

PART E

TECHNICAL REQUIREMENTS

Part E: Public Announcement System at Central Railway Station

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1 INTRODUCTION

RailCorp have embarked upon a project to provide an integrated Emergency Warning & Intercommunication System (EWIS) and Public Address (PA) System for the Central Station precinct.

This Contract shall provide for the supply and installation of PA systems in specific public areas as a part of the bigger PA/EWIS project.

Separately tendered contracts will provide PA systems to other public areas including EWIS systems not addressed in this contract.

The system design for the greater project relies on the PA system in this Contract delivering the audio for the EWIS. That is, the EWIS will be an input to the PA, not the other way round. Thus the PA system must comply with the relevant codes for 'Sound System for Emergency Purposes'.

1.1. PROJECT BACKGROUND

Central Station is Australia's largest and busiest railway station and a key interchange for Australian residents from the country, city, and visitors from other parts of the world, as well as a primary boarding point for special event trains to Olympic Park. Many travellers and commuters don't have English as a primary language and some have difficulty in readily understanding English.

RailCorp is determined to provide an adequate voice announcement facility and has recently completed a Proof of Concept project that trialled three different electro-acoustic system designs. The most effective design is being implemented in this project.

The electro-acoustic systems in this contract have been designed to meet high intelligibility targets in a hostile acoustic environment, with the result that the systems are more sophisticated and complex than that normally associated with PA or EWIS sound systems. This complexity poses challenges for conventional methods of implementation.

1.2. GLOSSARY

Parameter	Definition
Announcement System	the sound system pertaining to this scope of works for communication to the public commuters
Announcement Areas	the delineations of coverage for the Announcement System
EWIS	Early Warning & Intercommunication System, now referred to as 'Sound System For Emergency Purposes' in Australian and International standards
Sound System For Emergency Purposes	formerly EWIS
MECP	Master Emergency Control Panel
SECP	Secondary Emergency Control Panel
CAPU	Central Audio Processing Unit – audio equipment that has overall control of signal input, distribution, and fault reporting
DVA	Digital Voice Announcement system (by others)
SPI	Station Passenger Information
PSU	power supply unit
LAN	Local Area Network using TCP/IP protocols
Equipment Room	There are two rooms across the site to be used for housing centralised audio equipment, control, and EWIS equipment (by others)
PRAM	Programmable Remote Amplifier Module – phantom powered amplifiers located in the Announcement Areas

2 SCOPE OF WORKS

The scope of works for this contract includes:

- provision of a fully functional working PA system across the Central Station precinct in defined Announcement Areas,
- design and development of audio interfaces, processing and distribution systems,
- provision of 240 volt primary and secondary power outlets in Equipment Room 2 and Announcement Areas from designated Distribution Boards,
- supply and installation of equipment racks in Equipment Rooms 1 & 2,
- supply and installation of equipment in Equipment Rooms and across site, including all electronics for the Centralised Audio Processing and Distributed Amplification Systems,
- installation of Purchaser supplied equipment (loudspeakers) according to design,
- connect all equipment, including the supply and installation of all cables in containment across site,
- connect and interface the PA system to the Secondary Emergency Control Panel and DVA system,
- program equipment supplied in this Contract,
- test and pre-commission all equipment,
- switch over existing PA systems to the new Announcement Systems,
- remove redundant PA Systems and cabling and make good the site,
- provide Rail Worksite protection
- provide as-built, programming, and system documentation,
- provide spares
- training RailCorp staff,
- provide technical support during commissioning,
- provide maintenance during Defects Liability Period
- provide Defects Liability Period warranty and support, and
- provide on-going maintenance as a separable portion.

2.1. ANNOUNCEMENT AREAS

The project encompasses the provision of Announcement Systems in the Announcement Areas defined Table 1 and Drawing AD-CS-003.

Area	Defined	Comments
Platforms 1 – 23	all above ground platforms: country, interurban, and suburban	twenty three Announcement Areas
Platforms 24/25	ESR underground platforms	two Announcement Areas provide line level audio signals only to existing system
ESR Concourse	the long commuter area bounded by the Devonshire St Concourse and Eddy Avenue Concourse	one Announcement Area Future modifications to this area dictate that the area covered by the sound system is less than the current width of the concourse. The area of coverage is indicated on the drawing.
Devonshire St Concourse	the Paid and Unpaid commuter area bounded by the Devonshire St entrance, the ESR concourse, and the Devonshire Tunnel	one Announcement Area
Devonshire St Tunnel	the main commuter tunnel connecting the Devonshire St Concourse with Railway Square	one Announcement Area
Passenger tunnel 1	tunnel between the ESR and Country Concourses	one Announcement Area
Passenger tunnel 2	tunnel feeding the suburban platforms from the Devonshire St Concourse	one Announcement Area
Passenger tunnels 3 & 4	tunnel feeding the suburban and country platforms from the Devonshire St Concourse	one Announcement Area
Eddy Avenue Concourse (not including the amenities or ticket office)	the concourse feeding the suburban platforms	one Announcement Area

Table 1 – Announcement Areas

2.2. PROVISION

Provision shall mean design development, detailed design, supply, manufacture, code compliance, delivery, erection, installation, labelling, software programming, testing, commissioning, documentation, demonstration to the Purchaser, and training.

2.3. EQUIPMENT

The Contractor shall provide all major and minor items of equipment not provided by the Purchaser necessary to deliver a complete and working system, whether or not nominated in The RFT documents. This includes (but is not limited to) equipment racks, computer interfaces, control interfaces, audio processors, loose and fixed connecting cables, cable containment, amplifiers, mounting hardware, and other installed and non-installed items necessary to allow the systems to function correctly.

The Purchaser will supply all loudspeakers.

2.4. PROGRAMMING

The Contractor shall provide complete and working systems including the software and hardware programming of the CAPU and all control interfaces.

2.4.1 Touch screens

The Contractor shall program the touch screen control surfaces using the following process:

- develop a user statement and functional brief with the Purchaser.
- present draft touch-screen layouts and a written proposed control capability.
- the Purchaser will review the documentation, which will then be adjusted and signed off.
- the Contractor will then program the system as agreed.

The Contractor should allow for a further iterative process to refine the touch-screen layout and operability.

Two weeks prior to system testing, the Contractor shall supply a working touch-screen for acceptance.

2.4.2 AudiaFLEX

The Purchaser will provide the configuration files for the AudiaFLEX DSP equipment. The Contractor shall install the configuration files and be responsible for the correct functioning of the units within the system.

2.5. INTERFACE WITH EQUIPMENT BY OTHERS

The Contractor shall interface with the Secondary Emergency Control Panel such that compliance with AS1670.4 and AS60849 are met.

The Contractor shall interface the Digital Voice Announcement system (DVA) with the Announcement System. The DVA will be mounted in Equipment Room 1 by the Purchaser.

2.6. EXISTING PA SYSTEM

The existing PA systems shall remain fully operational during the course of the upgrade. Lapses in continuous service during switchover between old and new systems must be minimised and programmed for short periods where the public is not present (or when announcements are not necessary – i.e. platform closures).

2.7. REMOVAL OF REDUNDANT EQUIPMENT AND CABLING

The Contractor shall remove redundant PA equipment from the Announcement Areas covered by this contract, and make good the site. This means removal of old equipment whether functioning or not, whether left over from a previous installation, or existing and operational including cabling.

All redundant/removed equipment shall remain the property of RailCorp.

