Practical considerations for DTV In Antenna & Combiner Systems.

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Digital Terrestrial Television - DTT

RFS, Offering superior RF solutions for broadcasters worldwide, from analogue radio and TV to DAB, mobile TV and Digital TV Switch Over

Ashley Bicknell
Senior Broadcast Systems Sales Manager

Transmission equipment represents a significant capital investment and generally has a very long service life so it is of significant benefit to the broadcaster or site operator to take into account a wide range of factors when looking at new equipment. There are many aspects of the passive transmission system that need to be considered and I will look briefly at some of these issues in this workshop.

Overview

- **Understand your existing infrastructure and what outcomes are required.**
- **Future Considerations.**
  - **Simulcast period, Analogue switch off and the digital dividend, expansion (capacity).**
- **Occupational health & safety (OH&S).**
- **Physical, mechanical and structural issues.**
- **DTT Considerations for transmission.**
- **System redundancy.**
- **Lead times.**

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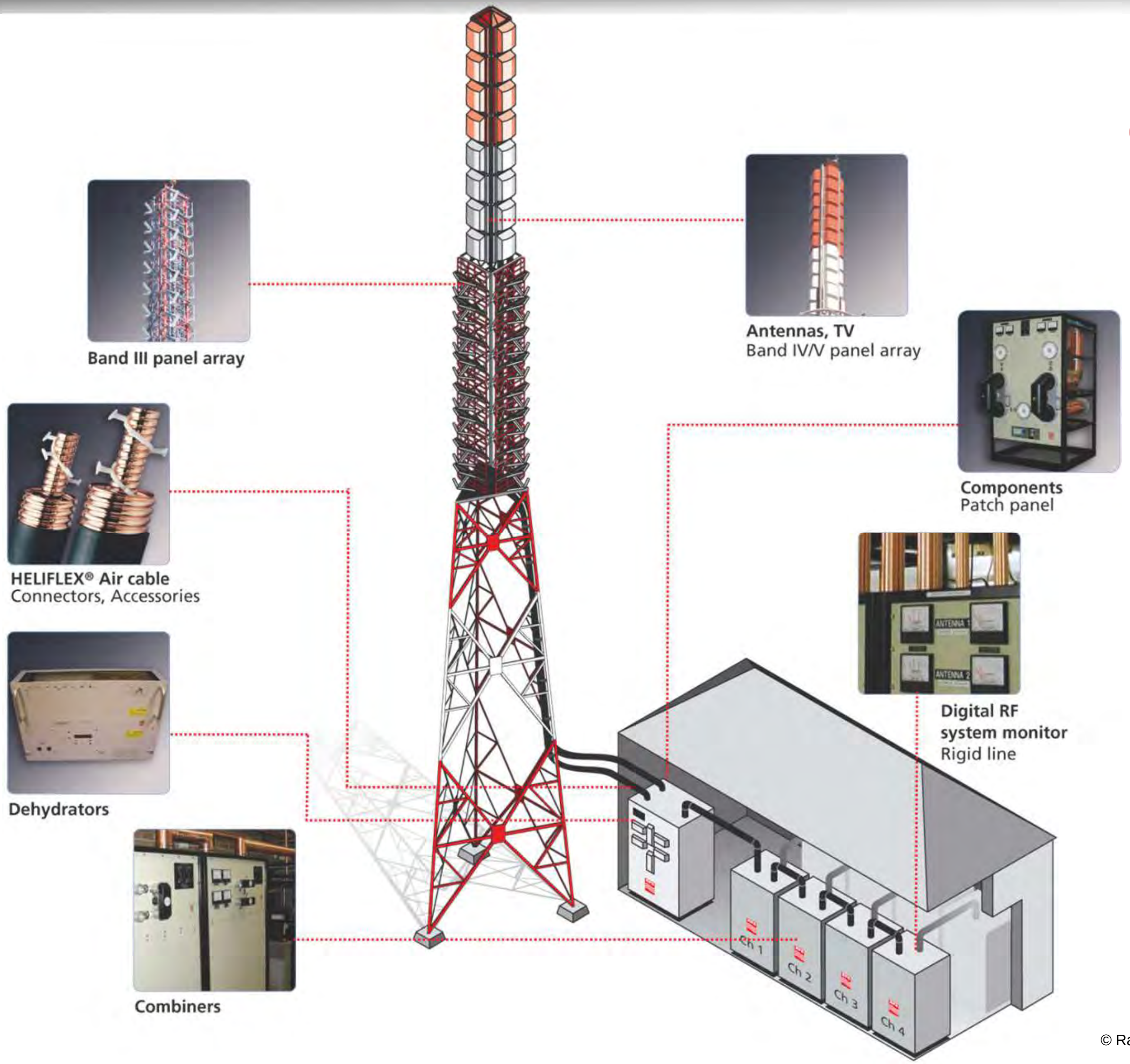
RF Components in the Transmission System



