

## **1 SCOPE**

Free TV Australia Operational Practice 32 is a guideline for the minimum requirements for television coverage of various codes of football - Rugby League, Rugby Union, and Soccer. It provides an indication of infrastructure for an outside broadcast production using contemporary production techniques which meet broadcast television presentation requirements. Scenarios have been provided which are typical of NRL, Rugby and Soccer football coverage.

This Operational Practice has been developed by the Free TV Australia Project Group - Outside Broadcasts in the interests of maximising TV and Radio production potential and productivity at sports venues and avoidance of costly omissions at planning and construction stages.

TVOB coverage of soccer and rugby football codes has progressed with the general availability of "super slo-mo" cameras and digital cable-less (wireless) cameras and a range of special effects cameras. These developments have increased the venue space requirements for TVOB operations and imposed more stringent requirements on lighting specifications for night matches.

## **2 TYPICAL COVERAGE**

### **2.1 Cameras**

The configuration of a typical match at an approved venue will be:

Cameras covering the field of play	10
Cameras for O/B studio	1

### **2.2 Camera positions**

#### **2.2.1 Camera Platform**

A typical working platform is in the order of 8 metres wide (approximately 1.8 metres per camera) and 2.5 metres deep. The platform needs to be centred on the half way line. This is exclusive of Club / venue camera operations. An additional area would be necessary for such operations.

#### **2.2.2 Main Camera Platform Position**

(To accommodate 4 x hard cameras with telephoto lenses)

Actual positioning of the platform is subject to individual grandstand architectural design but the ideal location is 40 metres west of the (western) sideline and 10 metres relative height above the playing field (d:h + 4:1) with a clear view of the field inclusive of ALL dead ball corners, and with height above crowd to clear standing and hand waving patrons in between the camera deck and field of play.

Access to the camera deck should not be restricted following spectator seating in adjacent seating areas.

A range of d:h of 3:1 to 5:1 is generally acceptable, but coverage is compromised by excessive distance from the field ( $d = 60$  metres maximum) or excessive height.

### **2.2.3 Roof Camera**

A roof, gantry or gondola camera platform is proposed wherever grandstand structures can permit placement of a suitable platform. The platform should be 1.8 metres square on or near on the half way line, and should comply with current State and Federal work safety requirements. (Provision of the roof camera platform can possibly ease space requirements at the main camera position.). Access to the roof camera platform (or gondola) should not be restricted following spectator seating in adjacent spectator seating areas.

Access ways to the roof camera should provide for transporting of equipment to the platform, including “hard” cameras (typical 30 kg) and tele zooms (typically 40kg) Lifting aids are to comply with 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**

A typical rugby league TV coverage requires:

- 6/7 x on-field cameras
- 2 x running camera along western sideline (possible RF)
- 1 x running camera along eastern sideline (rugby , possible RF)
- 2 x “hard” cameras behind north western and south western dead ball corners on tripods, 5 metres back from the dead ball lines. These cameras are fitted with telezoom lenses and can be Super Slo Mo cameras as available.
- 2 x running / tripod cameras behind the north eastern and south eastern dead ball corners.
- 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 in line with the sidelines, 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 to protect camera operators from unruly crowd behaviour.

#### **2.2.4 Special Cameras**

Special cameras (additional to above) may be used at major matches. These can include camera cranes, rail cameras, dressing room cameras, helicopters, blimps etc. Special camera requirements shall be negotiated in the lead up to such matches.

A reverse angle camera on or near centre line on the eastern side of the ground could be specified for some matches. A scaffold or in-seating camera platform would be required subject to individual ground facilities.

#### **2.2.5 Soccer**

Camera positions for soccer TVOBs may vary from the basic rugby football plan, with camera placements behind the goals on centre line and ground level cameras at the quarter lines on the western side as alternatives to the rugby camera plan.

#### **2.2.6 Final Camera Placement**

The above camera positions are typical of Rugby League coverage but final camera placement will always be at the prerogative of the program producer and director.

### **2.3 Commentary Boxes**

The main TV commentary box should be on centre line, in the vicinity of the main camera platform with a clear view of the entire field, including the “players’ bench” and should not be obstructed by the camera platform. The TV commentary box is required to accommodate up to 4 x commentators, TV producer, Associate Producer and Statistician, with commentators seated at the front of the box, and production staff on a raised platform to the rear of the commentators.

