1. SCOPE

Free TV Australia Operational Practice 32 is a guideline to the minimum requirements for industry standard television coverage of rugby league, rugby union, and football (soccer). It outlines infrastructure requirements for a television outside broadcast production using contemporary production techniques which meet current broadcast television presentation requirements, the requirements of each code's controlling body as well as catering for future developments. Scenarios have been provided which are typical of coverages of each of the three codes.

This operational practice has been developed by the Free TV Australia Project Group - Outside Broadcasts, its intention being to maximise television and radio production potential and productivity at sports venues and the avoidance of costly omissions at planning and construction stages.

TVOB coverage of football codes has progressed with the general availability of super and ultra slow motion (slo-mo) cameras along with wireless (RF) and other specialty cameras in dressing rooms and other player areas. These and further ongoing developments, both technical and production oriented require space and infrastructure requirements and impose stringent requirements on lighting specifications being met for night matches in particular.

2. TYPICAL COVERAGE

2.1 Cameras

The configuration for typical matches at a venue will be:

Cameras covering the field of play	12
Cameras for O/B studio	3

Dressing/warm-up rooms/coach box, 6 minimum (venue dependent)

Specialty cable cameras, cranes, POVs 2-3, motorised (manned) cameras

2.2 Camera positions

2.2.1 Camera platforms

A typical working platform is in the order of 1.8 to 2.0 metres wide for each camera and 2.5 to 3.0 metres deep. TV platforms are to be exclusive of sporting group and venue camera operations.

2.2.2 Main camera platform position

(To accommodate 4 x hard cameras 8 metres wide)

Actual positioning of the platform is subject to individual grandstand architectural design. Ideally it should be located between 30-40 metres from the western sideline at a height that gives an angle to that sideline between 20—30 degrees to the horizontal and an angle to the centre of the pitch between 12—16 degrees to the horizontal. e.g. at 40 metres from the sideline, the relative height above the playing field should be between 16 and 22 metres.

The location should have a totally unobstructed view of the field inclusive of all sidelines and dead ball corners, with the height above crowd sufficient to clear standing and hand waving patrons in between the camera deck and field of play. Coverage is compromised by excessive distance from the field (d = 60 metres maximum) or excessive height.

Access to the camera deck should not be restricted by having to access it through spectator seating in adjacent seating areas.

Equipment access to the main camera platform should be via a back-of-house lift that connects the OB compound with the television production areas. The access should be flat with approved ramps that connect various floor levels, i.e. no stairs, so that road cases on wheels and trolleys can be used to ferry the equipment.

Space should be allocated to safely store empty equipment cases.

2.2.3 Roof camera

A roof, gantry or gondola camera platform is often used wherever grandstand structures can permit placement of a suitable platform. The platform should be 1.8 metres square located in line with the half way line, and should comply with current State and Federal work safety requirements. Access to the roof camera platform (or gondola) should not be restricted by having to access it through spectator seating in adjacent seating areas.

Access ways to the roof camera should provide for transporting of equipment to the platform, including “hard” cameras (typical 30 kg) and large lenses (typically 45kg). Lifting aids are to comply with current work safety regulations.

Camera platforms above spectator areas should be fitted with kick boards and drop-nets to prevent any items accidentally falling to the spectator area.

2.2.4 Field cameras rugby league and rugby union.

Typical rugby league and rugby union TV coverages require 9 to 10 on-field cameras:

- 2 x ENG handheld roving cameras (ERC) along western sideline.
- 1 x ENG handheld roving camera (ERC) along eastern sideline.
- 2 x cameras, often super slo mo, behind each of the north western and south western dead ball corners on tripods, 5 metres back from the dead ball lines.
- 2 x cameras, often super slo mo behind each of the north eastern and south eastern dead ball corners on tripods, 5 metres back from the dead ball lines.
- Field layout is required to allow for a 5 metre player run-off from the dead ball line to the behind the line cameras. If such space cannot be available, camera space needs to be allocated immediately behind the perimeter fencing 1m in from the sidelines at each end of the field, alternatively, “alcoves” could be incorporated into the north and south end boundary fences to accommodate the cameras.
- The on field camera positions need to be protected by crowd barriers and debris screens where possible, to protect camera operators and equipment from unruly crowd behaviour.
- 2 x dressing room and/or warm-up area point of view (POV) cameras for each competing team

2.2.5 Reverse angle and specialty cameras

Specialty/POV cameras (additional to above) may be deployed at selected matches. These can include cable cameras, camera cranes and rail cameras close to the field of play, motorised (manned) cameras, helicopters, blimps etc. Special camera requirements shall be advised of in the lead up to such matches.

An elevated reverse angle camera on or near the centre line of the pitch on the eastern side of the ground, with a clear and unobstructed view should be expected to be used on a majority of matches. A scaffold or in-seating camera platform would be required subject to individual ground facilities.

2.2.6 Cameras - rugby union specific

TVOB coverages for rugby union have additional camera placements to that of rugby league located behind the goalposts and in the NW or SW corners of the venue. These cameras are, due to the requirement to be "high", often situated in seating areas.

2.2.7 Cameras – football (soccer)

Cameras as per 2.2.1, 2.2.2, 2.2.3 and 2.2.5 Offside cameras: - In line with each penalty box on the same side as the main camera platform. These cameras should be at the same height and angle as the main cameras.