Passive RF Components

- Antenna
- Cable
- Rigid Line & patch panels
- Combiners/filters

➔ Transmitters are not passive RF components

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Existing equipment & future requirements.

Each system/site needs to be assessed against the new requirements for Digital TV, the number of services both analogue and digital and their respective peak and average powers need to be considered to determine the current capabilities of the existing RF infrastructure. It is based on this assessment of the feed system, antennas, and main feeders that a plan can be made.

Where to Start

- Begin by understanding the existing RF system
  - Coverage
  - Bandwidth (pattern & impedance)
  - Power rating
  - Voltage or peak power rating
  - Tower capacity
  - Condition of existing components
- Then assess this against your requirements for digital TV and other future requirements, so what are the drivers for these future requirements.

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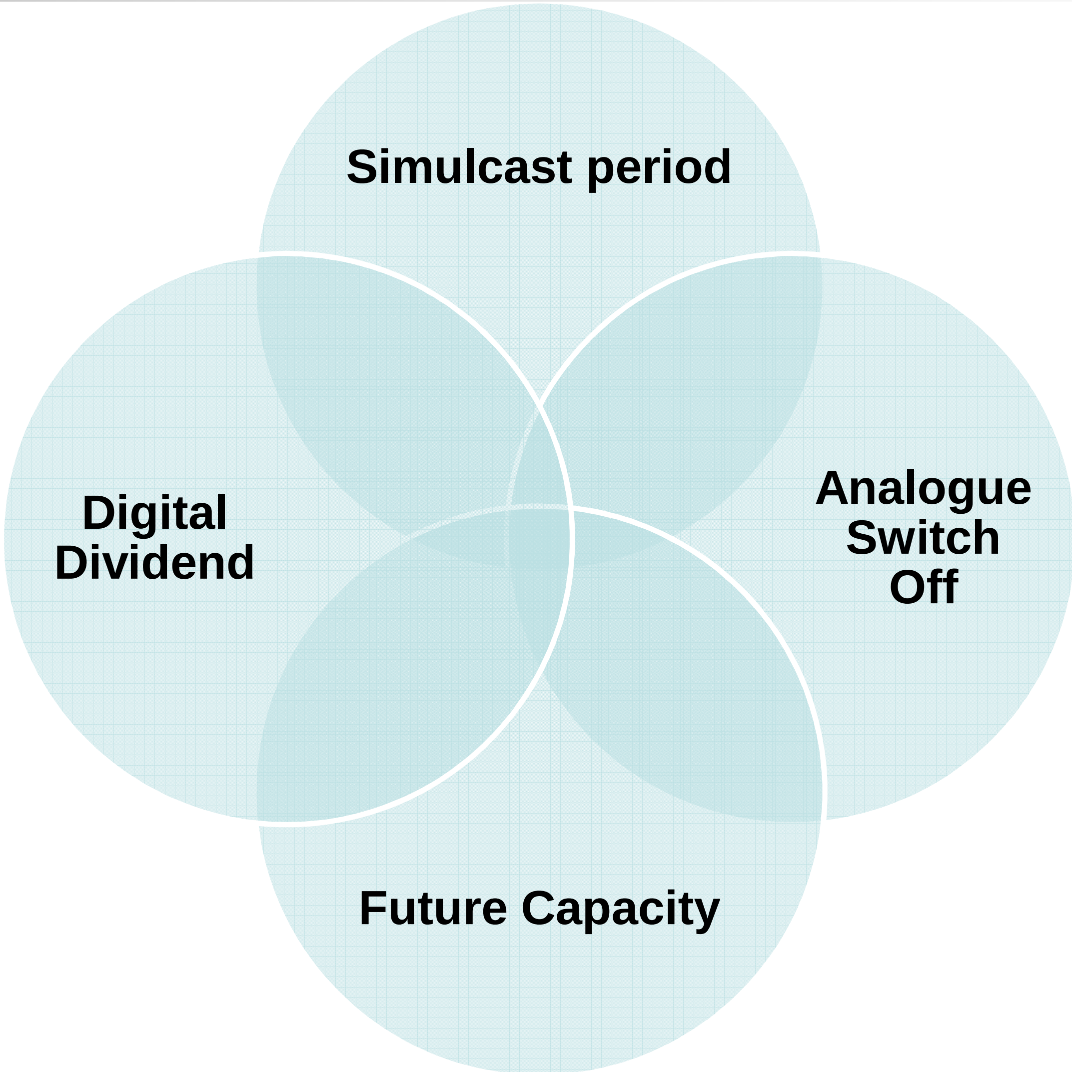
Future Considerations