Provision is required for cable installation from the OB compound.  
(See CABLING)

#### **2.3.1 Commentary Box Dimensions**

Typical size for the main commentary box is in the order of 4 metres frontage x 4 metres deep.

#### **2.3.2 Studio**

A TV Studio area is required adjacent to the TV commentary box for hosting of the TV program. Typical dimensions for TV studio are 4 metres x 4 metres preferably with 3.6metres (minimum) ceiling height and (background) view to the field of play.

The commentary box / studio area needs to be air conditioned with capacity to cope with up to a 12 person heat load plus studio lighting load. Evaporator fans need to be low noise units (Not to exceed NR 35) with local control for optional shut down during studio on air segments.

Lighting Bars are to be installed in the studio / on camera area for mounting of TV lights. Location and load capacity of the bars is to be decided in consultation between venue management and TV Technical representatives.

A 30 Ampere three phase interconnect cable is required from the OB compound for lighting power.

### **2.3.3 Radio Commentary Boxes**

Provision needs to be made for Radio broadcast boxes adjacent to the TV 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.

Coax, Telco and screened audio cables need to be installed between the TV OB area and radio commentary boxes to provide for video replays, sound splits and communications circuits between radio and TV services.

### **2.3.4 Sideline Commentary position**

On field space is to be allocated to TV operations at centre line, western side, for sideline commentator/s. Personnel requiring sideline space, additional to commentator/s are producer, floor manager, audio assistant.

Space provision also needs to be made for a half equipment rack to house wireless mic and associated equipment.

### **2.3.5 Arena lights**

Arena lights should remain ON following end of play until end of telecast as the field of play is the hostings backdrop. Arena lights should be switched to training level following the telecast until "bump out" is completed for crew safety.

### **2.3.6 Wireless 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.

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### 2.3.7 Radio Frequency (RF) Spectrum Management

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

Allocation of frequency bands is generally as follows:

- 2.5 GHz microwave band: Portable wireless cameras  
In-car camera uplinks  
Relay helicopter down links  
Camera helicopter down links
- 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 communications  
Telemetry and data communications
- 520 – 820 MHz band Wireless microphone operations
- Aggregate RF systems requirements can be in the order of 12 x 2.5 GHz channels, 4 to 6 x 7 / 8 GHz channels, 4 to 6 x 13 GHz channels
- 10 x UHF duplex RT frequencies and 4 to 6 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.

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

### **2.3.9 Unilateral Commentary Boxes**

A unilateral TV commentary box should be provided for international / interstate unilateral commentaries. The unilateral commentary box should be sited as per the main commentary box, with clear sight lines to the field and equipped as per the main commentary box.

Facilities for unilateral commentary boxes should be sited similarly to the main TV Commentary Box, similarly equipped and fitted out.

Unilateral facilities should be placed near the centre line and with clear line of sight to the field.

Dimensions for the unilateral commentary box are in the order of 4 metres x 4 metres.

## **3. OUTSIDE BROADCAST COMPOUND**

### **3.1 General**

A level hardstand area for outside broadcast control units (OB Units) parking is required convenient to the camera platform/ TV commentary box area.

The OB van compound should be fenced off from public access for security of TV operations, and for public safety.

Major outside broadcast vehicles are semi trailer units built to Australian road transport regulations. Venue vehicle access and load bearing capacity needs to comply with maximum vehicle dimension and weight specifications. Typical requirements are 17.5 metres combined trailer and prime mover length, maximum height of 4.3 metres, and 8.5 tonne per axle loading.

Typical hardstand area is in the order of 500 square metres either 25 metres x 20 metres or 50 metres x 10 metres, rectangular.

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.

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

Provision is to be made to site a satellite uplink vehicle within the compound, or adjacent to the compound with clear line of sight to the North-East sky.

An additional area of nominal 300 square metres should be available for international unilateral operators.

### **3.2 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
- 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

## **4. POWER**

### **4.1 Typical Requirements**

Typical power requirement is for 150 Ampere per phase three phase supply adjacent to the outside broadcast vehicles hardstand area. Power should be available over 4x three phase outlets or via ‘Power-lock’ bulk connectors. Industry standard power connections are Cutler Hammer DS63 outlets, Wilco 5 pin 3 phase (40 amp/50 amp) connectors and outlets and / or “Power Lock” bulk supply connectors.