A goal camera should be situated behind the goal, on the longitudinal axis of the pitch, at a height which permits the penalty mark to be seen above the crossbar of the goal. The angle of the line of sight to the horizontal should be between 12° and 15°.

2.2.8 Field cameras – football (soccer)

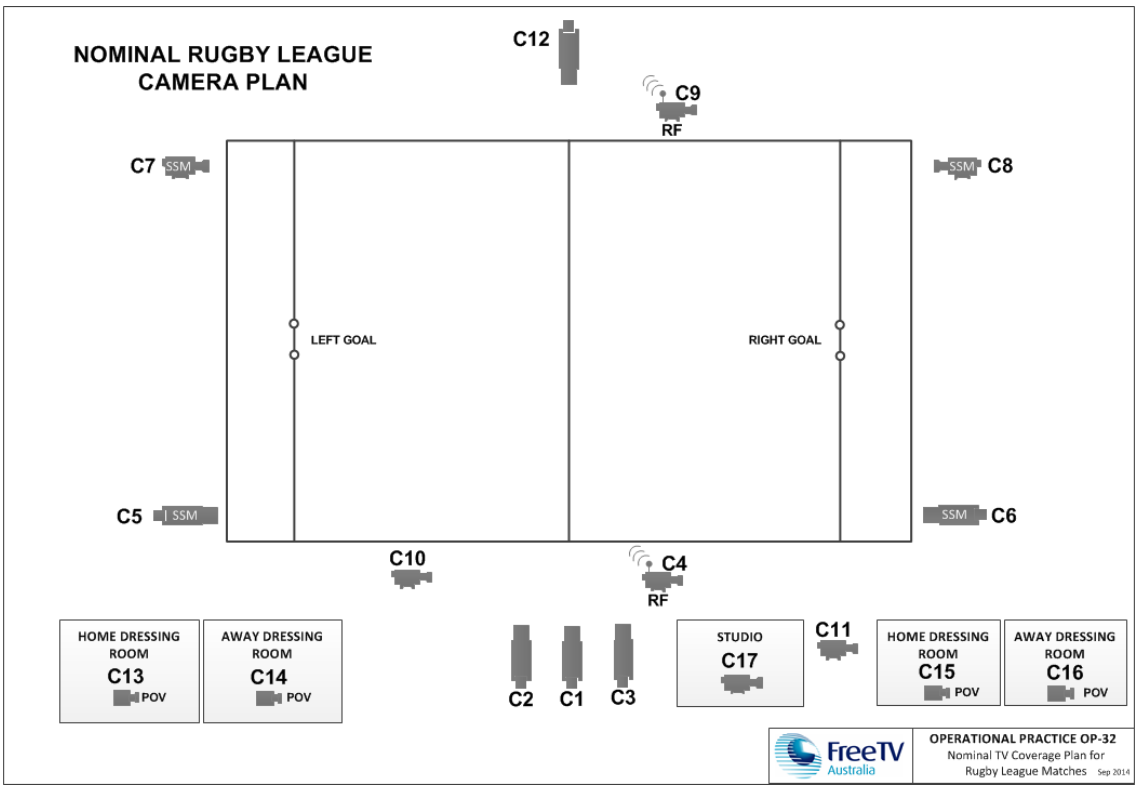
Typical football coverage requires 5 to 6 on field cameras:

- 1 ENG handheld roving cameras (ERC) along western sideline
- 2 cameras often super or extreme slo-mo located with a view of the penalty box area at each end of the pitch.
- 2 cameras mounted on swivelling low mounts in line with each 18 yard (16.5m) line.
- 2 cameras on tripods, 3 to 5 metres behind the byline located between the penalty box and the goal square at each end of the pitch. These areas to be clear of any ground signage.