These important issues are all interdependent and effect many of the technical requirements and will all have an impact over the service life of any new equipment.

Future Considerations

Simulcast Period.

What is the expectation during this period?

- Are analogue services to continue to operate at their current service levels or is there to be a degradation to encourage the population to transition to digital.
- What is the expected duration of the simulcast period.
- Is there the possibility of expansion of services during the simulcast period.

This drives the immediate capacity requirement for your systems.

Standard TV

High Definition TV

Future Considerations

Analogue Switch Off.

What is the expectation at analogue switch off?

- When will this occur?
- Are the digital channels to be restacked at or after analogue switch off?

This drives the tunability requirements for any combiner systems.

This drives the immediate bandwidth requirement for your systems.

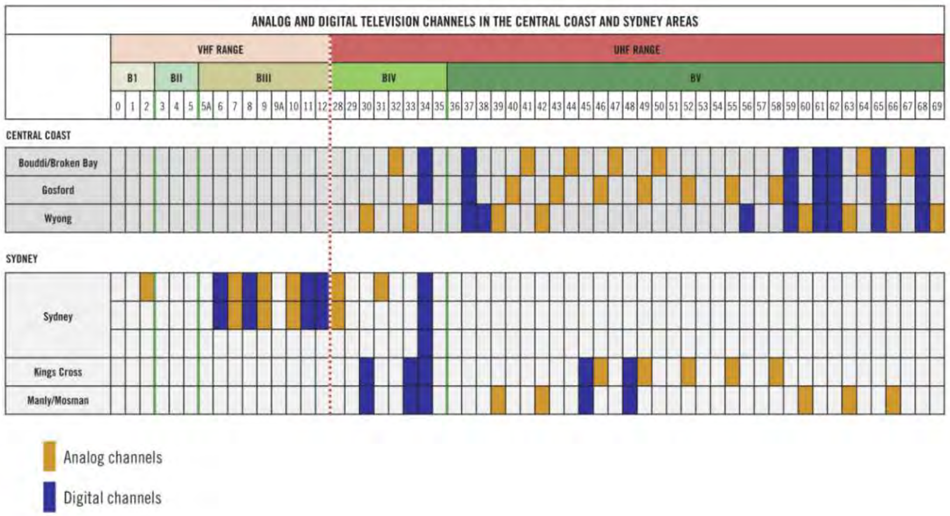
Future Considerations

Digital Dividend.

What is the plan for the digital dividend?

- When will this occur?
- What is the expected usage of the bandwidth freed as a result of the digital dividend?
  Is this freed bandwidth to be used telecommunications or some other use.
- Does the digital dividend present a business opportunity to the broadcaster or site operator. This could mean a new revenue stream from operators accessing your infrastructure.

➔ This can drive the future bandwidth and capacity requirements for your systems.

