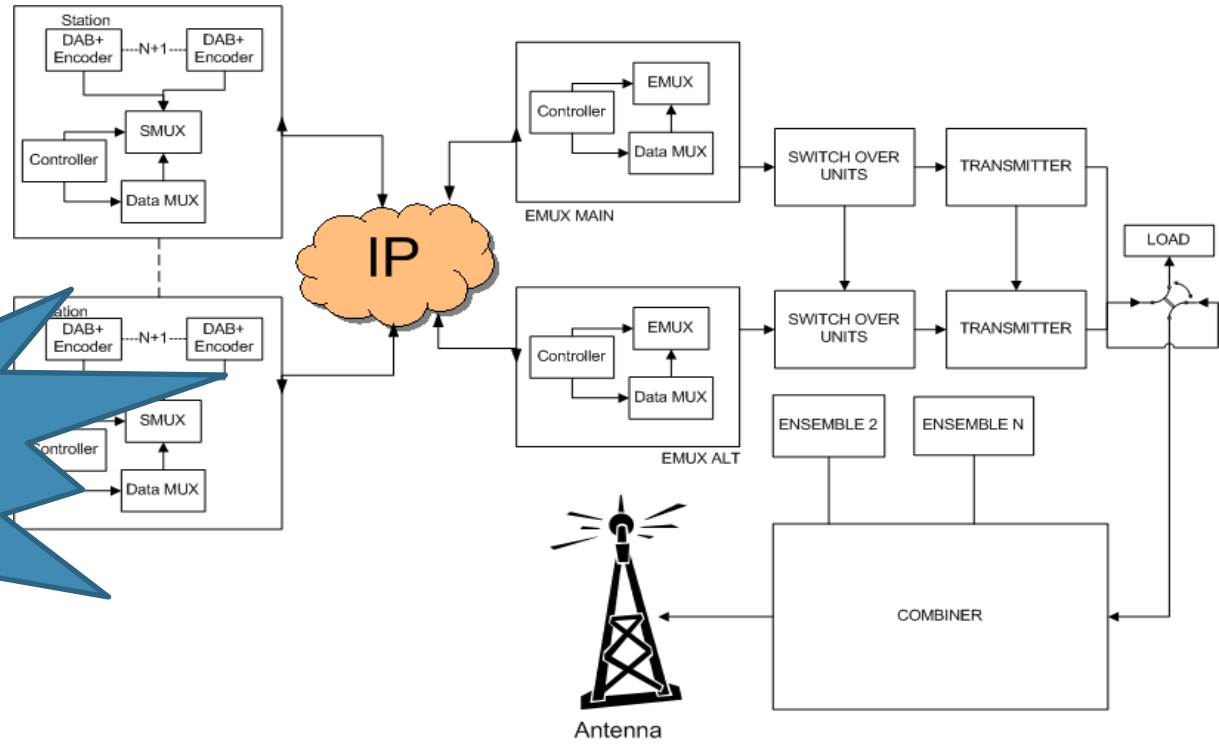
Studios include encoders, PAD servers, capacity control

Ensemble multiplexer and common equipment located at transmitter site

Contribution network can use mixed bearers

Bearer diversity usual the responsibility of the studio

Bearer failure is often the biggest cause of transmission outage!