### **4.2 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.

### **4.3 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 entertainment venue.

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

#### **4.4 Local and Standby Emergency Generators**

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

Sourcing of generators is 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.

Where generator hardstand cannot be within the OB van compound interconnect cabling specified to full electrical load (150 Amps / phase, three phase) is required to be installed between the generator site and the OB Compound.

Three phase 30 Ampere rated interconnect cables (Wilco 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 van power to main operational areas.

### **5. AUDIO / VIDEO (A/V) CONNECTIVITY**

#### **5.1 General**

TV program material may be required to be fed to and occasionally returned from other locations. Full quality feeds from the OB unit to another location such as a broadcast station should be over a "Contribution" quality circuit.

Both Standard Definition (SD) and High Definition (HD) picture formats are now expected to be in 16x9 wide screen. For SD, the preferable video connection is component serial digital video (SDI) with at least stereo audio. The alternative for SD and necessary for HD are digital link connections that use MPEG compression systems. However, the degree and type of compression, and as a consequence, the quality loss on such "contribution" circuits, need to be pre-confirmed. In certain circumstances if no other connection is possible, if agreed, an analog video link may be used for SD program material.

Audio requirements may include enhancements such as "Pro-logic" surround stereo encoding or discrete multichannel surround (eg. 5.1 surround). Multichannel audio may be carried in digital AES/EBU circuits in "Dolby-E" format. Additional audio channels may be required if separate music and/or effects channels are required.

In all cases, care is required to ensure that picture-sound delay offsets (lip-sync) are within limits.

#### **5.2 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 Telco services.

TV signals emanating from the OB unit will generally be 16x9 wide screen digital video, and at least stereo audio.

The video referee should be provided with widescreen monitoring. The venue A/V service provider would need to provide a format converter for reticulation to any 4x3 in house monitors.

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

(Refer to Addendum # 1, Cable Installations)

## **6. CABLING**

### **6.1 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, on camera position and field, and to all other operations areas, and to the nominated post match presentation area.

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 provision for 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 CABLING" is a preferred option.

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

Where cables need to be routed above traffic area open cable trays with cantilever mounting from below allow for simple cable runs with "lift in" installation possible.

Cable conduits are not recommended for temporary cable installs, but where there is no other option conduits should be a minimum 150mm diameter 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.

### **6.2 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, and that cable installations are subjected to continuing upgrades.

Implementation of HDTV equipment is impacting on cable installation with increased demand for Fibre optic camera cables, precision digital video coaxial cable, and (multi way) fibre optic cables for utility use.

Co-axial video cable is to be specified for end to end delivery of uncompressed digital 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 replacement and upgrade of such installations.

Preference is for cantilevered cable trays exclusive to TV cabling. Conduits – if provided – should be free of turns no less than 120 degrees from any change of direction. Where conduits are the only option, 150mm diameter is the minimum specification, and multiple conduits should be available to all operations areas with provision for upgrade and expansion.

(See Addendum #1 TVOB Cable Installation requirements for NRL, RU and Soccer venues).

## **7. BACKHAUL**

### **7.1 General**

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

The Telco access point should be adjacent to the OB compound.

Space provision for a satellite uplink vehicle with clear view to North-East sky is required within or adjacent to the OB compound.