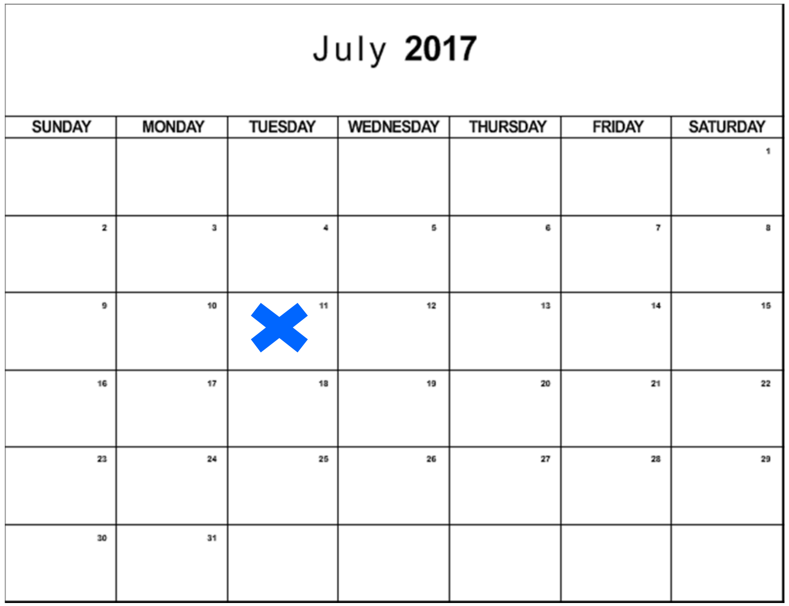


Future Considerations

Future Capacity.

What is the plan for the future?

- Are new services planned?
- Mobile television, is this an opportunity?
- Pay TV, CATV systems
- Datacasting



Considerations beyond immediate requirements can provide opportunities in the future.

Occupational health & safety (OH&S)

An increasingly important factor in many countries are health and safety issues for both the general public and people working in the industry.

Specific areas where requirements are being observed

- Equipment operating temperatures
- Climbing access, internal & external ladders.
- Fall arrest systems
- Rescue systems
- Confined space requirements
- Internal lighting
- Radiation levels

Physical, mechanical and structural issues

These issues are sometimes not given sufficient consideration at the early stages and often cause issues later.

Physical issues

- Floor space in buildings.
- Heat loading in buildings
- Shipping, site access, transport and unloading limitations at site.
- Height limitations (both indoors and on the tower)
- Lightning protection
- Aviation or clearance lighting

Structural issues

- Weight
- Wind Load
- Tower suitability
- Site wind speed requirements
- Additional loads
- Interfacing between new and existing equipment.

Physical, mechanical and structural issues

These issues are sometimes not given sufficient consideration at the early stages and often cause issues later.

Mechanical issues

- Environmental conditions
    - Corrosion
    - Ice
- Serviceability requirements, wind speed etc.

Installation issues

- Type of tower
- Existing equipment
- Climbing and access requirements
- Lifting capacity constraints
- Lifting size constraints
- Lifting method
- Feeder gantry / ladder space & details for clamps
- Tower interface and mounting.

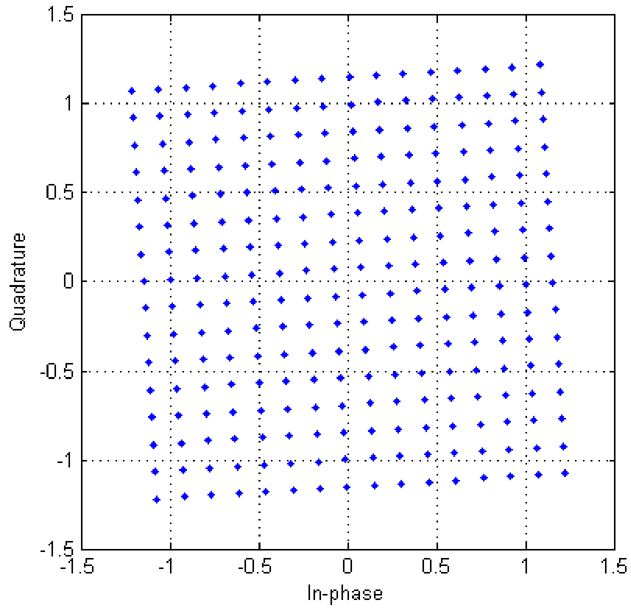
DTT, Considerations for Transmission

Transmitter powers & coverage

Unlike analogue TV, digital TV coverage/service area is not purely dependant on TX power and transmission system gain. There are other factors within the digital scheme that have a significant effect and these are independent of the TX power and transmission system gain. As a result we can provide systems to meet field strength requirements but it is up to network planners to determine what field strengths are required to meet the service objectives given the signal parameters.