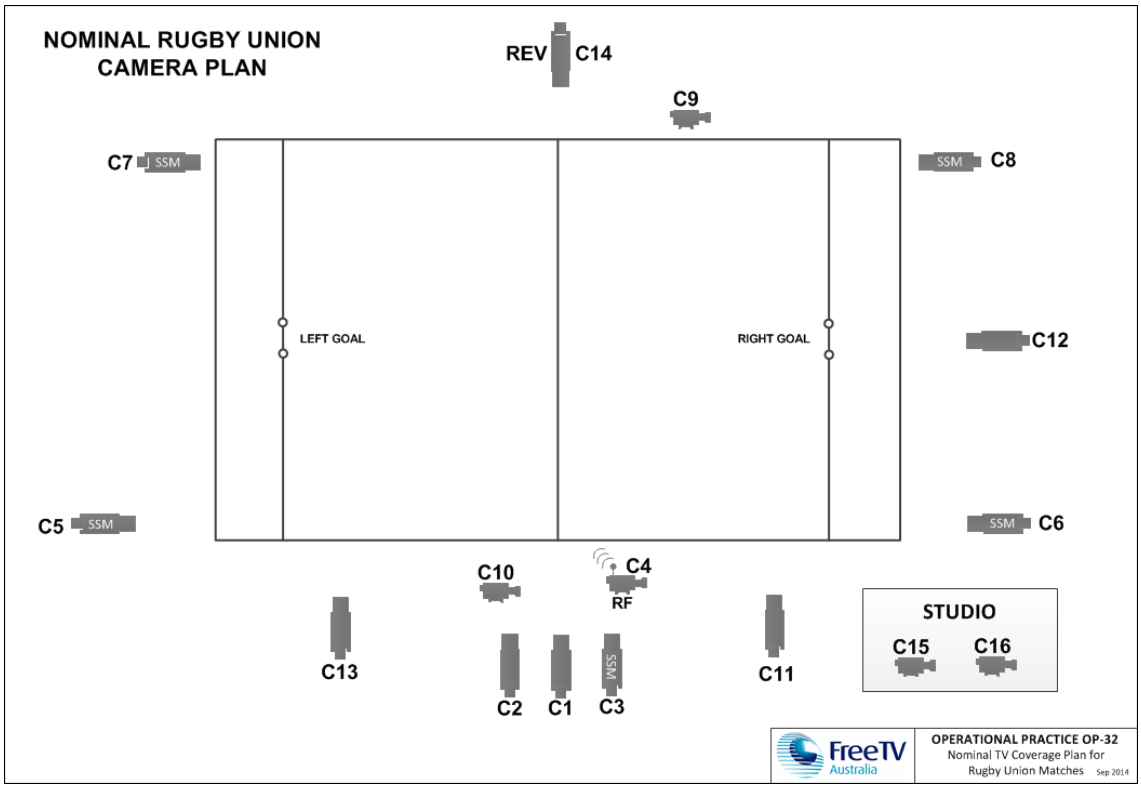
2.2.9 Specialty camera infrastructure

There are various cameras (cable cameras) and facilities available for production use that require "hard" fixing points to be symmetrically placed around the ground for the installation of cameras and other equipment on catenary type mounts. Suitable points, typically 'high", light towers, grandstand roofs etc. around the ground need to be identified and engineering specifications made available. In new or renovated venues these points should be included in the design phase of the project.

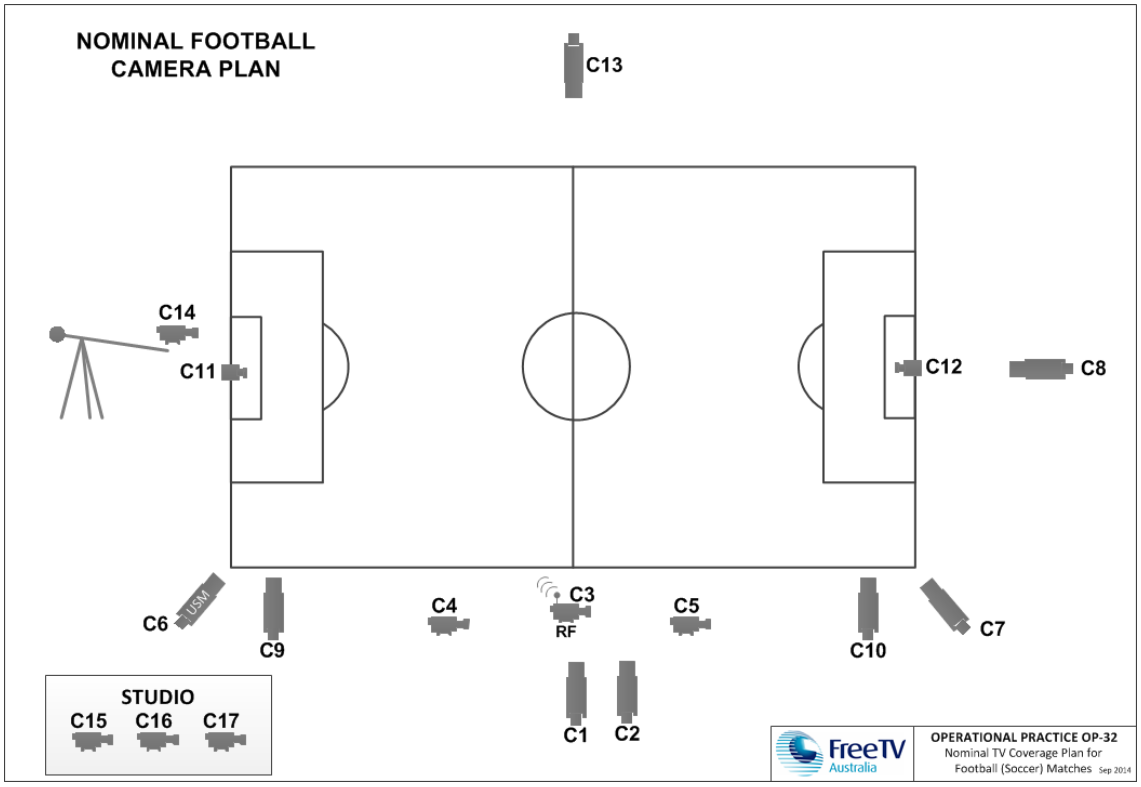
2.2.10 Technical plans for rugby league, rugby union and football telecasts