The removal of redundant equipment cannot commence until testing and commissioning is complete.

3 FUNCTIONAL AND PERFORMANCE REQUIREMENTS

The sound system consists of four conceptual sections:

- Audio Sources
- Central Audio Processing
- Distributed Amplification System
- Requirements for Emergency Purposes

3.1. AUDIO SOURCES

Table 2 lists the site-wide audio sources. Sources marked 'Contractor' are to be supplied in this contract. The Contractor shall provide inputs for all sources (including those by others) in the CAPU.

Source	Provided by	Description	System Input	Quantity Inputs
SECP EWIS panel	others	audio for emergency purposes	analogue line level	10
DVA	others	scheduled announcements	analogue line level	40
platform announcements	Contractor	microphones mounted in control rooms on Platforms 16 - 23	A/D converters at each location	4
SM paging	Contractor	Non-EWIS microphone in Station Master's Office.	analogue microphone level	1
RPICS	Contractor	Microphone in RPICS for directing the public.	analogue microphone level	2
SPI: Platforms 1-15	Contractor	Microphone on SPI operator console for directing the public.	analogue microphone level	1
Duty Manager	Contractor	Microphone on Duty Manager's console for directing the public.	analogue microphone level	1
Music source	Contractor	single channel analogue input from a media computer	analogue line level	2
ambient sensing	Contractor	microphones located around the precinct and transmitted back to the CAPU for processing	A/D converters at each location	64
spare		inputs for future use	A/D line & mic	10

Table 2 - audio sources and system inputs

3.1.1 Platform located announcement microphones

The Contractor shall provide microphones, switching and visual indication located in the control room for each of the island-platform platforms 16 – 23 (4 total). Table 6 in Section 4.3.1 defines the microphone and stand to be supplied. The functional requirements are:

- station staff should be able to select which local platform to speak to (A or B) or both simultaneously (A+B)
- a momentary press to talk button (physical or virtual) shall activate the microphone
- there must be a visual indication of the destination(s) selected
- the CAPU must remotely detect if the microphones are working correctly
- the Contractor shall present the method of switching and indication for approval by the Purchaser.

3.1.2 Ambient noise sensing microphones

Ambient noise sensing microphones shall be provided for each Announcement Area as defined in Section 4.3.1: 'Microphones' and Appendix E3 - Combining ambient noise sensing microphones.

- a) Each microphone is to be phantom powered.
- b) Each sensing microphone signal shall be digitised and transmitted back to the CAPU for processing.
- c) The microphones must be mounted in such a manner as to minimise the visual impact on the site, and be vandal resistant.
- d) The CAPU must automatically and remotely detect if the microphones are working correctly.

The Contractor shall program the CAPU such that in the event of the failure of all ambient noise sensing microphones for a particular Announcement Area, the CAPU outputs a serial command to the associated AudiaFLEX to recall a preset state bypassing the operation of the AGC. When the CAPU detects the change of state indicating that the microphones are operational again, it shall send a change of state command to the AudiaFLEX to restore AGC operation. The Purchaser will advise the serial commands.

3.1.3 Media Server

A separate computer running music replay software shall be supplied, installed and networked. The requirements are:

- the simultaneous replay of two playlists in mono through two separate line level audio outputs
- a minimum of 250Gb hard disk space
- the device must be remotely managed via Ethernet over the Central Station CCTV LAN
- hardware replacements must be available for a minimum of two years
- music replay including selection of playlists and transport controls must be controlled by the GUIs in the SM's office: SM, RPICS, SPI, Duty Manager

- this unit shall be rack mounted in Equipment Room 1

3.2. CENTRAL AUDIO PROCESSING

Drawing AD-CS-001 'Central Audio Processing Concept' indicates the generalised signal flow of the sources and central processing electronics, and block representation of the Distributed Amplification System.

The equipment in Equipment Room 1 provides for:

- inputting of Audio Sources
- inputting ambient sensing and platform announcement microphones via digital buses from local Announcement Areas and those from Equipment Room 2
- processing of source signals
- insertion of the AudiaFLEX units in the signal path
- distribution of output signal to the Distributed Amplification System
- distribution of audio signals to Equipment Room 2
- executing emergency override for all EWIS Zones
- reporting of equipment and line faults for all Announcement System electronics

The equipment in Equipment Room 2 provides for:

- ambient noise sensing microphone inputs from local Announcement Areas
- receiving Announcement Area master signals to be transmitted to local Announcement Areas
- insertion of the AudiaFLEX units in the signal chain for processing of local Announcement Area loudspeakers
- distribution of Announcement Area Amplification buses for associated Areas
- fault reporting of local equipment to CAPU in Equipment Room 1

3.2.1 Central Audio Processing Unit (CAPU)

The CAPU is the overall signal processing and distribution unit that electronically manages the Announcement System across site. Drawing AD-CS-001 proposes the conceptual basis of the system.

The Contractor shall provide a CAPU to accommodate all functional and performance requirements of The RFT documents with an excess capacity of 30% for both processing and equipment slots/expansion.

The functional requirements of the CAPU are:

- input microphone and line level sources
- send these sources to the AudiaFLEX units
- route the returns from the AudiaFLEX units to the appropriate Announcement Area buses
- drive the Distributed Amplification System buses for the local Announcement Areas
- distribute signals to the other Equipment Room CAPU
- interface with the SECP

- monitor the fault status of all Announcement System electronics

The CAPU shall:

- a) be fully with compliant with AS60849.
- b) each individual electronic unit in the CAPU shall have fully redundant power supplies, the secondary unit providing uninterrupted automated switchover in the instance of the failure of the primary supply.
- c) continue to pass audio in the event that the control computer goes down,
- d) monitor the performance of inserted DSP equipment by transmitting and detecting the presence of a 20 kHz pilot tone passed through the inserted equipment,
- e) report all fault information from all equipment including: DSP units, microphones, remote amplifiers and loudspeakers, and transmit it to the EWIS system via the SECP, and RailCorp SPI Maintenance.
- f) keep status logs of the condition of the sound system, automatically saved in calendar month files for a rolling six months.
- g) be connected to the Central Station CCTV LAN, such that external authorised computers can log in via a password and hierarchy system to interrogate the status and performance of the system.

The Contractor shall program the signal flow blocks in each CAPU and connection for each loudspeaker and amplifier so that the system is fully functioning.

A. CAPU Frames/Electronics

The CAPU shall be implemented using at least two independent electronic units in each Equipment Room in order to mitigate the risk of technical failure and facilitate Service Level Agreements. The inputs and outputs are to be 'spread' across frames/units so that if one unit fails, there will still be the capability to transmit sound to site.

Table 3 indicates the spread of critical microphone inputs for Equipment Room 1 CAPU. Note: it is not necessary to spread the other inputs in a similar manner.

CAPU Frame 1	CAPU Frame 2
Station Manager front desk	Duty Manager
RPICS 1 paging microphone	RPICS 2 paging microphone
SPI Operator	

Table 3 - critical microphone frame allocation

The outputs to the Distributed Amplification System buses shall be similarly spread across hardware. (see 3.2.4)

B. System Diagnosis and Fault Logs

System diagnosis and fault logs shall be available over the CCTV Intranet by remotely logging in via a Username and password authority system. A web browser interface is the preferred method. The Contractor shall provide all software necessary to achieve this.