The main contributor within the digital scheme is the Mode (QPSK, 16QAM, 64QAM etc.) with reductions in the signal complexity substantially increasing the service area, this is however at the expense of data throughput.

Other factors like FEC, Guard interval etc. have a smaller but still significant effect.



DTT, Considerations for Transmission

Transmitter powers & coverage

Newer standards like DVB-T2 also provide significant benefits in terms of data throughput or increased service area for the same data throughput as detailed in the below table provided by DVB in the DVB Fact Sheet August 2011.

Leaping over the older standards provides significant benefits to the broadcaster and spectrum managers.

As a result, DVB-T2 can offer a much higher data rate than DVB-T *or* a much more robust signal. For comparison, the last two rows of the table show the maximum data rate at a fixed C/N ratio and the required C/N ratio at a fixed useful data rate.

	DVB-T	DVB-T2 (new / improved options in red)
FEC	Convolutional Coding+Reed Solomon 1/2, 2/3, 3/4, 5/6, 7/8	LDPC + BCH 1/2, 3/5, 2/3, 3/4, 4/5, 5/6
Modes	QPSK, 16QAM, 64QAM	QPSK, 16QAM, 64QAM, 256QAM
Guard Interval	1/4, 1/8, 1/16, 1/32	1/4, 19/128, 1/8, 19/256, 1/16, 1/32, 1/128
FFT Size	2k, 8k	1k, 2k, 4k, 8k, 16k, 32k
Scattered Pilots	8% of total	1%, 2%, 4%, 8% of total
Continual Pilots	2.6% of total	0.35% of total
Typical data rate (UK)	24 Mbit/s	40 Mbit/s
Max. data rate (@20 dB C/N)	29 Mbit/s	47.8 Mbit/s
Required C/N ratio (@22 Mbit/s)	16.7 dB	8.9 dB

DTT, Considerations for Transmission

Factors affecting coverage

- Site Height is important
- Cannot transmit VHF and higher frequency signals beyond the horizon or through mountains so site location is also critical.
- Service range
  in km =4.12 x sqrt (h)
  (h is in metres)

  so for a 200m site height the service range is 58km (this is not taking into account any signal level requirements)
- Increasing site or antenna height has the largest effect on increasing potential coverage distance

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DTT, Considerations for Transmission

Factors affecting coverage – Propagation loss

- Propagation Loss can have a major impact on the received field strength

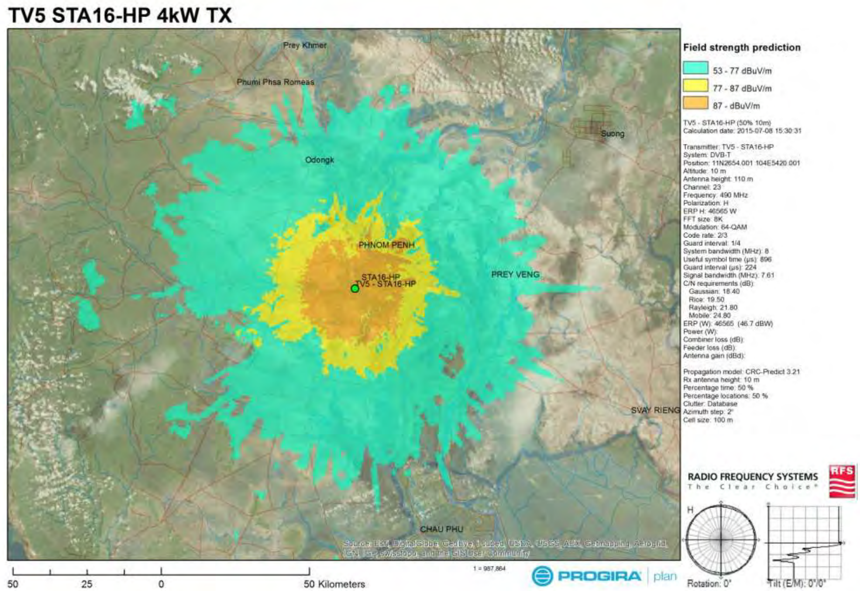
- Mountains, buildings, trees, etc. can all reduce the signal by as much as 20 dB and sometimes even more.

- Site location is the best way to reduce propagation losses.