Nominal TV Coverage Plan for Rugby League Matches



Nominal TV Coverage Plan for Rugby Union Matches



Nominal TV Coverage Plan for Football (Soccer) Matches

2.2.11 Typical camera configurations rugby league and rugby union

TYPE	LOCATION	ZOOM LENGTH (typical)
Hard camera	Camera deck or higher	20:1or 75:1
Hard camera	Camera deck	75:1
Hard camera	Camera deck possible Super slo-mo	86:1 or >
Portable camera	W sideline (RF)	22:1 or W/A
Hard camera	NW corner super slo-mo	86:1 or >
Hard camera	SW corner super slo-mo	86:1 or >
Portable/hard cam	NE corner super slo-mo	86:1 or > or 22:1
Portable/hard cam	SE corner super slo-mo	86:1 or > or 22:1
Portable camera	E sideline (RF)	22:1 or W/A
Portable camera	Benches, I/views	22:1
Portable camera	Studio	22:1
Hard camera	East side of venue in stand	75:1

Alternate positions for Football

Behind goal North
Behind goal South
Western side, three qtr line north
Western side, three qtr line south

2.2.12 Final camera placement

The camera positions in Section 2 are typical of rugby league, rugby union and football coverages but final camera placement will always be at the prerogative of the program producer and director.

2.3 Commentary areas and studios

The Host Broadcaster or Main Commentary Box should be on the centre line of a rectangular football field, in the vicinity of the main camera platform with a clear view of the entire field including the players' benches and should not be obstructed by the cameras. Studio, unilateral and radio booths should be either side of this booth.

2.3.1 Commentary box dimensions and construction

A "Standard" Commentary Box should have a width to accommodate a team of four across the front bench. Typical size for the main commentary box is in the order of 4 metres frontage x 4 metres deep. The front of the booth should be glazed the whole width. If a mullion is required it should be on the sides not the centre. The glass should be fixed, laminated and mounted perpendicular to the ground. If the glass is angled the angle of any television lights in the commentary box need to be taken into consideration as reflections may appear on camera in

the commentary booth. There should not be any other glass in the commentary booth. Parallel glass in commentary booths, typically used on the front sides of the booth, is the major offender in promoting unwanted acoustic resonance.

The commentary box needs to achieve specific acoustic criteria. Construction materials, construction methods and physical dimensions all play a role in the outcome. Ideally an acoustic engineer / consulting firm with experience building studio facilities would have to be engaged to assist in the design to meet the specifications.

The design objective is to create a space with many acoustic resonances spread evenly across the frequency spectrum. Internal acoustic treatment is required to dampen the liveliness and tame the resonances. Noise entering the broadcast space can be airborne or transmitted through the floor. Impact isolation between floors should be kept to a minimum. Note: cable paths into the studio / commentary boxes should have removable acoustic isolation such as fire pillows provided to achieve the above mentioned criteria for the room.

The commentary booth needs to be air conditioned with capacity to cope with up to 12 people heat load plus television lighting. Evaporator fans need to be low noise units and achieve <30dB(A) with local thermostat and control for optional shut down during studio on-air segments.

Work lights in the commentary booth should consist of fluorescent batten tube lights or similar high output lights, to be utilised for the bump-in / bump-out. A second stage of lighting focused on the benches should be utilised for “on air” conditions. This can be down lights or focused batten lighting. Lighting controls should be available in the commentary booth. Special attention should be paid to any glare that is omitted from the commentary booth lighting and any flicker that is introduced by the lamps.

Three 48.4mm scaffold tubes (lighting bars) to be installed 50 mm below ceiling height down the length of the room—one in the centre the other two 400mm in from side walls for the mounting of “television” lighting fixtures. Each bar should be rated to carry in the order of 40Kg. Provision for three phase power *(32 Amp)* should be available for lighting or other high current requirements.

A scaffold tube should be provided outside, along the front of the commentary box for the mounting of radio mic and other RF antennae. The positioning of the bar has to take into consideration that antennae will be mounted so there are clear sightlines to the field of play and mandatory safety distances from people is required. Final placement to be determined after consultation with TV broadcasters and other RF users at the venue which will take into account safety in regard to access.

Cable access holes are required at the front and sides of the area for cabling to the antenna mounting bar and other media facilities as required. These access ways to be minimum 150mm in diameter.

A front bench should span the entire width of the room and should be 800mm deep for the placement of television monitors, commentary units, computers and the electronic equipment. Typically this bench has video monitors, commentary units, talkback stations, computers and tablets. Cable access holes are helpful in tidying up the installation and maximising the bench space. The front bench should be easily removed to repurpose the space as a presentation studio.

A 150—300mm riser is required behind the front bench area to house up to 3 production personnel. An 800m deep bench top is required, with the desk being able to be removed as required.

Access for equipment to all media areas should be flat with suitably graded ramps used between floor levels. Goods lift or suitably protected passenger lift access is required for these areas.

Any build or refit of broadcast facilities should be made in direct consultation with all rights holders television technical and production representatives.

2.3.2 Studios

The Venue should have a television studio space available. This should be located as close as practically possible to the main commentary box. The dimensions of the television studio should exceed that of the commentary booth in order to accommodate a presentation desk/table suitable for at least four presenters and three cameras. Typical dimensions for TV studio are 6 metres x 6 metres with 3.6 metres (minimum) ceiling height and should have a (background) view to the field of play. The window of the studio is to be as "mullion free" as possible and sloped inwards at an angle of 17 degrees to the vertical at the sill (inwards at the head/top of the window), to minimise reflections from lights.