3.2.2 CAPU Control Computers

The Contractor shall provide redundant computers to control the CAPU. These shall comply with the following:

- be industrial grade with regard to mounting and of the highest reliability (MTBF)
- be rack mounted in Equipment Room 1
- the Control Computers shall be able to remotely control the CAPU located in Equipment Room 2
- the Master Computer shall have a Slave Computer that automatically takes control in the event of failure of the first, without any loss of data. In the event that the Slave switches in, the Slave must notify the fault to the SECP and SPI Maintenance.
- be operated by a KVM switch
- have a firmly secured LCD screen rack mounted at eye height, minimum 17"
- have a keyboard and trackball mouse rack mounted in a drawer at operating height
- this computer shall not replay music nor be available for running any programs not associated with the Announcement System

3.2.3 AudiaFLEX Units inserted into the CAPU

Digital Signal processing shall be implemented in Biamp AudiaFLEX DSP units with the following functions:

- specific signal processing for speech microphone inputs
- processing of ambient noise sensing microphones and control of announcement levels
- signal processing to control the beam-steering loudspeakers
- overall signal processing for each loudspeaker zone

The Contractor shall supply, install and connect seven AudiaFLEX units in Equipment Room 1, and three AudiaFLEX units in Equipment Room 2. The AudiaFLEX units shall be linked by CobraNet. The AudiaFlex systems in separate Equipment Rooms shall be linked via an Ethernet network.

3.2.4 Signal Distribution

The outputs of the CAPU for each Announcement Area shall be transmitted to the Distributed Amplification System via digital audio buses with the following requirements:

- all audio channels transmitted to a loudspeaker shall be on a single bus. Eg., ALA07CH speakers require eight audio channels which shall be transmitted on the same bus.
- a level of redundancy shall be provided by using two signal paths for each identical loudspeaker types in an Announcement Area. The effect of this is that if one signal chain fails, half of the speakers will continue to operate. This is to be achieved using two leapfrogging daisy chained buses with alternate loudspeakers. (see Drawings AD-CS-001, AD-CS-002a, b & c)
- each of the leapfrogging distribution buses shall originate from different bus-driving cards and frames in the Equipment Rooms.

The Contractor shall provide extra signal outputs for future expansion:

- eight analogue balanced line out
- eight AES digital outputs

These outputs will be terminated on a patch panel in the extra rack to be provided for the DVA system.

3.3. DISTRIBUTED AMPLIFICATION SYSTEM

The Distributed Amplification System consists of cabling, cable containment, amplification with audio processing, mounting hardware, and loudspeakers.

The Contractor shall provide a Distributed Amplification System with the following requirements:

- all copper based signal distribution from the Equipment Room CAPU to each local amplifier shall comply with 'Sound System for Emergency Purposes' codes and standards.
- all fibre-optic based signal distribution from the Equipment Room CAPU shall be run in fire rated containment
- each digital bus is to transmit 8 audio channels or more plus control data to the amplifiers, and return performance monitoring data from the loudspeakers
- amplifiers are to be located close to the loudspeakers
- amplifiers must be easily accessible for service
- the signal distribution system shall utilise daisy chained leapfrogging signal buses for alternate loudspeakers
- there shall be fault monitoring of all devices including loudspeakers

3.3.1 Programmable Remote Amplifier Modules

The Programmable Remote Amplifier Modules (PRAM) shall have the following characteristics:

- be powered via the audio bus with power and data refreshers as required
- have an included digital delay and DSP
- provide status/fault reporting of itself and connected loudspeakers to AS60849 standards
- be hot-swappable
- upon substitution of a faulty unit, the control settings shall be automatically downloaded to the new unit
- be a low-power consumption device
- reboot to full system functionality in the event of power failure

The Contractor shall provide calculations prior to installation proving that the distributed power supply design is able to meet the requirements for PRAMS to deliver the appropriate power with all channels driven.

3.3.2 240 Volt Power for Distributed Amplification System

The Contractor must provide any Primary and Secondary 240 volt GPO outlets required to power equipment in Equipment Room 2 and each Announcement Area from a Distribution Board nominated by the Purchaser.

The requirement for all equipment to have a secondary supply providing uninterrupted automated switchover in the instance of the failure of the primary supply must be provided for.

3.3.3 Loudspeakers

The mounting of all loudspeakers must fully comply with the electro-acoustic design requirements in Section 8, which includes exact loudspeaker locations, orientations and inclinations.

3.4. REQUIREMENTS FOR EMERGENCY PURPOSES

The installation of this 'Sound System for Emergency Purposes' shall be executed in accordance with AS1670.4.

All equipment must comply with AS60849. It is not essential for the equipment to have an Active Fire Listing, however preference will be given to equipment that does.

3.4.1 General Functions

- a) The system shall be capable of broadcasting within 60s after primary or secondary power is applied.
- b) The system must be capable of transmitting within 3s of receiving an alarm.
- c) The SECP must be able to override the non-emergency functions. When any alarm is detected, the system shall immediately disable any functions not connected with the emergency.
- d) Wiring between indicator panels, remote amplifiers, evacuation zone loudspeakers, and emergency call points shall not affect the normal operation of other zones if there is a short or open-circuit.
- e) Failure of a single amplifier or loudspeaker circuit shall not result in the failure of any other amplifier or loudspeaker circuit.
- f) Any condition that will affect the normal operation of the system shall be detected and reported at the SECP, including the disconnection or removal of devices such as remote amplifiers or loudspeakers.
- g) The system must have a Secondary supply providing uninterrupted automated switchover in the instance of the failure of the Primary supply.

3.4.2 Cabling

Wiring outside of the Equipment Rooms is to be per AS3000 (the wiring rules) stranded cabling with cross sectional area not less than 0.75 mm². Any joints or terminations require a box of equal fire rating to the cable. The communication loops between the components is required to be either fire rated cable or in a fire rated trunk for fibre such that the final system complies with AS1670.4.

Distribution cabling from the Equipment Rooms to an Announcement Area must be fire rated up to the first device within the EWIS zone that it serves.

3.4.3 Performance monitoring requirements

The supervision capability of the system shall completely comply with Australian safety standards (AS60849).

All equipment in the emergency alarm and voice announcement signal path shall monitor the following performance parameters (amongst others):

- a) short-circuit or disconnection or failure of the primary power source.
- b) short-circuit or disconnection or failure of the standby power source.
- c) short-circuit or disconnection or failure of any battery chargers for these power sources.
- d) rupture of any fuse or circuit breaker, isolator or protective device that may prevent an emergency broadcast.
- e) failure of a microphone, including capsule, pre-amplifier, and essential wiring.
- f) short and open circuit of signal lines between physically separated parts of the system.
- g) failure of interconnecting data or voice communication links.
- h) failure of critical signal paths through the amplification chain, individual amplifiers to be separately identified.
- i) missing amplifiers or critical modules.
- j) failure of any standby amplifier.
- k) failure of any loudspeaker circuit (open & short circuits).
- l) The fault indications shall be given within 100s of the fault occurring.

3.4.4 Interface with SECP

The EWIS system and the Announcement system shall be linked in Equipment Room 1 at the Secondary Emergency Control Panel (SECP).

The Contractor shall interface the CAPU to the SECP at the SECP with three connections for each of seven EWIS zones. The other three EWIS zones are for future use.