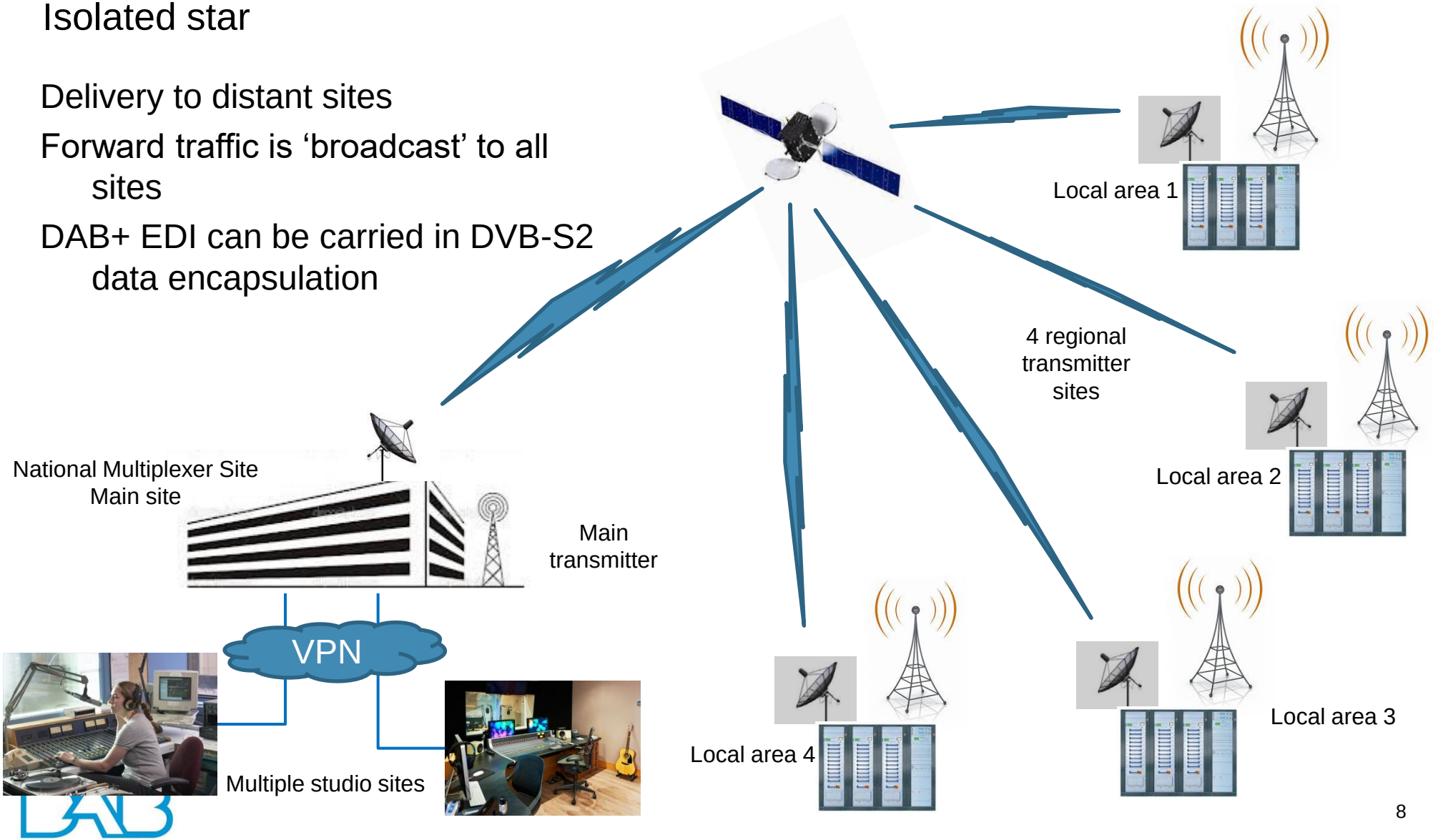
Network Planning: Equipment Location

Isolated star

Delivery to distant sites

Forward traffic is ‘broadcast’ to all sites

DAB+ EDI can be carried in DVB-S2 data encapsulation



Network Planning: Equipment Location

Partial mesh

Can be used for contribution and distribution

Often used for national networks

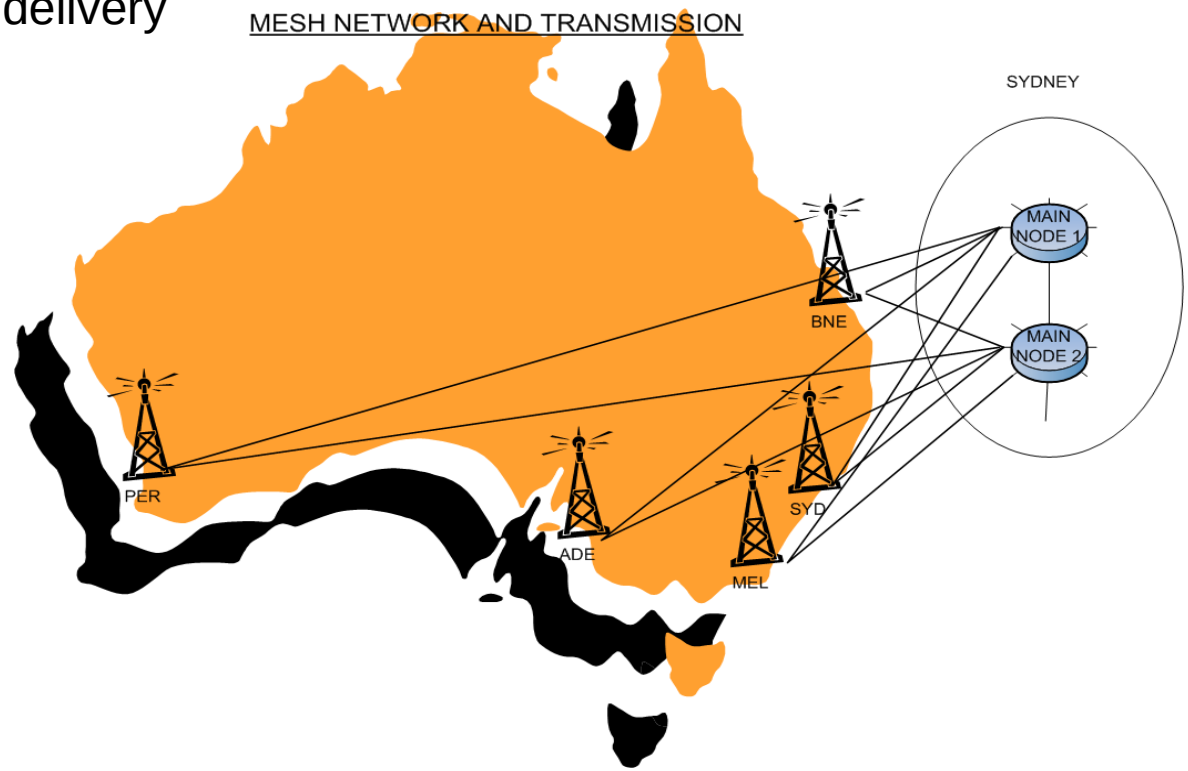
Overlayed star networks

Studios include encoders and PAD delivery

Central multiplexer sites have encoders, PAD servers, capacity control, ensemble multiplexer and common equipment

Contribution and distribution network usually provided by a major telco

Beware unduplicated routes!



Network Planning: Equipment Location

Interconnected islands

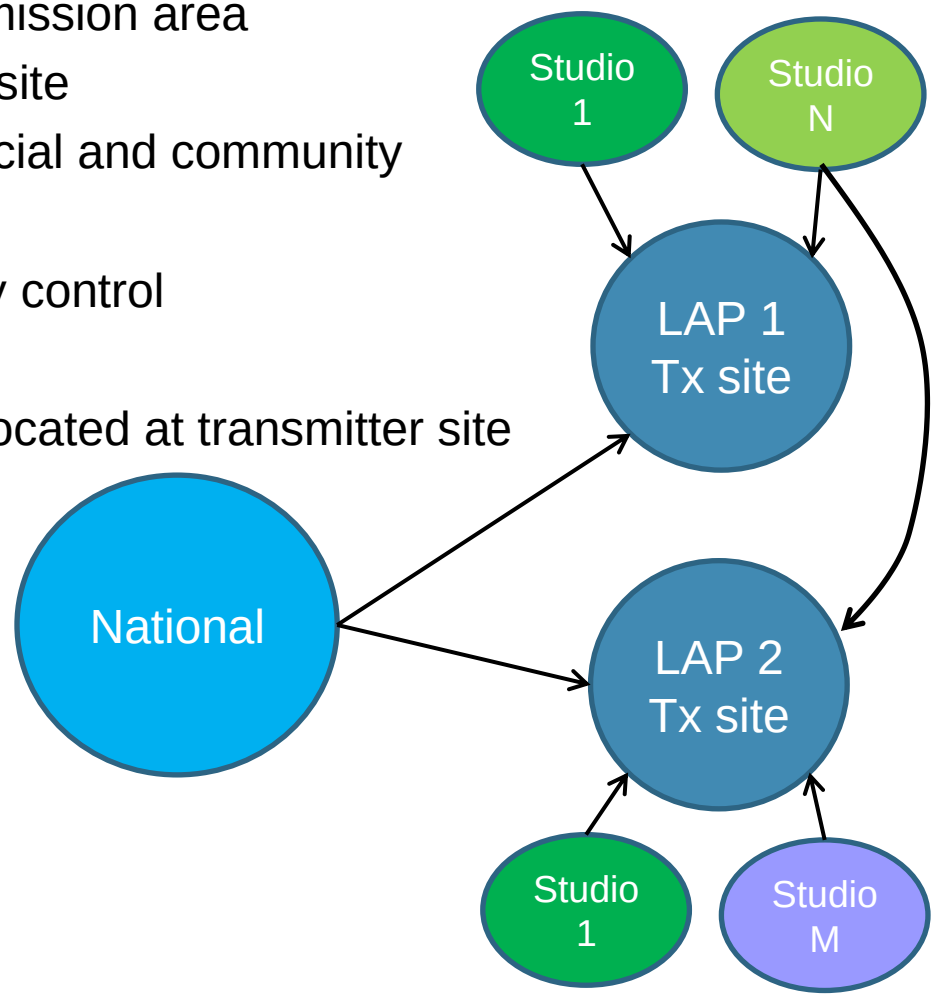
The majority of content is produced in the transmission area
Some additional content sourced from a central site
e.g. national programs mixed with local commercial and community