DTT, Considerations for Transmission

Factors affecting coverage – Receive Antennas

- Receive antenna type and installation also have a major effect on the received signal.
- Broadcasters have very little control over the viewers antenna types.
- Using Circular Polarization (CP) generally allows for the worst types of receive antennas, because orientation of the receive antenna is not as critical with CP, this also assists in dense urban areas to flatten the field strengths.
- Reception at long distances requires the viewers to use better (outdoor) antennas. In these cases, CP suffers by comparison with linear polarization because the ERP is 3 dB lower for the same transmitter size.



DTT, Considerations for Transmission

Channel Combining

The advantages of combining include:

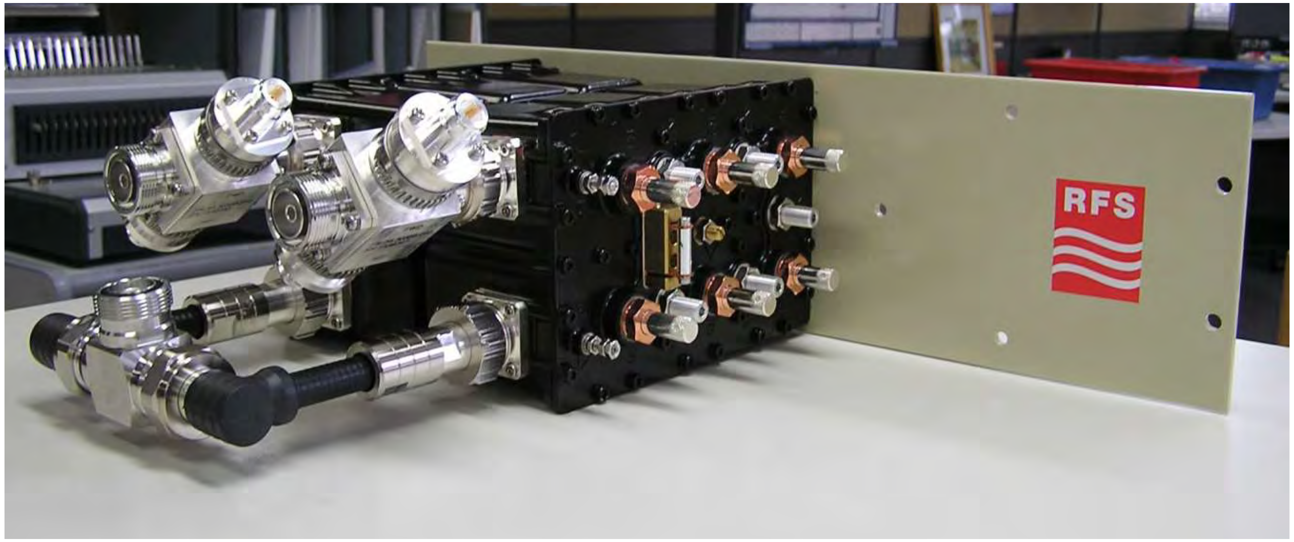
- Multiple transmitters onto a single antenna
- Near identical coverage from all channels (largely eliminates protection ratio issues)
- Shared antenna and feeder costs
- Frees tower space for extra services
- Can also provide transmitter "clean up" or mask filtering

DTT, Considerations for Transmission

Channel Combining

Costs of Combining:

- Additional floor space required in building
- Need to dissipate heat generated by combiner
- Additional losses
- More complex antennas are required (broadband, higher power and voltage ratings)