		Signal	Destination
Audio Signal	The SECP outputs a low level analogue audio signal to the CAPU in the event of an emergency, to be distributed to the EWIS Zones.	0-1 volt unbalanced + 30kHz pilot tone	CAPU A/D input. 1 signal/line for each EWIS zone. This input is permanently open and routed to the relevant Announcement Areas.
Emergency Override	The SECP provides a failsafe 24v DC trigger to the CAPU. The emergency override function shall be engaged whenever this signal ceases.	24 volt DC	CAPU GPI input. 1 signal/line for each EWIS zone
Fault Monitoring	The CAPU provides a failsafe 24v DC signal to the SECP indicating no faults in the PA system. In the event of a fault being detected, this 24 volts will cease being emitted.	24 volt DC	closed contact 24V DC relay in the SECP 1 signal/line for each EWIS zone

Table 4 - EWIS signals

The routing of emergency audio signals, emergency override functions, and fault reporting in the CAPU shall incorporate all Announcements Areas in this Contract. Each EWIS Zone may consist of more than one Announcement Area. Table 5 gives the relationship between EWIS Zones and Announcement Areas.

EWIS Zone	Related Announcement Areas
Z16	Platforms 1 – 15
Z17	Platforms 16 – 23
Z18	Platform 24 & 25
Z19	Devonshire Tunnel
Z20	Passenger Tunnels: 1 - 4
Z21	ESR Concourse Devonshire Concourse
Z23	Eddy Avenue Concourse

Table 5 - EWIS Zones

3.5. EQUIPMENT

3.5.1 General

The system will be in use 24 hours/day, 365 days/year. All equipment shall be designed to have a continuous operational life span of fifteen years.

All electronic items are required to be C-Tick compliant in accordance with ACMA regulations.

All aspects of configuration, control and system monitoring must be able to be managed from a remote PC on Central Station CCTV LAN. System software updates and/or software configuration changes must be able to be remotely managed via a windows based GUI interface. The system shall report system availability and export status reports into an Excel spreadsheet when queried.

Where hardware is installed for use in a redundancy configuration, there must be data synchronization between the primary and secondary system. In practice this means that all changes on the primary system are replicated on the secondary system automatically.

Hardware and software should be of a plug and play nature so that that minimal knowledge is required to replace these components; i.e. if a DSP requires replacement, a first level response technician must be able to install the hardware onto the network without any additional configuration from a remote location.

3.5.2 Computer Based Equipment

- a) All data switches and/or media conversion must be remotely manageable.
- b) Remote KVMs and Switching KVMs for any hardware which is normally the front end User's interface must be from a major PC supplier. The preference is for thin clients that can also act as a remote KVM. If remote KVMs are installed they must be capable of USB extension over distances greater than 5 metres. In addition, any remote KVM must allow for USB keyboards and mice, and be remotely manageable. KVM switches of the type that allow for the use of multiple PC's to share a single keyboard and mouse must be USB capable and use buffered switching.
- c) LCD monitors should have 100mm VESA mount capability. Where LCD monitors and/or other hardware are mounted on poles, walls, etc., they must use quick release mechanisms for hardware replacement that can be locked to be secure from theft.

3.5.3 Control Touch Screens

There shall be five touch-screen control surfaces supplied, programmed and installed:

- Station Master front desk
- RPICS 1
- RPICS 2
- SPI Operator
- Duty Manager

The control surfaces will control the paging and music inputs and routing in the CAPU, and not part of the AudiaFLEX:

- microphone on/off
- microphone destination – one or many
- music source / selection of playlist
- music destination
- music level control

The Control System shall output an Ethernet based command to the DVA system identifying:

- which microphone is transmitting
- ON/OFF status
- selected destination(s)

The Contractor shall connect the Touch Screen Control to the DVA system via Ethernet. The Purchaser will supply the command instructions.

The paging microphones shall have a priority system whereupon if more than one microphone is attempting to announce to the same Area(s), the microphone with the highest priority shall cause the others to be muted. The Purchaser will provide the Contractor with the priority allocations after award of contract.

The control system shall be operable across the RailCorp CCTV LAN, allowing remote control functionality. Access to the control system through touch-screens and computers shall be via password and organised on a hierarchy basis.

The control system detailed functional requirements will be developed during the initial stage of the Contractors' work, in conjunction with the Purchaser.

3.5.4 Equipment Rooms

The Contractor shall provide and install equipment racks and mounting hardware sufficient to house all the proposed equipment with 30% spare capacity. The Contractor shall:

- a) provide the Purchaser with a preliminary equipment rack layout for approval no later than one month after the award of contract.
- b) organise the ingress and egress of cables and install more containment as required to minimise signal contamination and avoid the influence of electromagnetic radiation.
- c) provide the Purchaser with the calculated heat load for the PA equipment to be installed in each Equipment Room no later than one month after the award of contract.
- d) supply and install one additional full size rack in Equipment Room 1 to be populated by RailCorp with DVA computers and associated network facilities.

3.6. PERFORMANCE SPECIFICATIONS

3.6.1 Microphone preamplifiers

Microphone pre-amplifiers shall have the following minimum performance standards:

Item	Minimum Standard
Gain range	60 dB to 0 dB in maximum of 6 dB steps
Max input level	1 volt
Signal to Noise Ratio re maximum output at gain of 40 dB	-80 dB
Input impedance	>1 k ohms
CMMR	better than 65 dB: 20 Hz to 20 kHz
Frequency response	20 Hz to 20 kHz \pm 0.5 dB

3.6.2 Analogue Audio Performance

All analogue audio processing shall meet the following minimum standards:

Item	Minimum Standard
Inputs & outputs	balanced
Frequency response	20 Hz to 20 kHz \pm 0.5 dB

3.6.3 Digital Audio Performance

All digital audio processing shall meet the following minimum standards:

Item	Minimum Standard
A/D	24 bit / 48 kHz
DSP	32 bit floating point
audio transmission to Distributed Amplifier System	16 bit / 48 kHz
bandwidth	20 Hz to 20 kHz \pm 0.5 dB
System latency	better than 5 ms from CAPU input to loudspeakers (not including any inserted delay or DSP processing)
Signal synchronisation for multiple audio channels arriving at a loudspeaker	better than 20 microseconds (not including any inserted delay or DSP processing)

3.6.4 Programmable Remote Amplifier Modules

The audio performance of the PRAM shall meet the following minimum requirements:

Item	Minimum Standard
onboard digital delay	up to 680 ms of delay in no greater than 4 ms increments, or 255 ms in 1 ms increments with accuracy of 20 microseconds or less
DSP requirements	4 x 2 nd order filters (parametric / high-pass / low-pass / all-pass) and attenuation
Output power with a sine wave at 400 Hz	minimum of 12.5 watts average power into 8 ohms minimum of 25 watts average power into 4 ohms
Dynamic headroom with 8 ohm load	At least 1 dB (The required maximum instantaneous VA into 8 ohms with program is therefore 4 dB above 12.5 watts)
Distortion at full power into 4 ohms at 3 kHz	-60 dB (0.1%)
Minimum load impedance power	2 ohms with less than -54 dB distortion re FSD
No of speaker connections per amplifier channel	two separate speaker connections per channel with impedance monitoring per connection
Speaker fault indication trigger	a fault indication is triggered if the monitored impedance is < 0.5 ohm or > 100 ohms
Amplification Class	Class D

3.6.5 Control Touch Screens

Item	Minimum Standard
Size	17 inch
Mount	100 mm VESA
Mouse	YES, via USB

The Control Touch-Screens must be a desk top LG L1510BF or equivalent.

3.6.6 Environmental

Equipment installed on railway platforms (underground and outdoors, undercover) must be suitable to operate in an environment where significant amounts of electromagnetic radiation, variations in power supply, vibration, dust (consisting of conductive and non-conductive particles) and changes in humidity and temperature are present. All critical equipment must have power filtration installed.