Studios include encoders, PAD servers, capacity control

Ensemble multiplexer and common equipment located at transmitter site

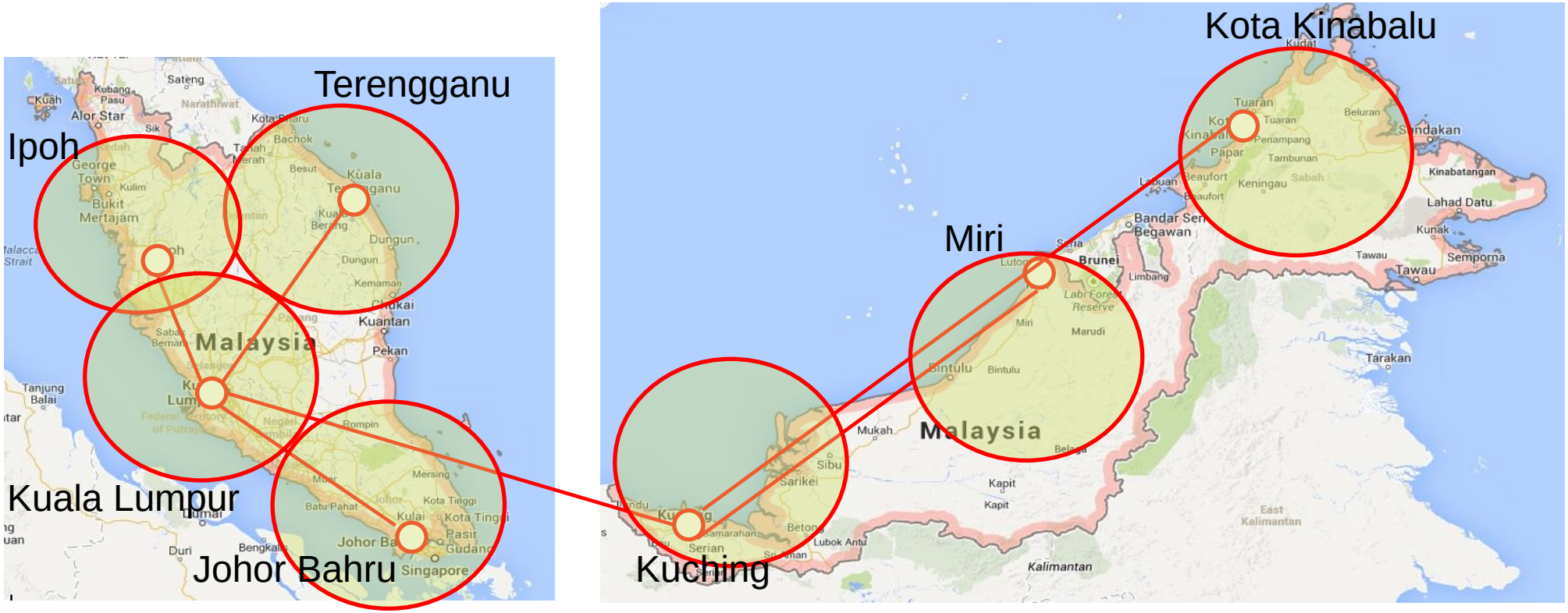
Local contribution network can use mixed bearers to a transmission site hosting the multiplexer

Need to minimise connectivity cost for central (national) programs



Network Planning: Equipment Location

Malaysian Example (hypothetical)



Network Planning: Equipment Location

Hierarchical or nested star

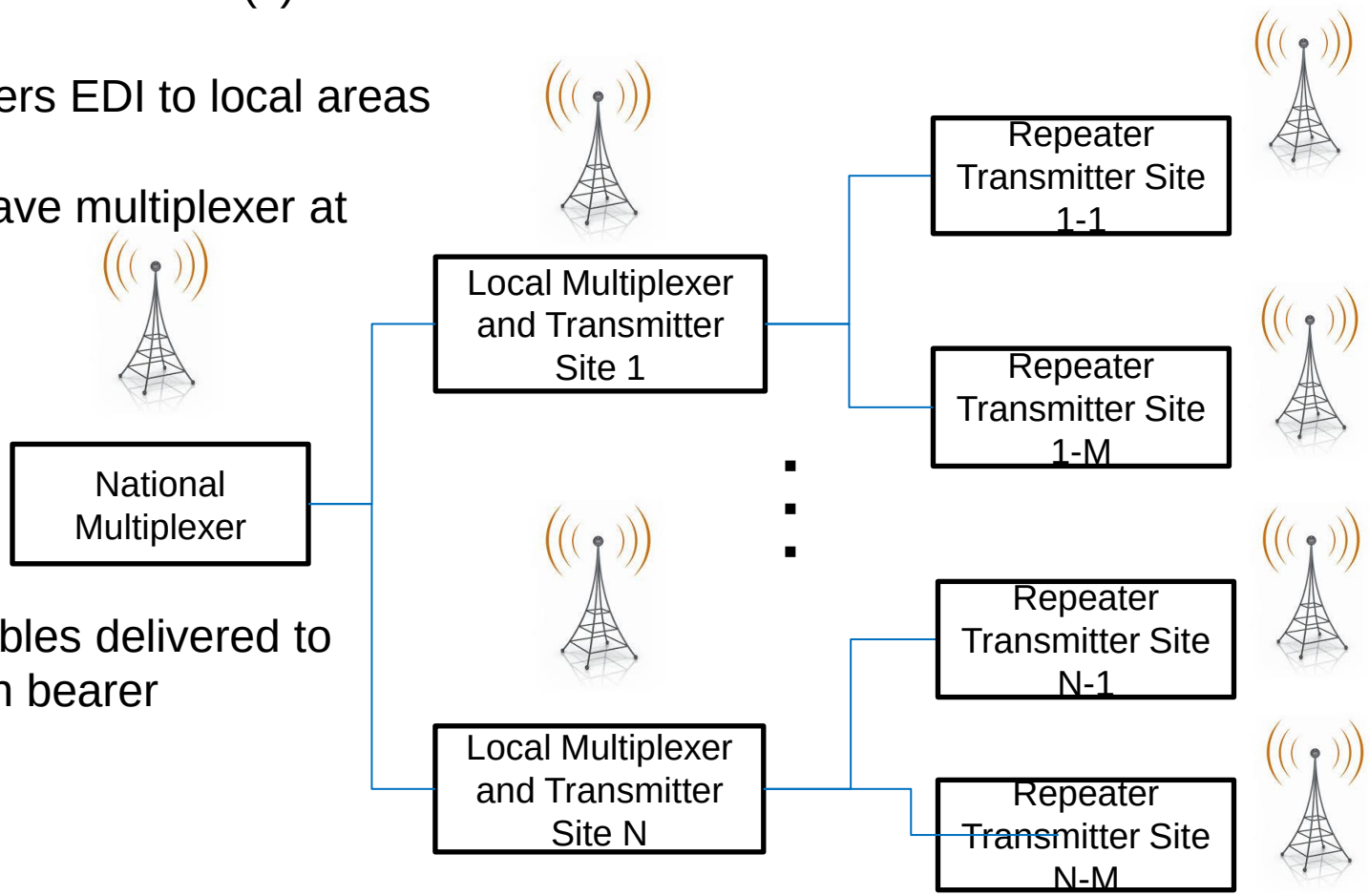
National ensemble(s) delivered to local areas