Three 48.4mm scaffold tubes (lighting bars) to be installed 50 mm below ceiling height down the length of the room—one in the centre the other two 400 mm in from side walls for the mounting of "television" lighting fixtures. Each bar should be rated to carry in the order of 40Kg. Provision for three phase power *(32 Amp)* should be available for lighting or other high current requirements.

Acoustic specification, air conditioning, finishing materials and colours, work lights, lighting bars, cable access, equipment access and storage for the television studio should equal or exceed the specification of the commentary booth.

Provision for three phase power *(32 Amp)* should be available in the vicinity for studio lighting.

Provision should be made for a green room, make-up and change facility within the broadcast spaces.

2.3.3 Unilateral broadcaster commentary boxes and studios

Unilateral (television and radio) commentary boxes and studios should be provided for venues / events where unilateral coverage is required. The number required is dependent on the status of the competition / game. These spaces maybe repurposed facilities that can be converted to broadcast facilities when required however the unilateral commentary boxes and studios should be built / fitted to the same specifications as the main commentary box. They should as far as possible be sited close to the main commentary box, with clear sight lines to the field.

2.3.4 Radio commentary boxes

Provision needs to be made for Radio broadcast boxes adjacent to the Television box area.

Nominal area for a Radio box is 3.5m X 3.5m with clear sight line to the field of play and to the main scoreboard. These rooms are to be built / fitted to the same acoustic specification as the main television commentary booth.

Each radio broadcaster requires direct two way audio cable connectivity, for commentators / reporters doing live interviews into the commentary radio boxes during broadcasts, to the following areas:

- The side line close to team benches (with good sightlines)
- Each team dressing room
- Main media interview room (and smaller rooms if provided)
  (and possibly other locations).

Check with the main radio broadcaster regarding the particular requirements for cabling. General purpose power outlets may also be required. Exposed areas should employ IP rated enclosures for connections.

Radio broadcasters utilise a range of backhaul to connect back to their studio including: ISDN, telephone and internet. Suitable cabling should be allowed from all boxes back to the venue's main communications room to enable direct access to connect to the stadium network, telco and ISP services.

2.3.5 Sideline commentary position and mixed zone

On field space is to be allocated to TV operations at centre line area, western side, for sideline commentator/s, producer, floor manager and cameraman, audio and lighting personnel.

3. Radio Frequency (RF) spectrum management

3.1 Wireless microphones

Reference should be made to FREE TV AUSTRALIA OP 27: Operation of wireless microphones in Australia, for matters concerning radio microphones.

Wireless microphones are extensively used for umpire calls and TV / radio interviewers. Wireless microphone frequency co-ordination is required on a venue by venue basis to avoid interference with TV operations, radio broadcasters, umpires and linesmen, ground announcers, entertainment, and other legitimate users of wireless microphone equipment.

3.2 Radio frequencies

Extensive use of the RF spectrum is necessary for comprehensive TVOB cover of Rugby League, Rugby Union, and Football games.

Allocation of frequency bands is generally as follows:

- 2.0 & 2.2 GHz microwave bands:
  Portable wireless cameras
  Specialty POV cameras
  Helicopter down links in the 2GHz band ONLY

For specific information on use and coordination of ENG / TOB in the 2 and 2.2GHz bands refer to:

OP63 Spectrum usage for ENG and TVOB Operations in the Brisbane / Gold Coast / Sunshine Coast Area

OP64 Spectrum usage for ENG and TVOB Operations in the Sydney / Canberra / Newcastle / Illawarra Area

OP65 Spectrum usage for ENG and TVOB Operations in the Melbourne Area

OP66 Spectrum usage for ENG and TVOB Operations in the Adelaide Area

OP67 Spectrum usage for ENG and TVOB Operations in the Hobart Area

OP68 Spectrum usage for ENG and TVOB Operations in the Darwin Area

OP69 Spectrum usage for ENG and TVOB Operations in the Rural and Remote Areas

- 7 / 8 GHz microwave band Medium haul point to point back haul links
- 13 GHz microwave band Short haul point to point back haul and local interconnect links
- 470 – 520 MHz band Duplex Radio Telephone (RT) voice, telemetry and data communications

- 520- 694, 1790-1800 MHz band. Wireless microphone operations
- Aggregate RF systems requirements can be in the order of 12 x 2.0 GHz channels, 4 to 6 x 7 / 8 GHz channels, 4 to 6 x 13 GHz channels, 10 x UHF duplex RT frequencies and 20 to 30 x wireless microphone frequencies.

RF spectrum usage is strictly controlled, and specific channel allocations are generally licensed to individual commercial entities. Temporary use of multiple frequencies as is required for operations on the major event scale require frequency co-ordination with established license holders and special licensing for the complete RF requirements for the period of the event.

It is essential that a rigid frequency management procedure be implemented on a venue by venue basis to ensure non interference between services within the precinct involved in TVOB origination, including authorised unilateral operators, and for other licensed users (ENG etc.) operating in near proximity to the OB precinct.

Frequency allocation and usage regulations are becoming increasing rigid and restricted. To this end it would be advantageous to consider making an enclosed venue electronically shielded from areas outside, by incorporating or using materials during construction that would reduce or minimise RF interference. Such infrastructure would need to be considered during the design stages of any new venue or those undergoing large-scale rebuilding programs.