- all electronic equipment mounted on railway platforms including; amplifiers, data refreshers, power supplies, junction and terminal boxes, shall have a protection rating of IP66 or be mounted in IP66 enclosures.
- all equipment shall continue to operate and not have their lifespan degraded by

operating in an ambient operating temperature of 0 to 50 degrees at full power. Equipment mounted in IP66 enclosures shall comply with this specification where the external temperature is in the 0 to 50 degree range.

4 DESIGN & PROJECT REQUIREMENTS

The Contractor shall interpret the functional and performances specifications and provide a working PA system described in the RFT documents. Any errors, omissions or ambiguities in RFT documents shall be brought to the attention of the Purchaser immediately for clarification.

4.1. GENERAL

It is a design requirement that the PA system be implemented utilising:

- centralised processing and distribution electronics installed in Equipment Rooms 1 & 2,
- a Distributed Amplification System utilising remotely located amplifiers with individual digital delay and DSP capability.

4.2. FACTORY ACCEPTANCE

The Contractor shall provide factory acceptance testing of specific systems and equipment if so requested by the Purchaser.

4.3. EQUIPMENT TO BE SUPPLIED BY THE CONTRACTOR

This section details equipment to be supplied by the Contractor that is brand and model specific. Other equipment also to be supplied by the Contractor is not listed here.

4.3.1 Microphones

Table 6 lists the microphones to be supplied and installed in this contract.

Location	Use	Make & Model	Quantity
Platforms 1 – 23	ambient noise sensing	Crown PZM-11LLS2	46
ESR Concourse	ambient noise sensing	Crown PZM-11LLS2	4
Devonshire Concourse	ambient noise sensing	Crown PZM-11LLS2	4
Devonshire Tunnel	ambient noise sensing	Crown PZM-11LLS2	2
passenger tunnel 1	ambient noise sensing	Crown PZM-11LLS2	1
passenger tunnel 2	ambient noise sensing	Crown PZM-11LLS2	1
passenger tunnel 3	ambient noise sensing	Crown PZM-11LLS2	1
passenger tunnel 4	ambient noise sensing	Crown PZM-11LLS2	1
Eddy Avenue Concourse	ambient noise sensing	Crown PZM-11LLS2	
SM	announcements to all areas	AKG D542E microphone on a K&M 29390(x) base	1
RPICS	announcements to all areas	Countryman Isomax E6 cardioid	2
SPI	announcements to all areas	Countryman Isomax E6 cardioid	1
Duty Manager	announcements to all areas	Countryman Isomax E6 cardioid	1
platform announcements	announcements to local platforms	AKG D542E microphone on a K&M 29390(x) base	4

Table 6 - microphone types & quantities

4.3.2 Computers

PC's should be HP brand with the exception of any RAID redundant PC's which must be DELL Power Edge 2950 models or equivalent with Level 5 RAID.

All PC's must be pre-loaded with Windows XP service pack 2. Windows VISTA is not acceptable.

The computers shall be programmed such that they have access via password on a hierarchy basis, with differing levels of control available for:

- administrator
- technician 1
- technician 2
- operator

An operations screen will be accessible for all levels of access to:

- access fault logs appropriate to their authority

- monitor all inputs via meters and audio
- monitor all outputs via meters and audio

The computer will control routing and level of the selected audio channel to a powered loudspeaker securely mounted in the rack above the LCD screen.

4.3.3 Audio monitor for Equipment Room 1

The Contractor shall supply and rigidly install a Yamaha HS50M or equivalent audio monitor in the equipment rack above the Control Computer screen.

4.4. FIBRE OPTIC LOOPS

The audio signal and control data transmission between Equipment Rooms 1 & 2 shall be via dual redundant fibre optic cables. The cables shall run by diverse paths.

The Contractor shall provide the Primary path and cable. The Purchaser will provide the Secondary path and cable between Equipment Room 1 and the Devonshire St Ticket Office. The Contractor shall complete the Secondary path from the Devonshire St Ticket Office and Equipment Room 2.

The Contractor shall terminate both Primary and Secondary fibre optic cables at all ends, providing patch panels as appropriate.

The cables shall be run so as to ensure that the installation complies with AS1670.4.

4.5. APPROVALS

The Contractor shall supply the following minimum technical information to the Purchaser for approval prior to the manufacture or delivery of any equipment:

- a) Functional block diagrams showing system configuration.
- b) Detailed system schematics.
- c) Calculations of voltage drops and current requirements for the distributed system of programmable remote amplifier modules for each loudspeaker zone.
- d) Specifications for all cables to be installed, together with full wiring drawings showing the duty, type, route, protection, separation and termination requirements for each cable.
- e) The Contractor shall develop principles and procedures for mounting electronic equipment across site, and submit for approval before commencing the development of mounting hardware.
- f) The Contractor shall then submit construction drawings for the mounting of all equipment for approval by the Purchaser, before installation is to proceed.
- g) Shop drawings of the racks and enclosures plus layout drawings of panels as appropriate, e.g. input panels, alarm panels - drawings shall demonstrate that equipment has been coordinated with other systems equipment.
- h) Site plans showing loudspeaker layouts and circuiting.
- i) Samples of equipment and cable items shall be provided e.g. brackets, support systems, amplifiers, control cabling. The samples for all items must be approved prior to installation.

5 STANDARDS

Materials and standards of workmanship shall fully comply with the relevant documents of the Standards Association of Australia (or where no Australian Standard exists, the ISO Standard as published by the International Organisation for Standardisation), including subsequent amendments applicable to any part or item forming part of the installation.

The following specific standards apply:

- AS 1670.4:2004 – Fire detection, warning, control and intercom systems— System design, installation and commissioning Part 4: Sound systems and intercom systems for emergency purposes
- AS 60849:2004 -Sound systems for emergency purposes (IEC 60849:1998 MOD)
- AS 2676.1:1992 - Guide to the installation, maintenance, testing and replacement of secondary batteries in buildings -Vented cells
- AS 4428.4:2004 - Fire detection, warning, control and intercom systems - Control and indicating equipment -Intercommunication systems for emergency purposes
- AS2052 - Metallic conduit and Fittings
- AS2053 - Conduits and Fittings for Electrical Installation
- AS3000 - Electrical Installations known as the Australian/New Zealand Wiring Rules
- AS 3008 - Electrical Installations - Selection of Cable
- AS/NZS 3013: Electrical Installations – Classification of the fire and mechanical performance of wiring systems
- BCA – Building Code of Australia

5.1. GENERAL INSTALLATION PRACTICES

Installation shall include the delivery, unloading, uncrating, setting in place, fixing to walls, floors, ceilings, counters or other structures, where required; interconnection-wiring of the components of the system; equipment alignment and adjustment; and all other work, whether or not expressly stated herein, which is necessary to result in a complete, tested, and fully operational system.

All installation practices shall be in accordance with, but not limited to, these specifications and drawings. If, in the opinion of the Contractor, an installation practice is desired or required which is contrary to these specifications or drawings, such installation shall not commence until written request for modification has been made to the Purchaser, and the Purchaser has approved the request.

During the installation and up to the date of final acceptance, the Contractor shall be under obligation at no cost to the Purchaser to protect finished and unfinished work, which forms part of this contract against damage, and to repair any work, which has been damaged.