Local areas have their own ensemble(s)

National multiplexer delivers EDI to local areas

Local areas (generally) have multiplexer at main transmitter site

National and local ensembles delivered to repeater sites on common bearer



Network Planning: Equipment Location

Hierarchical star network over satellite

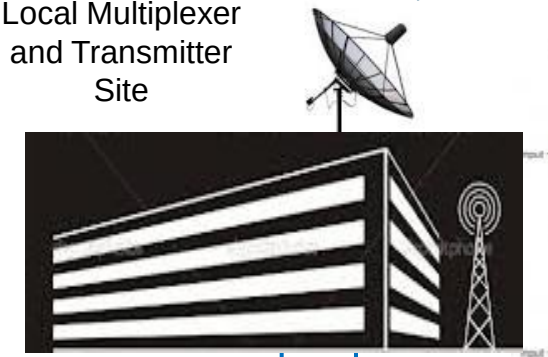
Delivery to local areas via satellite

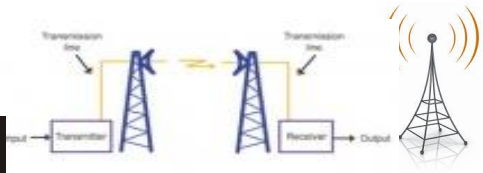
Delivery to repeaters via microwave

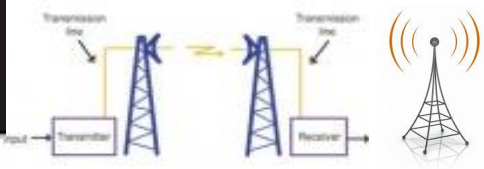
Local and national services share microwave links

Repeater transmitter sites in Local Area

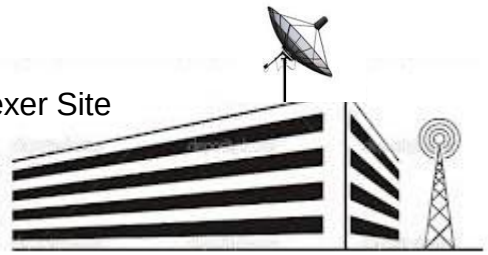
Local Multiplexer and Transmitter Site







National Multiplexer Site



Main transmitter

VPN

VPN

Network Planning: Equipment Location

Operations traffic

Control can use the same forward IP route as the forward traffic

- Forward content traffic will generally be multicast
- Control traffic will be UDP or TC

Monitoring and other reverse traffic can also use the same IP return route as forward traffic (in most cases)

Difficulties arise if the network is not wholly contained in an IP cloud, e.g. uses satellite delivery

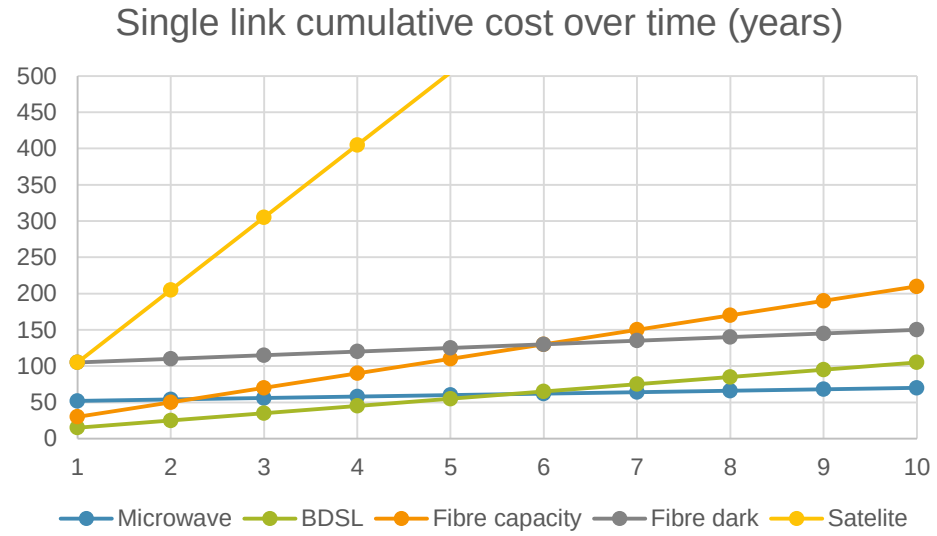
- Virtual Private Network (VPN) can be provided by Telco or privately
- Satellite return path can be provided using a TDMA access method over the satellite transponder