Wireless microphone frequency management is the prerogative of the event promoter and venue management, along with TVOB operators who all need to be fully involved in channel allocations from the early planning stage of a project.

Microwave and UHF frequencies are licensed but may be subject to frequency sharing arrangements. Co-ordination between users, including news services not directly involved in the event telecast, but licensed to operate in proximity of the event precinct is an essential pre-requisite for event RF spectrum planning.

Major events involving multiple operators of RF services require overall coordination to be under statutory authority control of use / misuse of RF spectrum assets.

4. Outside Broadcast compound

4.1 General

A level hardstand area for outside broadcast control units (OB vans) parking is required, it should be situated as close as possible to the camera platform/ TV commentary box area. This area (OB compound) should be securely fenced so as to provide security for television equipment, personnel, TV operations and the safety of the public. This is particularly important on large scale television operations where facilities are setup for many days or weeks and there is the need for only accredited personnel to have access to the compound.

Major outside broadcast vehicles are semi trailer units built to comply with Australian road transport regulations. Venue vehicle access and load bearing capacity needs to comply with maximum vehicle dimension and weight specifications. Typical requirements are 22.0 metres combined trailer and prime mover length, maximum height of 4.3 metres, and 8.5 tonne per axle loading.

Access to and egress from the OB compound needs to cater for the turning circle and overhead clearance requirements of maximum dimension articulated vehicles.

Special attention to overhead obstructions is necessary where ramps or uneven road surfaces are involved along with adequate clearance on the underside of the OB vans

Generator hardstand should be incorporated in the OB compound (see Section 5).

Typical hardstand area is in the order of 500 square metres either 25 metres x 20 metres or 50 metres x 10 metres, rectangular. This area would cater for up to two OB facilitators with more space co-sited with it, should the event have a number of Australian and overseas unilateral broadcasters.

The hardstand area is required to be level to accommodate OB vans with expanding sides with any slope for drainage being kept to a minimum.

Provision is to be made to site a satellite uplink vehicle within the compound, adjacent to the compound or within the venue area with suitable cable/fibre connectivity and local 32A 3 phase power outlets x 3 as a minimum. Clear line of sight to the north-east sky for the majority of Australian broadcasters and to the western sky for a number of international broadcasters is a location requirement. See Clause 8.1

Should the OB compound be situated within an enclosed space (underground or under a grandstand for instance) adequate ventilation is to be provided so as to comply with relevant safe work practice regulations as outlined by each State's regulatory body Code of Practice.

Air conditioning units on OB vans and portable sheds give off a considerable amount of heat which needs to be removed from the area and this along with any exhaust fumes from generators and vehicles (buses, delivery vehicles, fork lift trucks etc), needs to be taken into account when designing ventilation systems.

4.2 Personnel Amenities

Adequate personnel services need to be provided in the OB compound. These amenities should include:

- Toilet facilities, separate male and female facilities
- Sewer or self contained connection, town water connection
- Lighting for safe movement of personnel
- Drainage contours such as to minimise "ponding" during heavy rainfalls
- Food preparation area and catering area
- First Aid facility
- Regular cleaning and rubbish removal services
- Clearly marked emergency egress routes

5. POWER

5.1 Typical requirements

Typical power requirement is for 250 Amps per phase three phase (415Volt) supply adjacent to the outside broadcast vehicles hardstand area. Power should be available on powerlock connectors with OB facilitators providing their own distribution equipment as required. Major venues likely to be hosting major international events or those whose compounds service more than one venue should provide 2 or 3 power installations to accommodate multiple broadcasters and should specify 400 Amps per phase in construction and rebuilding planning.

3 x 15A single phase outlets should be provided adjacent to each power loc installation for overnight use.

5.2 Heavy neutral currents

The high level of use of switch mode power supplies in TVOB technical equipment has resulted in high neutral current drain in three phase mains supplies. High current neutral connections should be specified for mains power installations planned for TVOB compounds.

5.3 Circuit breakers and safety

Where mains power supplies are protected by residual current devices (RCDs) trip current of the source RCD should be adjustable, to be set to a higher trip current level than the main OB van circuit breaker, such that the OB van main circuit breaker serves as the prime safety switch for the TVOB operation.

TVOB mains supplies are to be separately protected from other electrical supplies servicing the rest of the venue.

Power reticulation ex the OB van to operational areas is to be RCD protected in accordance with Work Safety requirements.

5.4 Local and standby generators

Generator hardstand should be incorporated in the OB compound and should be adjacent to the mains power connect point.

Sourcing of generators is generally a TVOB responsibility. Generators are to be silenced to EPA requirements and are to be sited to obviate exhaust fume exposure to TVOB staff and patrons.

For indoor/undercover OB compounds, provision needs to be made to extract exhaust fumes. If this is not possible, interconnect cabling specified to full electrical load is required to be installed between the generator site and the OB compound.

Three phase 32 Ampere rated interconnect cables (5 pin connectors) are to be installed between the OB compound and commentary box / studio area, and between the OB compound and sideline for extension of OB compound power to main operational areas.

6. VENUE AUDIO / VIDEO (A/V) CONNECTIVITY

6.1 Venue audio / video (A/V) connections

The connect panel for venue A/V services should be located in the OB compound, co sited with TVOB cable terminations and telecommunications services.