During the installation and up to the date of completion of work, the Contractor shall perform the necessary tasks in such a manner as to avoid unnecessary risk to finished and unfinished work by others.

5.2. SAFETY

The Contractor shall be the Purchaser Contractor as defined by OH&S Regulation – 2001, and shall comply with all requirements of the OH&S Act 2000, Workers Compensation Act 1987, the Workplace Injury Management & Workers Compensation Act 1998, and the Rail Safety Act 2002. Contractors shall follow the requirements of Workcover 'Contractors working in Railway Construction Guide 2004', Workcover publication number 1322.

5.3. HERITAGE

Central Railway Station is a Heritage Site. The installation of all equipment including conduits, wiring, hardware, amplifiers, loudspeakers, accessories and fittings shall be carried out in accordance with Heritage conditions.

5.4. PENETRATIONS

The structural integrity of the building must be maintained at all times. All penetrations through structures shall be sealed with an approved material, in order to prevent ingress of moisture and vermin into buildings.

Penetrations through damp courses are not allowed.

All penetrations through fire barriers will be conducted under the supervision of the Purchaser, and an Essential Services Installation Compliance Certificate provided as required under the Building Code of Australia in accordance with the relevant Australian Standards.

5.5. MOUNTING & MECHANICAL INSTALLATION

The following standards shall be adhered to for the installation of all equipment:

- a) All equipment shall be firmly secured in place unless requirements of portability dictate otherwise. Fastenings and supports shall be adequate to support their loads with a safety factor of at least THREE. Any equipment to be secured over public areas (where members of the public are able to be underneath) shall be designed to the appropriate public safety standard and certified by an appropriately qualified professional.
- b) All boxes, equipment, etc., shall be plumb, level and square.
- c) Installation of equipment and cables shall be so as to minimise the visual impact.
- d) All penetrations and alterations to the station's infrastructure shall be made good.
- e) Equipment other than loudspeakers is to be located in easily accessible locations away from public areas and or pedestrian traffic.
- f) All equipment except loudspeakers shall be mounted no closer (horizontally) than 2 m. to the yellow line.
- g) Equipment located in areas where there are high levels of vibration and exposure to weather or moisture must use galvanized or stainless steel mounting brackets. The equipment must be secured in such a way that it cannot vibrate loose.
- h) Equipment that is located in areas that are accessible at ground level must be housed in lockable enclosures. The Purchaser will advise a keying regime.

- i) All equipment within public reach shall have tamper proof mounting mechanisms in order to prevent theft, vandalism, and accidental re-orientation from bumping.
- j) All mounting hardware and decorative grilles shall be painted an approved colour.
- k) All equipment shall be mounted to facilitate maintenance.

5.5.1 Ambient noise sensing microphone mounting

Platform Mounting

Two Crown PZM-11LLS2 microphones shall be installed under the canopy on each side of each island platform (4 total). The microphone shall be fitted to the centre of a waterproof plywood board with dimensions 600 mm x 600 mm. The board shall be painted with an approved colour and fixed directly to the underside of the platform roof. The Purchaser shall advise the locations of the microphones.

Mounting for all other areas

Crown PZM-11LLS2 microphones shall be installed on the ceiling of each Announcement Area. The microphones shall be fitted to the metal ceiling pan, and be covered by a small protective metal shroud. The metal shroud shall be painted with an approved colour and fixed directly to the underside of the ceiling. The Purchaser will advise the locations of the microphones.

5.5.2 Mounting platform announcement microphones

The platform announcement microphones for each island platform shall be wired into an XLR wall socket in the platform control room. The wall termination shall be connected to the A/D and transmitted back to Equipment Room 1 CAPU for activation, processing and distribution.

5.5.3 Mounting equipment in public places

Due to public congregation and movement, restrictions occur as to when equipment can be installed and serviced. The accessibility to equipment when being serviced must be addressed in the mounting of equipment across site.

Equipment mounting in public places must consider:

- a) safety
- b) accessibility
- c) cleaning
- d) interference with public so that they are not disrupted or impeded when the units are being serviced
- e) electro-magnetic radiation interference to and from adjacent equipment
- f) shielding from environmental impact
- g) minimising visual impact
- h) heritage

Some requirements are:

- a) Equipment should always be out of reach of public.

- b) Hardware shall be mounted so that it is able to be replaced at a working height of no greater than 1.8 metres above a 1.8 metre platform ladder = 3.6 metres.
- c) Mounting units against walls will be approved in preference to mounting units in the centre of walkways.
- d) Downward swinging hatches from ceilings are not acceptable.

5.5.4 Mounting of Loudspeakers

All loudspeakers shall be rigidly mounted.

5.6. EQUIPMENT RACKS

Figure 21 in Section 0 provides the required physical details of the equipment racks to be supplied and installed.

All racks shall be keyed alike and conform to the keying regime supplied by the Purchaser.

All cable ingress and egress shall be contained, and any cables passing through metal holes shall be protected by grommets.

All empty rack spaces and empty equipment slots shall be filled with blank panels. Equipment and blank panels shall be secured to the rack using black headed cage bolts.

All cable and wiring within equipment racks shall be:

- routed according to function, separating wires of different signals (analogue audio, digital audio, AC, data, etc.) by as much distance as possible.
- neatly loomed with plastic ties, with the ends of the ties cut in a rounded way so as to not exacerbate the occurrence of injury.
- allow for re-organisation and re-termination in the event of future changes to the system. Generally all cable should have an excess length equal to 1.5 times the rack width.

As a general practice, all power cables and high level cables shall be run on the right side of an equipment rack as viewed from the rear. All other cables shall be run on the left side of an equipment rack as viewed from the rear.

5.7. WIRING & TERMINATION

5.7.1 Termination

- a) Audio connections are to use 3 pin XLR connectors.
- b) RJ45 sockets shall be used for data connections except where fire rating is required.

5.7.2 Connectors

The Contractor shall provide and install new connectors of the type and quality as required by industry best practice. No connectors shall be installed in non-accessible locations or used for splicing cables.

All connectors shall incorporate strain relief mechanisms, which firmly grip the jacket of connected cables. All connectors shall be polarised to prevent improper seating.

Connectors which are proprietary to specific equipment shall be as supplied by the manufacturer of that equipment.

Low level audio connectors shall incorporate metallic shells.

Punch blocks utilising insulation displacement contacts and screw type terminal strips may be utilised for control and audio terminations in equipment racks. These devices may be used for control termination in the terminal panels.

5.8. CABLING

The Contractor shall provide all wire, cable and containment as required. All cable shall be new, unspliced and of a reputable brand conforming to industry standards.

Cables, terminations, fittings and accessories shall be of approved type and manufacture suitable for the task, delivering no impediment to technical performance.

Splicing of cables and conductors is not acceptable in any location other than the equipment racks and the terminal panels. Splicing of audio cable will not be allowed in any location. Splicing of control conductors shall be accomplished via punch block or terminal strip connections only.

All cables shall be run in conduits or fastened to cable trays supplied and installed by the Contractor, as appropriate and possible. In the instance that this is not possible, approval shall be sought from the Purchaser. Any surface mounted conduits or ducts shall be located under direction of the Purchaser.

All cable containment shall allow for 30% unused capacity.

There shall be two attachment points for any conduit clip, eg., double saddle.

All cables shall be adequately supported and fastened throughout their entire length. Cables in ceilings shall be installed parallel with and fastened to the main structural features. No cable shall be unsupported or lie on ceiling tiles or be attached to ceiling supports.