### **7.1 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 a suitable intermediate relay site.

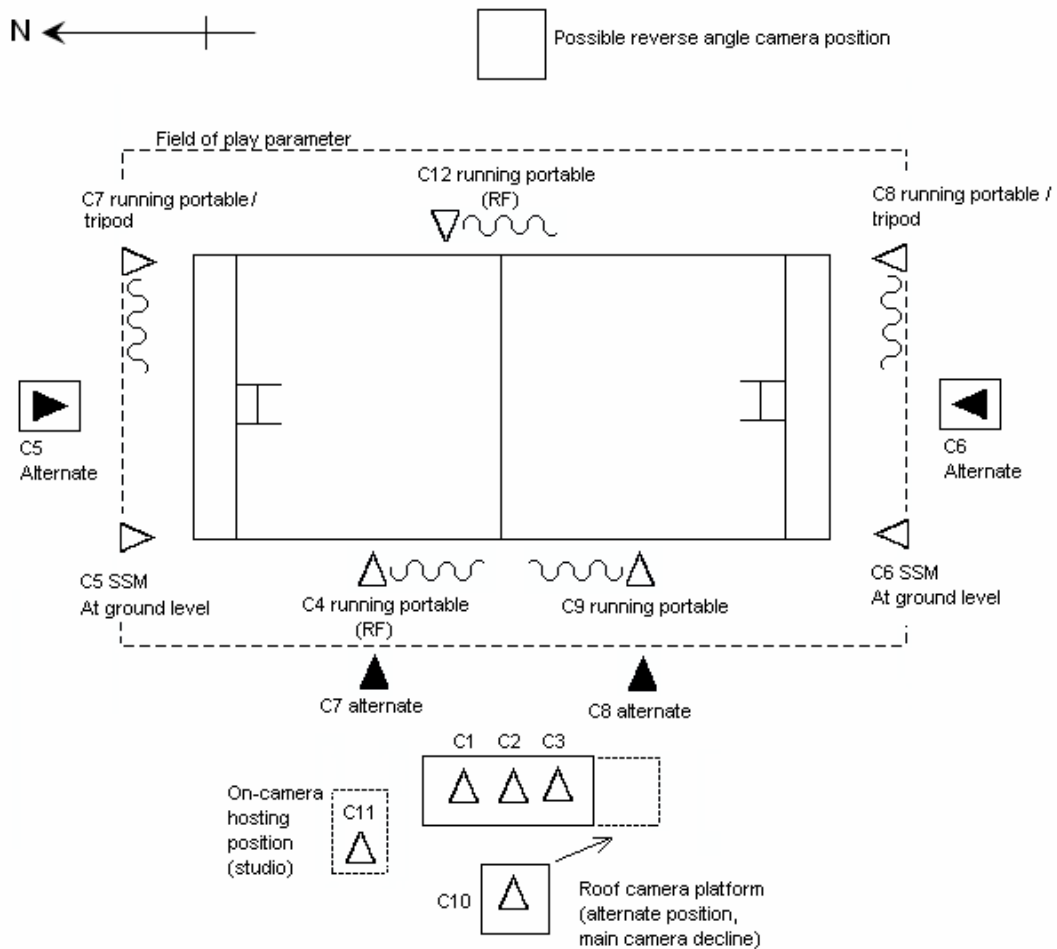
A microwave platform may also be required within the stadium for mounting of (manned or unmanned) wireless camera microwave receivers.

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 (OH&S) regulations.

**8. OUTLINE OF A TECHNICAL PLAN FOR RUGBY LEAGUE, RUGBY UNION AND SOCCER TELECASTS**

**Fig 1: Nominal camera positions**



**8.1 Camera Configurations**

C1	OB Camera	20:1 or 55: 1 Zoom
C2	OB Camera	50:1 Zoom
C3	OB Camera or Super slo-mo	50:1 Zoom
C4	Portable Camera W sideline (RF)	18:1 Zoom
C5	OB Camera or Super slo-mo	70:1 Zoom
C6	OB Camera or Super slo-mo	70:1 Zoom
C7	Portable Camera	18:1 Zoom
C8	Portable Camera	18:1 Zoom
C7 Alt	OB Camera	50:1 Zoom
C8 Alt	OB Camera	50:1 Zoom
C9	Portable camera W sideline	18:1 Zoom
C10	OB Camera on roof (or main Camera platform)	50:1 Zoom
C11	Portable Camera (studio)	18:1 Zoom
C12	Portable Camera E sideline (RF)	18:1 Zoom

Alternate positions for Soccer

C5	Behind goal North
C6	Behind goal South
C7	Western side, three qtr line North
C8	Western side, three qtr line South

**9. LIGHTING**

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

**9.1 International Standard for Colour TV Lighting at Sports venues**

Design criteria for development projects should meet an international standard with mechanical and electrical specifications to provide for upgrade to (future) HDTV standards.

Lighting level (EV) toward cameras	1400 lux
Colour temperature (TK)	4000 Kelvin to 5600 Kelvin within 500 Kelvin at individual venues
Colour rendering index (Ra)	>90

## **9.2 Local Standards**

Existing stadiums that do not meet international standards are classified as follows:

### **9.2.1 Professional Standard** (Minimum standard for TV cover)

EV toward cameras	1000 lux
Colour temperature	As above
Colour rendering index (Ra)	Minimum 65, > 90 preferred

Whilst satisfactory picture quality can be achieved at the minimum lighting levels stated (1000 lux), restrictions are placed on full usage of tele 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 OH&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.