TV signals emanating from the OB unit will be HD SDI with embedded audio (minimum stereo audio) supplied on BNC connectors.

The video referee/umpire/TMO should be provided with HD monitoring, with suitable cabling infrastructure supplied to their location

Interface connectors for off-air TV distribution, venue A/V distribution, Pay-TV cable and venue phone should be available at the connect panel.

6.2 Telecommunication services connections.

An area within the compound is required for the location of various circuit provider's equipment and services, (fibre interfaces, PSTN, data etc.) This area to have local power as required by the service providers and adequate space for their equipment. Modern equipment has seen the need for small air conditioning plants being used on the equipment housings so facility for water runoff needs to be considered.

7. CABLING

7.1 General

Simple access is required for cabling from the outside broadcast vehicle hardstand to the main camera platform, roof camera platform, main commentary box, unilateral commentary box, studio/on camera position and field, pre/post match presentation area, media press conference area/s.

TV cable installations are site specific and need to be planned on an individual basis, but provision needs to be made for cable routes which provide ease of access, do not compromise venue aesthetics and do not present risk to workers or public.

Cable routes within the venue should allow for obstacle free installation and removal of cables.

Wherever possible, ground level cable paths clear of public traffic areas are preferred.

As a general rule, day cabling allows for full cable install within a 20 man hour rig time, and de-rig within 12 man hours.

Where this cannot be achieved due to either stadium access problems or to the scale of the OB operation, installation of “season cables” is a preferred option.

Where cables need to be routed below ground level open cable troughs with easily removable and replaceable cover plates are the preferred option.

Where cables need to be routed above traffic areas, open cable trays with cantilever mounting from below allowing for simple cable runs with “lift in” installation without the need for mechanical aids— ladders, scaffolds, elevated work platform/scissor lifts.

Cable conduits are not recommended for temporary cable installs, but where there is no other option conduits should be a minimum 150mm diameter and curves/bends no greater than 30 degrees with draw wire installed. A minimum of 3x conduits should be available in order to separate signal cables from power cables, and to allow for (inevitable) future expansion.

7.2 Permanent cable install

Cable routes in major stadium complexes may be such as to preclude both DAY and SEASON cable installs.

In such cases permanent installations become the only option.

It should be recognised that TV production techniques change, particularly with equipment innovations. Changes to the types of cables used are becoming less with the SMPTE 311M fibre/copper hybrid cable terminated in SMPTE 304M connectors becoming the industry standard for current cameras.

Implementation of specialised equipment is seeing increased demand for fibre optic cables, precision digital video coaxial cable, and (multi way) fibre optic utility use cables for video, audio, data and communications acquisition and transmission.

Co-axial video cable is to be specified for end to end delivery of uncompressed HD video over the installed length of cable.

Cable types and cable technical specifications alter with advances in technology so cable schedules need to be updated prior to planning any permanent installation.

Permanent cable installations should be planned in consultation with venue management and TV Rights holders, with emphasis on specifications for cables, connectors and locations of outlets.

For multi-purpose venues, the total installation should encompass the highest common requirements of all possible event cabling.

Provision needs to be made for the maintenance, replacement and upgrade of such installations.

8. BACKHAUL

8.1 General

TVOB transmission to studio base can be via telecommunications circuits, satellite uplink or local microwave radio transmission.

The telecommunications access point should be adjacent to the OB compound, with any powered equipment being supplied from the same supply as the OB compound.

Compound space to be provided for up to 3 satellite uplink vehicles with a clear view to both the North-East and Western skies is required within or adjacent to the OB compound

8.2 Microwave link platform

A 2.0 m x 2.0 m platform is typically required for TVOB backhaul microwave link installation.

The platform is to be sited to allow clear line of sight radio transmission to the TV studios or to suitable intermediate relay sites as identified by the broadcasters.

A microwave platform may also be required within the stadium for mounting of RF camera microwave receivers and/or antennae.

The provision of microwave link platforms at the stadium will depend on the surrounding topography and available link paths in and out of the stadium.

Any structures need to comply with relevant Occupational Health & Safety (WH&S) regulations.

9. LIGHTING

(Reference should be made to FREE TV AUSTRALIA OP 31: Lighting Requirements for Television.)

A brief summary of lighting standards is as follows:-

9.1 International standard for TV venues

Lighting level (Ev) toward main cameras:	1400 lux (average)
Lighting level toward other directions:	1000 lux
Lighting level toward USM / SSM cameras:	1800 lux within defined zones- slo mo replay zones (SRZ)
Colour temperature (TK):	4000K to 6500K, but within 500K at individual venues: preferred value 5600K.
Colouring rendering index R_a:	$\geq$ 90
Maximum GR for main TV cameras:	<40
50 Hz mains flicker:	minimise flicker by cross aiming and spreading floodlights equally over the three phases: ≤10% flicker for ≤600fps ≤3% flicker for ≤1,000fps.

9.2 Professional standard

E_V toward main cameras:	1000 lux (average)
E_V toward other directions:	800 lux
Colour temperature:	4000 K to 6500 K, but within 500K at individual venues: preferred value 5600K. .
Colour rendering index R_a	Minimum requirement Ra 85, Ra > 90 preferred
Maximum GR for main TV cameras:	<40
50 Hz mains flicker:	minimise flicker by cross aiming and spreading floodlights equally over the three phases

Note: Whilst satisfactory picture quality can be achieved at the minimum lighting levels stated, restrictions are placed on full usage of zoom lenses and focusing becomes quite difficult for camera operators on BCU (big close up) camera angles. Super Slo-mo cameras cannot perform satisfactorily below Professional standard lighting.