All copper cable runs shall be grouped according to the signals being carried to reduce signal contamination. Separate groups shall be formed for the following:

- power
- control and data
- audio signals less than -20dbm
- audio signals between -20dbm and +20dbm
- audio signals above +20dbm

Each group shall be spaced at a minimum segregation of 300mm. Where cables of different signal level must cross they shall do so at an angle of 90 degrees for at least 300mm from the crossing point. Analogue audio cables should not be run within 500mm of power or digital data cables.

No cables shall be wired with a polarity reversal between connectors, at either end. Special care shall be taken when wiring all audio system cables to ensure that constant polarity is maintained.

Shields for audio cables shall be earthed at the input end only of the various equipment items in the system.

5.8.1 Fibre Optic Cables

All fibre optic cables shall be:

- rodent resistant
- low smoke
- zero halogen
- fire retardant

5.9. LABELLING

All connectors, patch leads, controls, termination panels, equipment and components shall be clearly and permanently labelled. Terminal blocks and equipment racks shall be permanently labelled in a format approved by the Purchaser. Abbreviations are acceptable only where shown on drawings.

All fixed labels, other than those affixed to cables, shall be permanently engraved in metal or plastic laminate and attached with double-sided tape.

All junction boxes and terminations must show identifiers.

5.9.1 Cable Labels

There shall be no unlabelled cables at any place in the system.

All cables shall be clearly labelled and documented, using unique identification numbers on each end. The schedule of cables shall be provided as part of the as built documentation including:

- source
- cable type
- function
- destination
- connectors

All cabling must be labelled with labels that do not fade, fall off, or allow brake dust to infiltrate and obscure the characters (such as with clear plastic sleeves over lettering). Brake dust must be able to be wiped off all labels without removing the lettering.

The proposed cable numbering system shall be submitted to the Purchaser for approval to ensure consistency and co-ordination with that of the rest of the facility.

All labelling shall be completed prior to final system commissioning and acceptance testing.

6 TESTING, COMMISSIONING & HANDOVER

6.1. WIRELESS NETWORKING

The Contractor shall supply a wireless Ethernet system to control the AudiaFLEXs in Equipment Rooms 1 & 2 via laptop computers during Commissioning. Each Announcement Area will require wireless access to the AudiaFLEX system. The coverage area includes all Announcement Areas including 75% of each platform.

Wireless systems must be free from interference and unauthorized access. All

wireless systems must be approved by the Purchaser.

The wireless network shall be disabled after Commissioning.

6.2. SYSTEM TESTING & COMMISSIONING

The system shall be pre-commissioned by the contractor. Pre-commissioning includes:

- a) confirming that every device and signal chain is operating correctly.
- b) testing all copper cables for continuity and polarity.
- c) testing all fibre-optic cables for continuity and power/loss.
- d) ensuring that all extraneous hum and noise is removed.
- e) ensuring that all loudspeaker are connected with correct polarity and to the correct amplifier.
- f) confirming that all loudspeakers are correctly located and oriented.
- g) ensuring that all fault and status reporting facilities are correctly operating.
- h) any faults detected shall be rectified and retested.
- i) a schedule of all tests shall be included in the 'as built' documentation.

The contractor shall:

- submit a technical plan of the proposed pre-commissioning process for approval by the Purchaser. The plan shall include the proposed:
 - sequence of areas to be tested
 - test result sheets
 - test equipment
- allow four days to demonstrate to the Purchaser that all aspects of the system are functioning correctly
- allow for two technicians who are highly familiar with the system to be present for ten non-consecutive days to assist the Purchaser with fault finding
- supply all necessary skilled personnel to train the Purchaser in the operation of all equipment with User adjustments necessary for the Commissioning.

6.3. DOCUMENTATION

The as built documentation shall be compiled and supplied such that a third party is able to:

- understand the nature of the system
- operate all equipment
- locate all equipment
- maintain all equipment
- rebuild the system as necessary

The documentation shall be organised into:

- Operational & Maintenance Manual
- Record Drawings
- Operator Reference Drawings

The Operational and Maintenance Manual for the full system and all sub-systems shall be provided in the format of 3 copies of firmly bound A4 books, and 3 electronic copies on data CDs in the following formats:

- Microsoft Word format for text.
- Visio 2003 format for drawings.

All documentation must be able to be duplicated by RailCorp for the purposes of RailCorp, without incurring any extra costs or infringing copyright.

The Contractor shall provide ten copies of any manual restricted by copyright.

6.3.1 Operational and Maintenance Manual

The front page of the manual shall include contact details (name, address, telephone and fax numbers and e-mail address) of the system supplier.

The Manual shall detail in words and reference the Record Drawings contained therein:

System Overview

- system functional overview
- philosophy of design
- system description
- interconnection of entire facility

System Operation

- detailed system operation

Maintenance

- 24 hour emergency assistance number
- full technical descriptions
- routine care
- maintenance and testing
- simple fault-finding procedures

- a schedule of items requiring routine performance checks
- frequency and details of performance checks and procedures at weekly, monthly, quarterly, half-yearly and yearly intervals (as a minimum)
- replacement component catalogue numbers and supplier's contact details

Installation Reference

The following information details the as installed system:

- system software files and settings
- firmware version documentation
- technical explanations as to the functions of the software, boot up procedures, reinstallation procedures, and placement of files for all provided software and firmware
- wiring schedules including; source and destination cable numbers, types, function and lengths
- an index of the Record Drawings
- all control settings
- commissioning results
- manufacturers technical manuals
- all settings programmed into loudspeaker management processors or equalisers at the finalisation of commissioning
- the keying regime for all racks and equipment cupboards
- the list of the spares provided

All items shall be consistently cross-referenced with a unique code number.

A draft copy of the manual **MUST** be provided for inspection by the Purchaser not less than 4 weeks before the testing is scheduled to commence.

6.3.2 Record Drawings

All Record Drawings shall be 'as-built' and show (but not be limited to):

- a site map marked with all equipment racks, EWIS zones and Announcement Areas, cable paths, facilities and termination panels, and the locations of all input panels, ambient noise sensors, and loudspeakers
- system functional overview
- interconnection circuit of entire facility
- block diagrams
- logic diagrams
- equipment rack layouts
- rack wiring schematic including power
- complete circuit diagrams
- detailed individual technology schematics: CAPU, RPICS and SM office installations, platform announcement facilities, etc.
- construction drawings of all custom-made items of equipment

System schematics shall indicate (but not be limited to):

- equipment type
- equipment location
- connection of all equipment
- cable connections (including ID numbers for cables as set out in the cable schedule)
- location of terminal boxes (including ID numbers)
- location of amplifiers and loudspeakers (including ID numbers)

6.3.3 Operator Reference Drawings

The Contractor shall supply and install on the walls of Equipment Rooms 1 & 2, in a position nominated by the Purchaser, framed and protected full size drawings of:

- the site map marked with all equipment racks, EWIS zones and Announcement Areas, cable paths, facilities and termination panels, and the locations of all input panels, ambient noise sensors, and loudspeakers
- the system functional overview
- the interconnection circuit of entire facility

6.4. SOFTWARE

For both commercial and non-commercial (custom) software, the Contractor shall supply a complete set of software including the license and documentation for all devices, utilities and tools used in the operation and maintenance of the system.

Commercial software provided by the Contractor shall be procured and transferred in full compliance with the publisher's copyright, licensing and other requirements of ownership and use. License agreements shall be registered according to instructions from the Purchaser.