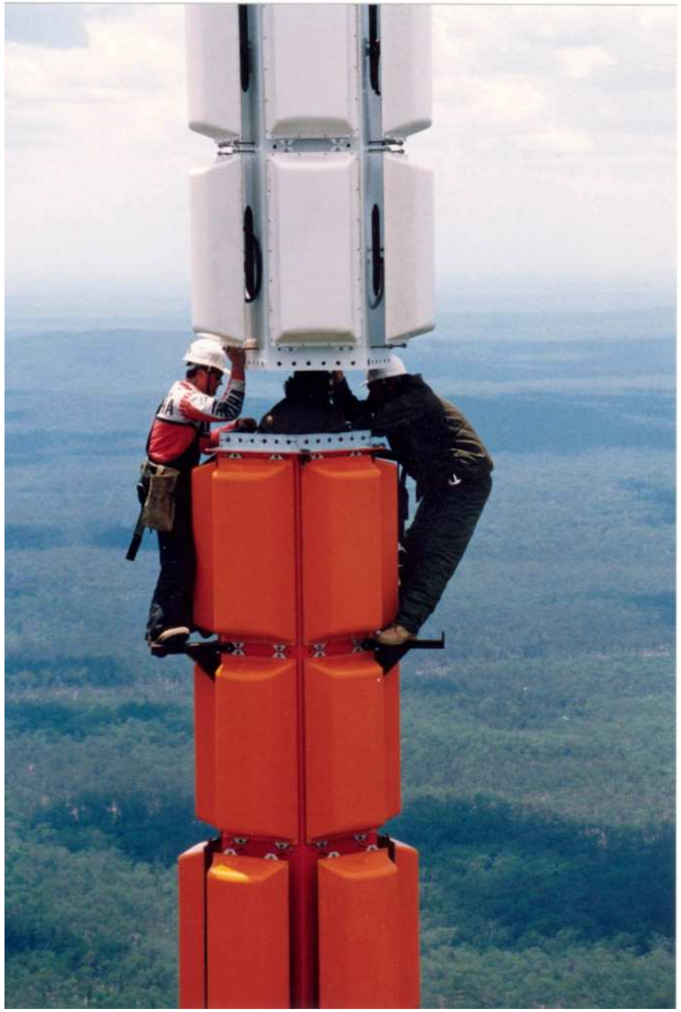


System redundancy

System redundancy is an important issue that should not be overlooked. These systems have long lives and can be in service under sometimes severe conditions for many decades. As a result some consideration should be given to the ability to maintain the system and there is generally a preference to be able to continue service while this is occurring.

The levels of redundancy can vary considerably from complete duplication (redundant sites) or dual chain combiner and dual feeder antenna solutions on one site to no redundancy at all depending on requirements.

Consideration to each sites redundancy requirements should be a factor in the tendering process and while there are certainly capital costs associated with this the importance of maintaining service can often outweigh this cost.



System redundancy

Factors to be considered when determining the required level of redundancy.

•Broadcaster requirements.

•Site vulnerability.

•Population served by the site.

•Political importance.

•Level of redundant service required.

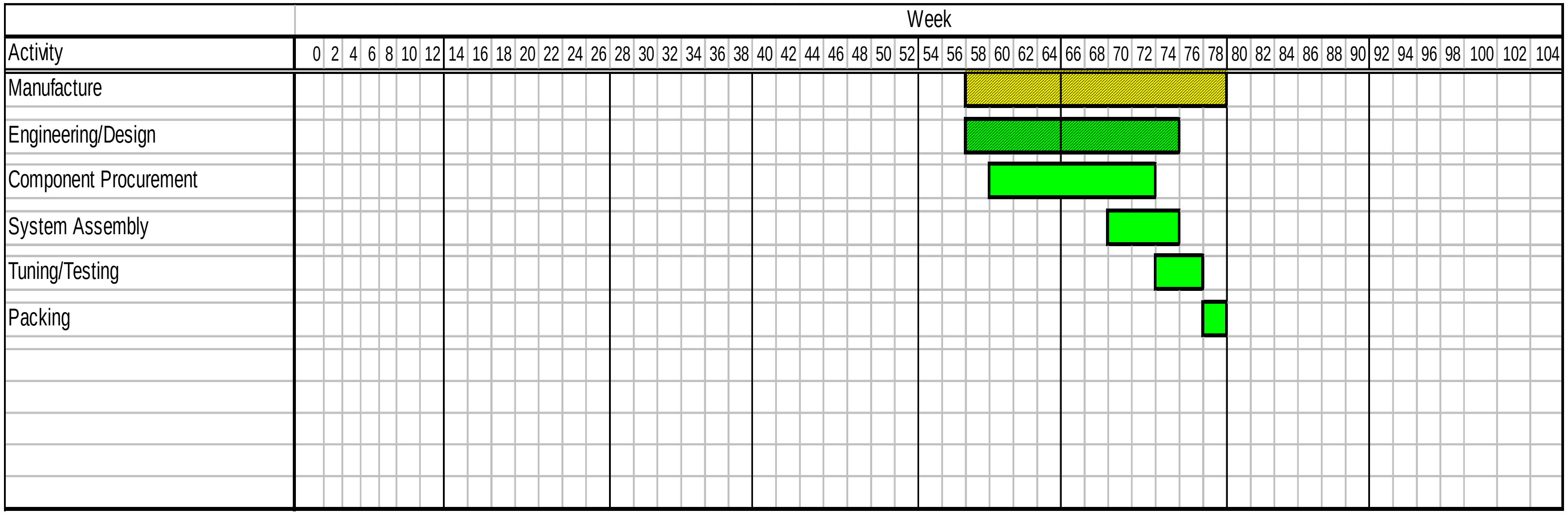
- •It may not be necessary to provide redundant service at the same level as normal service i.e. operation at lower power during maintenance may be an acceptable option.