**ADDENDUM # 1**

**CABLE INSTALLATIONS AT NRL, RU and SOCCER FOOTBALL STADIUMS**

**NOTE:**

- Implementation of HDTV equipment is impacting on cable installation with increased demand for Fibre optic camera cables, precision digital video coaxial cable, and (multi way) fibre optic cables for utility use.
- Co-axial video cable is to be specified for end to end delivery of uncompressed digital video over the installed length of cable.

The following cable listings are typical of requirements for NRL, RU and Soccer telecasts but intended only for guideline reference. 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.

Due to the varied nature of possible indoor entertainment events a multipurpose cabling approach is considered the most practical.

The installation of wall box patch points around the building allows for the most versatile building coverage.

Each wall box should contain as a minimum:

- 4x triax camera cables
- 4x Fibre optic camera cables
- 5x digital coaxial video
- 8x XLR audio
- 2x Cat 6 computer cable

These points should be located:

- either side of the usual main stage area
- at the position usually used for FOH lighting/audio
- on the upper most level for high/speciality cameras
- in the backstage/dressing room area
- at the exterior of the building in the area that would be used for arrivals
- at other strategically logical locations on multiple levels

It should be possible to patch either directly or via an in house A/V room between any of these locations and the outside broadcast compound.

**Outside Broadcast Compound to Main Camera Platform**

3x Fibre optic camera cables  
4 x triaxial<sup>1</sup> camera cables  
2 x digital coaxial video  
1x single phase power

**Outside Broadcast Compound to Roof Camera Platform**

1x Fibre optic camera cable  
1 x triaxial<sup>1</sup> camera  
5 x shielded audio

**Outside Broadcast Compound to TV Commentary Box Number 1.**

2 x triaxial<sup>1</sup> camera  
6 x digital coaxial video  
2x 12 way audio multi-mic cable (typical suppliers, Burndy, Gepco)  
1 x 20 pair Telco (Audio)  
1 x 20 pair Telco (Data)  
1 x 30 Amp three phase Wilco 5 pin interconnect cable  
4x CAT 6 computer cable  
1x 8 way multi Fibre optic cable

**Outside Broadcast Compound to Commentary Box 2. (Unilaterals)**

1 x triaxia<sup>2</sup> camera  
4 x digital coaxial video  
1x 12 way audio multi-mic cable (typical suppliers, Burndy, Gepco)  
1 x 20 pair Telco (Audio)  
1 x 20 pair Telco (Data)  
1 x 30 Amp three phase Wilco 5 pin interconnect cable  
2x CAT 6 computer cable

**Outside Broadcast Compound to Field (Players Race)**

4x Fibre optic camera cable  
8 x triaxial<sup>2</sup> camera  
4 x digital coaxial video  
2x 12 way audio multi-mic cables  
1 x 20 pair Telco (Audio)

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<sup>1</sup> Installed Triax cables are to be 11mm or 14mm diameter as required to meet HDTV performance requirements over the installed length of the cable ( including any “day cable” extensions to the installed cable. Maximum working lengths are 1000 metres for 14 mm cable and 500 metres for 11 mm cable

<sup>2</sup> Installed Triax cables are to be 11mm or 14mm diameter as required to meet HDTV performance requirements over the installed length of the cable (including any “day cable” extensions to the installed cable. Maximum working lengths are 1000 metres for 14 mm cable and 500 metres for 11 mm cable

- 1 x 20 pair Telco (Data)
- 1 x 30 Amp three phase Wilco 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 room as follows:

- 2 x triaxial<sup>2</sup> camera
- 2 x digital coaxial video
- 1x single phase power interconnect cable
- 2x CAT 6 computer cable
- 4 x Screened Audio cable

**Outside Broadcast Compound to wireless camera Microwave Platform**

- 2 x Microwave Triax
- 1x Single phase power interconnect cable
- 1x RF coax
- 2x digital coax video
- 4x audio
- 2 x Cat 6 computer cable

**Outside Broadcast Compound to VIDEO REF**

- 2 x digital coax video
- 5 pair Telco cable
- 2 x audio cables
- 2 x Cat 6 computer cable

**Outside Broadcast Compound to A/V**

- 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 Triax
- 1 x Single phase power (to connect to OB Van )
- 2 x RF coax
- 2 x digital coax video
- 4 x audio
- 2 x Cat 6 computer cable