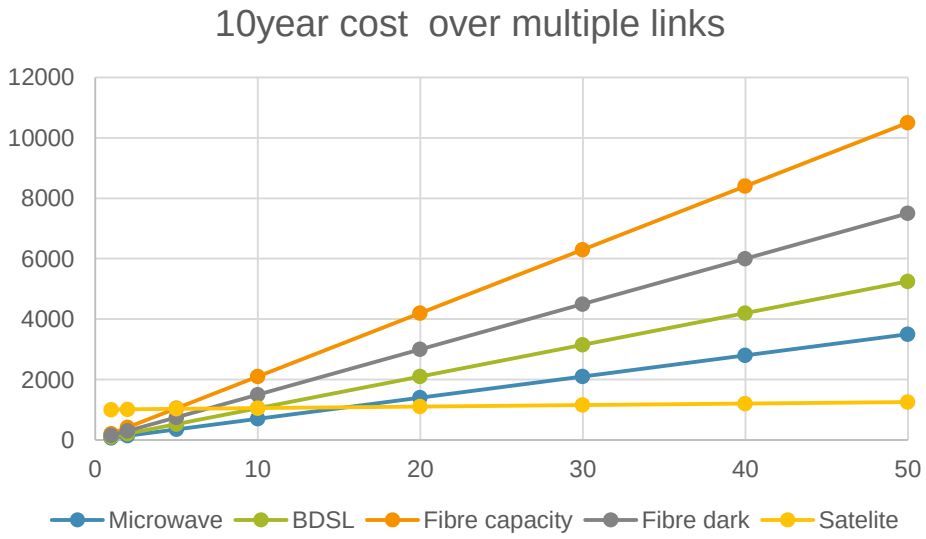
Cost Benefit Analysis

Cost Examples

Costs are dependant on country, location and distance covered

Type	Capex	Opex /yr
Microwave	50	2
BDSL	5	10
Fibre capacity	10	20
Fibre dark	100	5
Satelite	5	100





Summary

Complex multifaceted problem where there are always compromises

An iterative or phased approach is often attractive

BUT…. Must get the principles right from the start

Thank you

For further information, please contact:

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or

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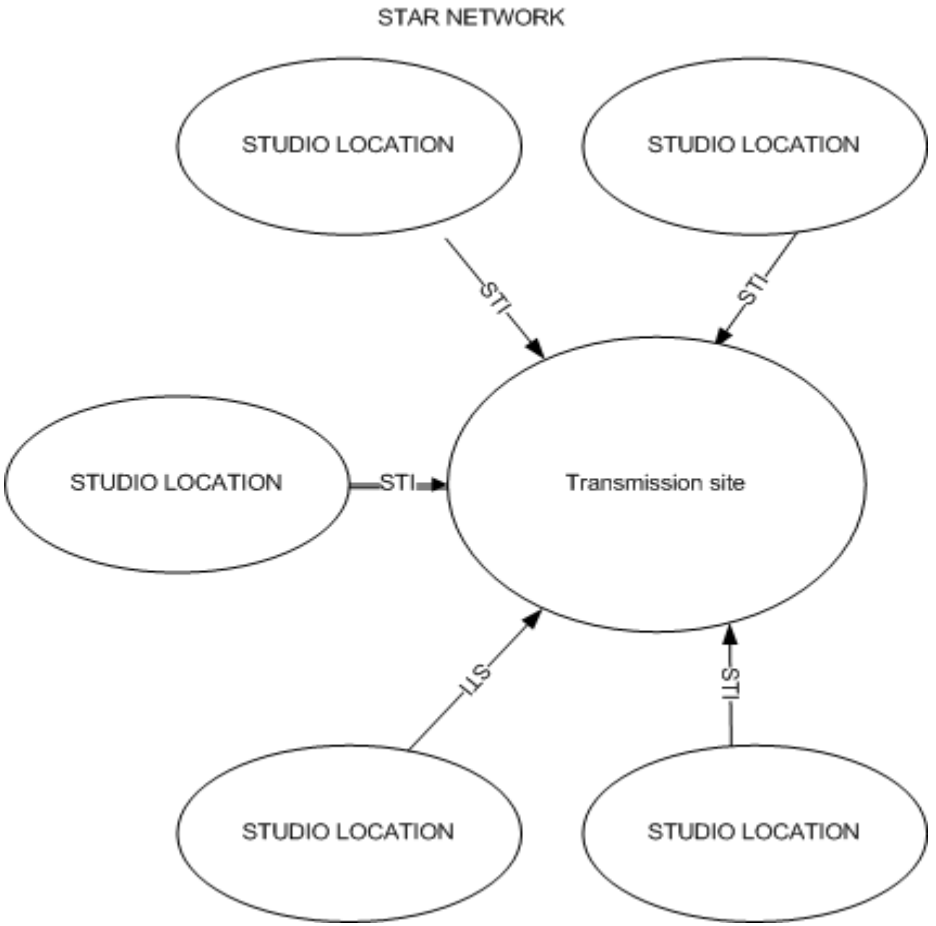
Additional items

- Optional audio input methods
- Trade-offs with cost
- Virtualisation and cloud impact
- Independence of program and monitoring networks
  - Cost impacts and risks
- Link types and reliability
  - Telco
  - Microwave
  - Mobile networks

Network Planning: Network types

Star Network

- Multiplexing equipment
- Individual links per studio site
- Stations are in control of their content
- Privacy