•Physical site limitations, towers, buildings etc.

•Cost.

Lead Times

Lead times are an important consideration in complex projects like digital TV implementation. Standard off the shelf equipment will meet the requirements for a portion of the sites but there is usually some sites or requirements that result in the need for custom designed systems.



Lead Times

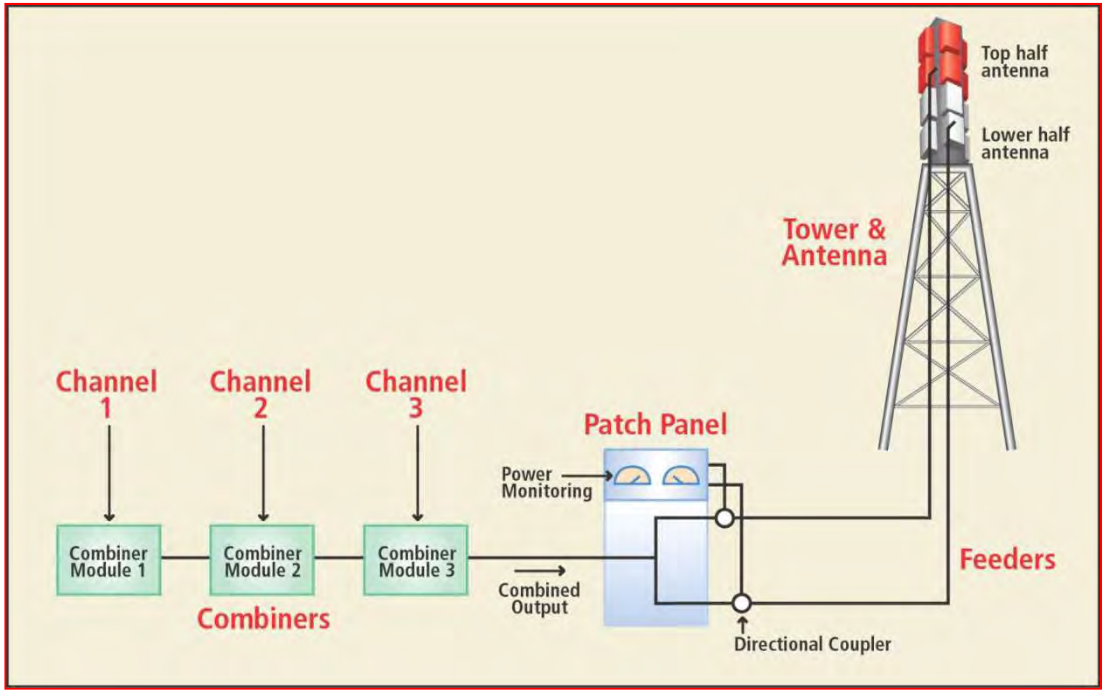
These custom designs out of necessity take longer to engineer and manufacture and hence have longer lead times.

Standard lead times for the main system items are in the order of 8 – 10 weeks and 12 – 14 weeks for specialised custom designs.

The Complete System

So in conclusion careful initial planning with a view to the future and a solid understanding of the technology involved are the keys to successful digital projects.

Consultation with equipment manufacturers beforehand can assist with ensuring that goals are practical and economical.



Overview

- The most important thing as a broadcaster is that you get what you want.
- The most important thing as a supplier is that the broadcaster gets what they want.

- So we both want the same thing.
- Issues at, or after installation are the last thing we both want.

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