10. SAFETY

All personnel working on TVOBs are to be familiar with and to comply with relevant WH&S regulations.

A site specific risk assessment is to be undertaken by venue management and TVOB operations management during planning stages of the event.

TVOB personnel are to be inducted as to venue and TVOB safety requirements prior to commencement of duties.

Scaffolding, camera tracks, aerial cabling and other constructions are to be installed by suitably licensed persons.

Camera cranes, scissor lifts, fork lifts and other mobile work platforms are to be operated by licensed persons.

Electrical installations are to be undertaken by licensed persons, and tested and tagged in compliance with statutory regulations.

Temporary TV cable installations are to comply with site hazard reduction policies.

As safety regulations can vary subject to individual state government regulations, applicable requirements need to be determined on a site by site basis.

11. CABLE INSTALLATIONS AT RUGBY LEAGUE, RUGBY UNION and FOOTBALL STADIUMS

Current television production equipment is becoming increasingly reliant on the use of fibre optic cables for the acquisition and distribution of camera, audio and communications signals which is therefore seeing many existing stadia being left with outdated cable installations. Any existing tri-axial camera cable and co-axial video cable within venues that may still be used for instance, to distribute video signals to venue distribution points should be of such a specification that it will deliver uncompressed High Definition (HD SDI) video over the installed length of cable. Existing shielded audio cable is often of some use.

The following cable listings are typical of requirements for rugby league, rugby union and football coverages but intended only for reference.

Permanent cable installations should be planned with consultation between venue management, TV rights holders and OB facilitators, with emphasis on specifications for cables, connectors and the location of outlets.

Outside Broadcast Compound to Main Camera Platform

6 x SMPTE 311M camera cables SMPTE 304M connectors

2 x 6 pair single mode fibre optic cable terminated with LC connectors.

2 x coaxial video, specified so that it will deliver HD uncompressed video signals (may be downgraded due to length, to SD uncompressed signals, depending on required use).

1x single phase power

3 x CAT 6 cables

1 x 12 way audio multi-mic cable

Outside Broadcast Compound to Roof Camera Platform

2 x SMPTE 311M camera cable

2 x CAT 6 cables

Outside Broadcast Compound to TV Commentary Box Number 1.

2 x SMPTE 311M camera cables SMPTE 304M connectors

2 x 12 pair single mode fibre optic cable terminated with LC connectors.

6 x coaxial video, specified so that it will deliver HD uncompressed video signals (may be downgraded due to length, to SD uncompressed signals, depending on required use).

1 x 12 way audio multi-mic cable

1 x 20 pair Telco (Audio)

6 x CAT 6 cables

1 x 32 Amp three phase 5 pin power cable

Outside Broadcast Compound to TV studio No. 1

3 x SMPTE 311M camera cables SMPTE 304M connectors

1 x 12 pair single mode fibre optic cable terminated with LC connectors.

1 x 12 way audio multi-mic cable

1 x 32 Amp three phase 5 pin interconnect cable

Depending on location of studio to commentary facility, some sharing of cables may be possible.

Outside Broadcast Compound to Commentary Box 2. (Unilateral)

1 x SMPTE 311M camera cable with SMPTE 304M connector.

2 x 12 pair single mode fibre optic cable terminated with LC connectors.

6 x digital coaxial video, specified so that it will deliver HD uncompressed signals (may be downgraded due to length to SD uncompressed signals depending on the required use.

1 x 12 way audio multi-mic cable

1 x 20 pair Telco (Audio)

6 x CAT 6 cables

Outside Broadcast Compound to Field (sideline centre of venue)

8 x SMPTE 311M camera cables SMPTE 304M connectors

1 x 12 pair single mode fibre optic cable terminated with LC connectors.

6 x coaxial video, specified so that it will deliver HD uncompressed signals (may be downgraded due to length, to SD uncompressed signals, depending on required use).

1 x 12 way audio multi-mic cables

1 x 20 pair Telco

6 x CAT 6 cables

1 x 32 Amp three phase 5 pin interconnect cable

Outside Broadcast Compound to Dressing Room(s)

TV cabling is required to each player activity area of both “home” and “visitors” dressing rooms as follows:

2 x SMPTE 311M camera cables

4 x single mode fibre optic cable with LC connectors

2 x CAT 6 cables

Outside Broadcast Compound to Video Referee/Umpire

2 x coaxial video, specified so that it will deliver HD uncompressed signals.

4 pair single mode fibre optic cables with LC connectors

4 x shielded audio cables

4 x CAT 6 cables

Outside Broadcast Compound to Coach’s rooms

4 x single mode fibre optic cable with LC connectors (each)

Outside Broadcast Compound to venue A/V room/system

Off-Air TV RF distribution

Venue A/V distribution

Venue communications services

Cat 6 computer cable (for possible access to venue IT services)

Any additional services as specified by venue A/V service provider

Outside Broadcast Compound to Backhaul microwave platform

2 x Microwave equipment specification triax.

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