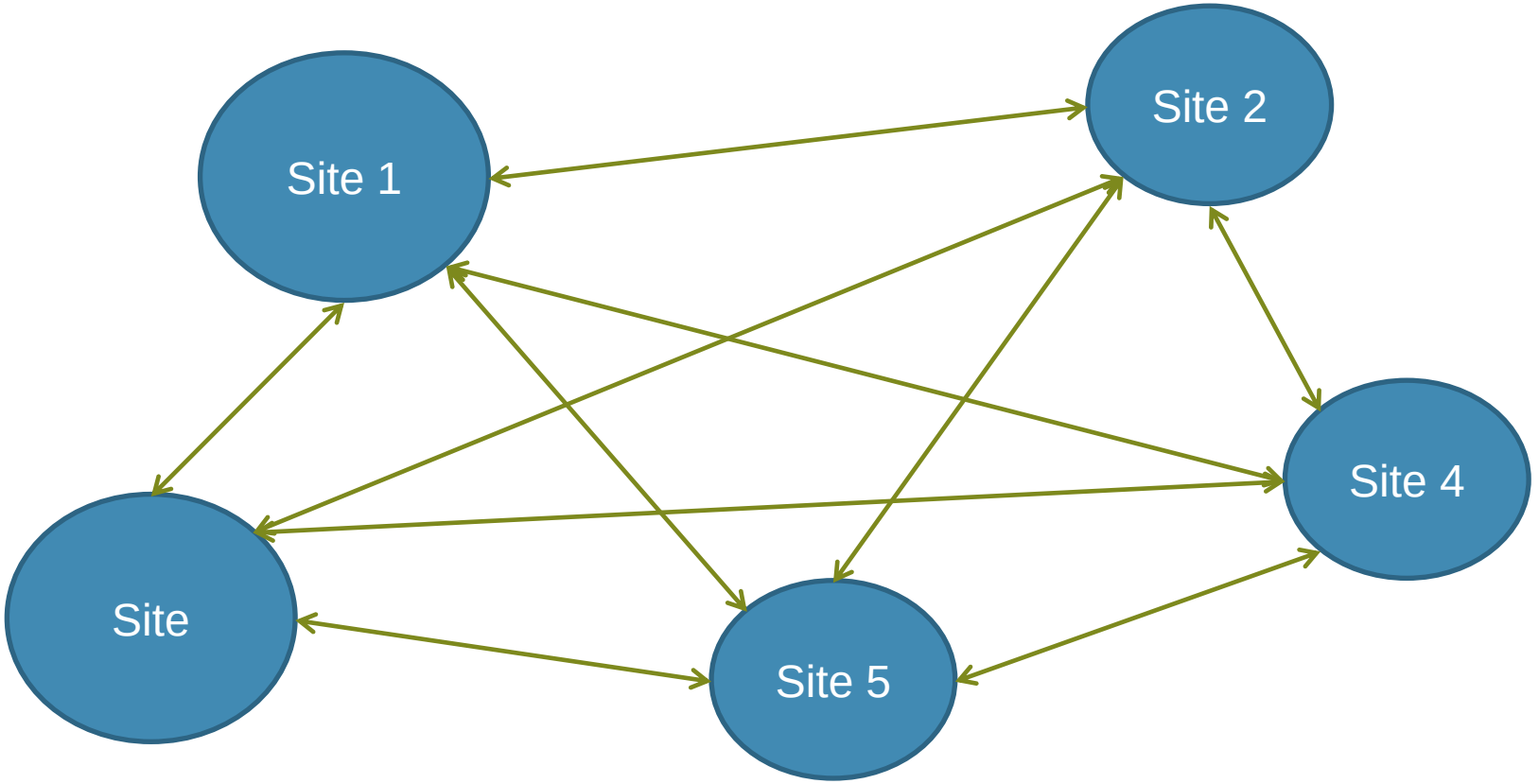


Network Planning: Network types

Mesh Network - logical

Multiple routes to each destination

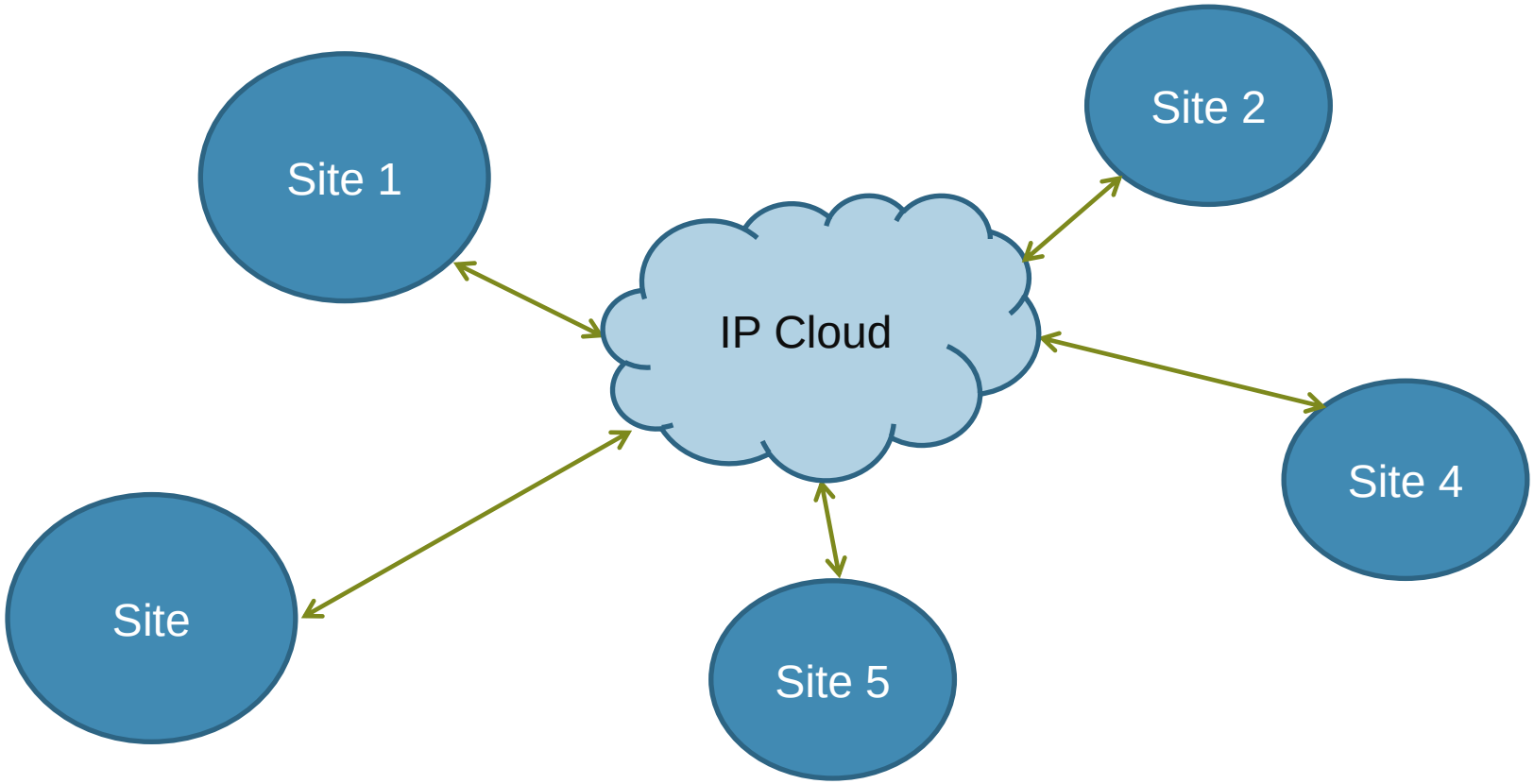
Should provide higher reliability?



Network Planning: Network types

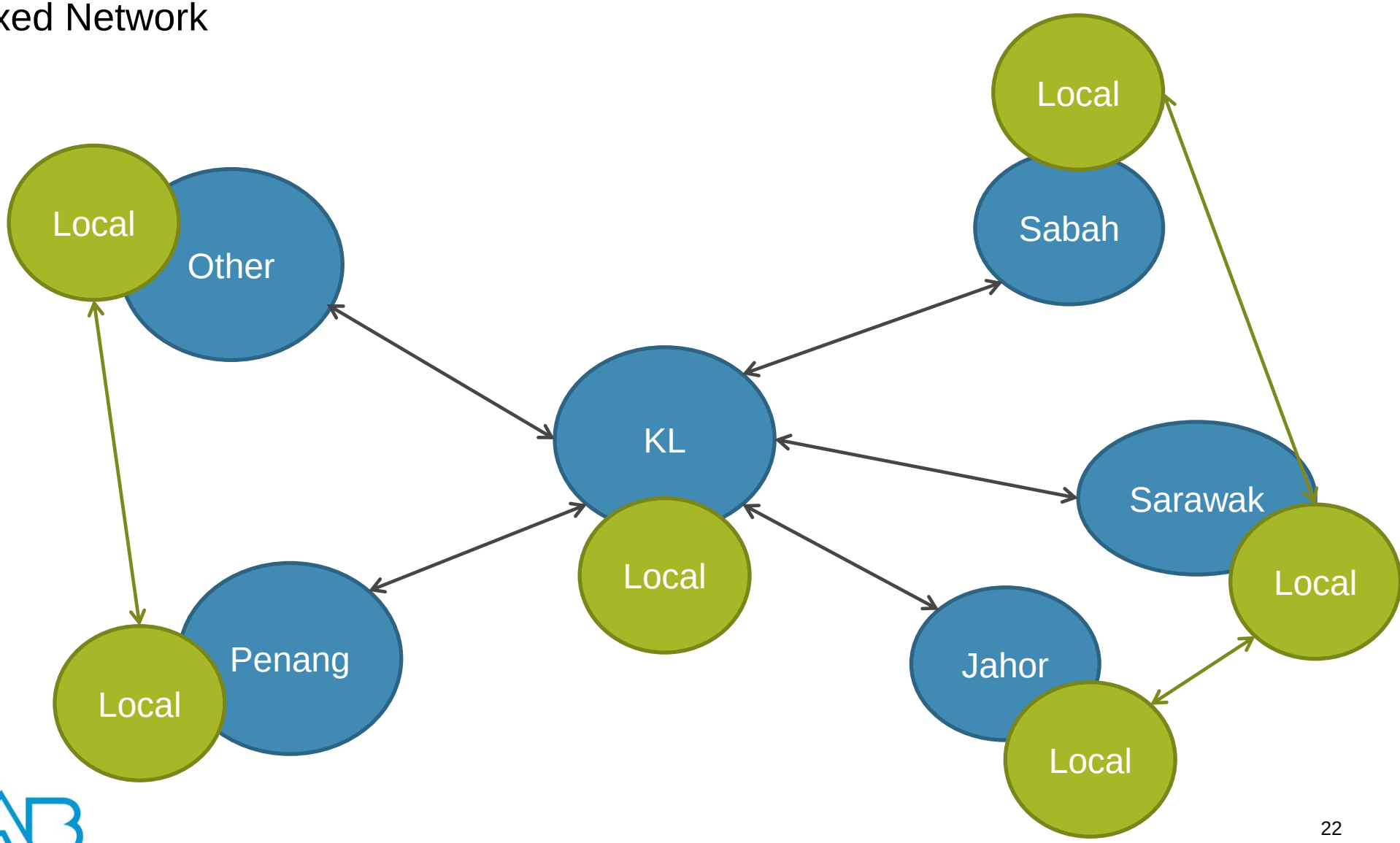
Mesh Network - physical

Beware of single route connectivity in the cloud!



Network Planning: Network types

Mixed Network



Network Planning: Network types

Choices!!

- Are all the connections within the same network?
- Do the connections all use the same bearer type, bit rate?
- Will some sites need to connect to other on an intermittent basis?
- Peak vs average loads
- How do I minimise the Capex and Opex?
- How do I ensure the required security?
- How do I ensure that the network is future-proof?

Complex multifaceted problem where there are always compromises

An iterative or phased approach can be attractive

BUT…. Must get the principles right from the start

Network Planning: Equipment Location

Network design is based on minimum cost of ownership

Common architectures – forward traffic

- Isolated area star
- Partial-mesh
- Interconnected islands
- Hierarchical star

Operations traffic

Further considerations

- For national networks there may be a single multiplexer to deliver content at multiple locations
  - Requires the delivery of ETI/EDI to multiple locations (1.5 – 2Mbps)

Network Planning: Connectivity

Bearer Types

Terrestrial

- Ownership
  - Telco
  - Private
    - Physical
      - Fibre
      - Microwave
      - Cable – E1/E3, BDSL
      - Mobile
      - Off-Air

Satellite

- Ownership
- Footprint

Logical

- Point-to-Point – V or X series?
- IP based
  - Multicast v P-P (e.g. TCP/IP)
  - Standard or proprietary
  - QoS
  - Routing
  - Security and access control
- VPN encapsulation
  - Requires specific bandwidth to be allocated within a greater network

Network Planning: Connectivity

Bearer Costs

Terrestrial Telco

- Provide a managed service
- Usually will not commit to 100% GoS
  - Have managed down times
- Low Capex but high Opex

Private

- Typically microwave
- Very low Opex after initial Capex
  - Beware multi-hop links
  - Beware tower costs

Satellite

- Managed transponder service but sometime earth stations may / may not be owned
- Cost effective for simultaneous delivery to multiple areas / transmitter sites

Network Planning: Connectivity

Link capacity requirements – forward DAB+ traffic

Ensemble

- ETI = 2Mbps
  - G.703/4
- EDI = 1.5Mbps
  - IP

Service

- Typical 64kbps plus overheads
- IP preferred
- Traditional STI too expensive and too many overheads

Service to remote ensemble

- Deliver the service individually (even if multiple services) using IP
- Can use VPN in telco cloud

Network Planning: Connectivity

Link capacity requirements – control and monitoring traffic

Forward control

- e.g. over RDP sessions or network products e.g. Radmin, Teamviewer or VNC
- Allow machine control and manipulation
  - E.g. settings adjustments, software updates
- Forward data capacity is generally intermittent
  - Keyboard input <100bps
  - There may need to be acknowledgment protocols for both DAB content and NMS
    - E.g. EDI can use ARQ for data integrity
  - File download can be substantial (10s MB files)
    - Slow can be OK if reliable

Network Planning: Connectivity

Link capacity requirements – control and monitoring traffic

Return monitoring and real time operating sessions

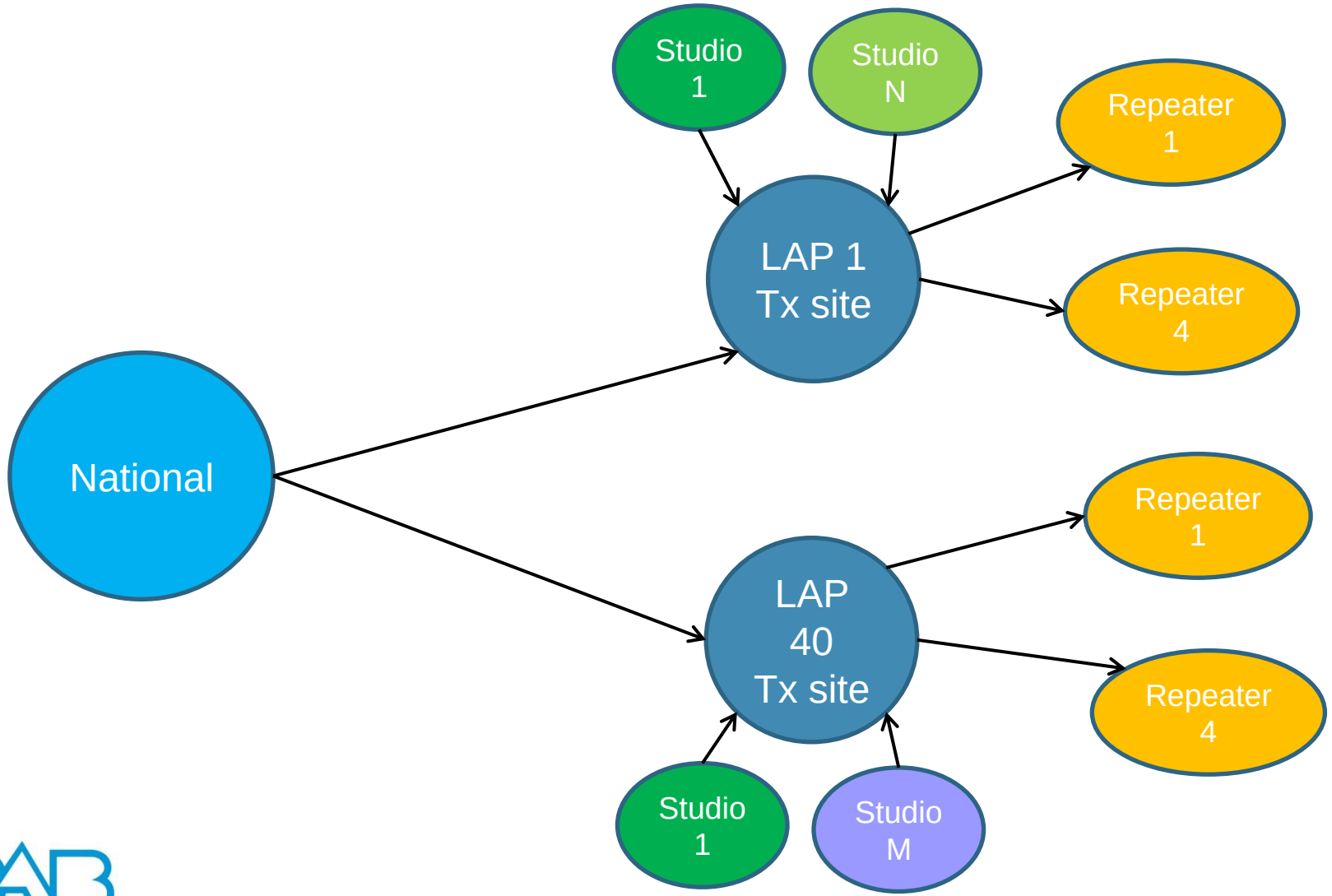
- DAB traffic protocol return path
- NMS information – generally SNMP
- Remote session return traffic e.g. screen images and audio
- Reverse capacity is continuous

Example calculation

- 40 areas within country with 5 transmitter sites per area
- 1 national ensemble and 1 local ensemble
- Centralised monitoring and control
- NMS SNMP traffic = 50 monitoring points per transmitter site x an average information packet size of 128B (max =480B) per 10 second period which results in approximately 640B/s = 5.12kbps, say 5kbps.
- RDP sessions and 64kbps forward and 256kbps reverse (to Master Control)
    - 8 sites simultaneous out of 200 (4%)

Network Planning: Connectivity

Link capacity requirements – control and monitoring traffic



Network Planning: Connectivity

Link capacity requirements – control and monitoring traffic

Example calculation – terrestrial VPN

	National System	
	Components	Total
Forward traffic	DAB+ ensembles = 1 x 1.5Mbps (EDI mutlicast) Forward control = 200*4% x 64kbps = 512kbps	2Mbps
Reverse traffic	Reverse monitor traffic 200*4% x 256kbps = 2Mbps SNMP traffic = 200 x 5kbps = 1Mbps	3Mbps

Network Planning: Contents

1. System requirements
2. Network types
3. Equipment location options
4. Connectivity options and link capacity
5. Cost benefit analysis

Cost Benefit Analysis

Connectivity options

Capex v Opex

- Method 1 – minimise initial investment cost
- Method 2 – build what is needed for the long term
- Method 3 – staged development

Cost Benefit Analysis

Connectivity options

Method 1 – minimise initial investment cost

- Focused on Capex minimisation
- Reliability is secondary – especially during the first few years of operation as the listener base builds
- Often trades higher Opex for lower Capex
  - Changes to architecture are then considered later when the market is established and the ‘shock’ of the initial Capex is past
- Pros
  - Minimises initial out-going cash
  - Can provide quick implementation due to use of third party services, e.g. Telco
- Cons
  - Typically single link systems with no back-up
  - Ongoing cost can be higher so need a long term view of when to change to lower Opex solution
  - Overall cost of ownership is higher
- Typically results in lowest cost Telco service, e.g. BDSL

Cost Benefit Analysis

Connectivity options

Method 2 – build what is needed for the long term

- Focused on long term architecture
- Reliability is built-in from the start
- Trades higher Capex for lower Opex
  - Can analyse the payback period
  - Better for established or rapid take up markets
- Pros
  - Minimises Opex and long term cost
  - Minimum long term cost of ownership
  - Maximum reliability demonstrates commitment to listeners
- Cons
  - Higher initial cash flow during construction
  - Can be seen as over designed for new market areas where listener base needs to be established
- Typically results in owner managed links, e.g. microwave

Cost Benefit Analysis

Connectivity options

Method 3 – staged development

- Design long term architecture but build out as the listener base increases
- Reliability options are built-in from the start, but may not be included in the initial deployment
- Tries to optimise cash flow while minimising longer term cost of ownership
- Pros
  - Good for new or low initial listener based deployments
  - Provides capability in line with listener base and earning capacity
    - More commercial basis than public broadcaster approach
- Cons
  - Initial deployments can suffer from poor reliability due to single ended links and low grade bearers
- Typically results in initial telco supplied low cost bearers, e.g. BDSL with a view to convert to microwave when the listener base increases