The Purchaser shall retain full rights to all custom software and programming developed by the Contractor as part of the project, including maintenance updates and documentation. This shall include the right to use, reproduce and modify the software as reasonably required to operate the systems and support ongoing maintenance and development.

Software maintenance shall be provided at no cost to the Purchaser for the duration of the Defects Liability Period.

6.5. TRAINING

The Contractor shall be responsible for developing a Training Management Plan and Training Schedule, and providing training to a minimum of 20 staff. The Training Management Plan shall document all of the training needs required after undertaking a training Needs Analysis of the Staff. The Contractor shall provide all necessary documentation appropriately bound for the training (including individual student copies and soft copies in Microsoft Word format). The documentation shall include, but not be limited to:

- course curriculum
- lesson plans
- exercise booklets

- evaluation forms
- Help/Quick Reference guide

The training shall be conducted in separate sessions for:

- Training The Trainer
- Maintenance staff
- Operations staff

The Purchaser will provide numbers of attendees for each training session coinciding with standard morning and afternoon shifts three days prior to that particular training session.

The Contractor shall be available to provide this training in the two weeks prior to and after system commissioning and cut-over.

The Contractor shall also provide at least 20 man-days (160 hours) for on site supervision and assistance to trained system operators throughout the Precinct during the first 60 days after changeover to the new system.

6.6. SPARES

An appropriate set of spares shall be provided, including consumable and modular items which can be replaced by on-site maintenance staff.

The following items shall be supplied as spares:

Item	Quantity
microphones	2 of each type
microphone mounting/stands	1 of each type
LCD touch screens	1
CAPU card frames	1 of each type
power supplies for card frames	2 of each type
installed cards (I/O, processing, fibre I/O, etc)	3 of each type
Distributed Amplification System driving electronics including interfaces, cards, etc.	10% of quantity supplied (minimum of 3)
Control Computer	1
music server	0
custom manufactured equipment	10% of quantity supplied (minimum of 3)
proprietary equipment in the signal path not otherwise specified	10% of quantity supplied (minimum of 3)
proprietary equipment not in the signal path not otherwise specified	10% of quantity supplied
PRAMS and docking stations (or equivalent equipment being supplied)	10
data refresh and line powering units and docking stations (or equivalent equipment being supplied)	5
AudiaFLEX	1
AudiaFLEX I/O cards	5 of each type
all mounting hardware	10% of quantity supplied (minimum of 3)
all mounting enclosures	10 of each type
loudspeakers mounting hardware	10 of each type
termination panels	10% of quantity supplied (minimum of 3)
patch panels	1 of each fully loaded with connectors

The Contractor shall recommend any additional spares and/or quantities that they feel is appropriate above that listed here.

The spares list should take into account:

- the critical nature of the items
- the expected failure rate
- the lead time of supply
- the possibility of obsolescence
- spares of all critical and specialised equipment are to include equipment that are likely to be phased out or made redundant by the manufacturer in the near future.

Spares of all equipment must be handed over at the time of commissioning.

6.7. SERVICE & MAINTENANCE CONTRACT

The Contractor shall provide a service and maintenance contract on two basis:

- cleaning and preventative maintenance
- 2nd level response to breakdown maintenance

6.7.1 Cleaning and preventative maintenance

The Contractor shall provide cleaning and preventative maintenance for the installed system for three years after the Defects Liability Period has expired, plus two following one year periods (3 + 1 + 1).

The Contractor shall nominate the routine cleaning and service tasks for all equipment on a:

- monthly,
- three monthly,
- six monthly,
- yearly, and
- recommended service basis.

The Contractor must:

- provide appropriately qualified personal with sufficient expertise and knowledge to carry out the works
- provide a Plan of Work for the next month, each month
- perform the Work specified in the Monthly Planned Work Schedule
- provide a Monthly Work Summary Report to the Purchaser's Representative by the first working day of every month
- meet with the Purchaser's Representative at least once every three (3) months after commencement of the contract to review the Work and consider any proposals to improve the Work
- have adequate quality control processes in place for the cleaning and maintenance tasks

RailCorp will supply:

- fan and filter consumables
- supporting hardware
- spare parts
- any cable(s)

for the works as and when required.

The Contractor must collect RailCorp supplied consumables and replacement equipment from designated locations.

The Contractor must supply:

- suitable cleaning products to maintain the Designated Equipment in a proper functioning order (Detergents, glass cleaner etc.)
- transport to and from RailCorp premises. (RailCorp assets must be securely housed inside vehicles. Soft top covering for the vehicle is not acceptable.)
- step ladders (only fibre glass step ladders must be used)
- barricades and warning tape.
- extension leads (all extension leads must have compliant tags)
- tools (All power tool leads must have compliant tags.)
- back pack type vacuum cleaners (power leads must have compliant tags)
- worksite protection services

6.7.2 2nd level response to breakdown maintenance

1st Level response to faults will be handled by RailCorp. These include:

- take and log call
- attempt to restore remotely
- pass on to 2nd level response team (Contractor)
- manage fault

The 2nd Level response shall:

- in the case that a complete Announcement Area has failed, repair the fault within four hours,
- in the case that at least 50% of the Announcement Area is still operating, repair the fault before 5:00am next morning.

The Contractor will be notified of the location and nature of the required work and if necessary, the replacement equipment will be made available by RailCorp for collection by the Contractor from a designated location in order to allow the Contractor reasonable time to complete the Work as per contract.

7 PURCHASER SUPPLIED ITEMS

The Purchaser will supply:

- a) all loudspeakers.
- b) configuration files for AudiaFLEX units.
- c) the Secondary fibre optic path and cable between Equipment Room 1 & Devonshire St Ticket Office,

The Contractor shall accept delivery of all loudspeakers at a Sydney metropolitan location nominated by the Contractor. The Contractor shall be responsible for all equipment so received.

The equipment shall be segregated, protected, insured and clearly labelled the property of RailCorp whilst stored by the Contractor.

All Purchaser supplied items shall be delivered to Site and installed by the Contractor.

8 ELECTRO-ACOUSTIC IMPLEMENTATION

8.1. OVERVIEW OF ELECTRO-ACOUSTIC REQUIREMENTS

The sound system has dual purposes:

- for communicating pertinent information to passengers, *and*
- to aid in the orderly evacuation in the event of an emergency.

The acoustical and operating environments in Central Station create significant challenges for the delivery of satisfactory speech intelligibility. The electro-acoustic systems have been designed to meet high intelligibility targets in this hostile environment, with the result that the systems are more sophisticated and complex than that normally associated with station PA or emergency sound systems. This complexity poses challenges for a conventional method of implementation.

The systems utilise loudspeakers with radiation patterns tailored to each situation. Most of the loudspeakers require complex signal processing, using more than one amplifier channel to achieve the desired radiation pattern. For example, each beam steered array uses eight amplifier channels, one for each driver, with a different delay and signal processing on each driver.

In addition, all loudspeakers across site are time sequenced, requiring individual delay times for each loudspeaker. (there are instances where one amplifier may drive a number of paralleled speakers)

To implement this technology using a 100/70 volt distribution system would require an inordinate number of speaker cables to be installed across the Central Station precinct. In addition, many areas in Central Station have insufficient locations for mounting electronic equipment in relative close proximity to the loudspeakers, and therefore the majority of speaker cables would need to originate in the Equipment Rooms. Creating a suitable egress for these cables out of the Equipment Rooms via containment paths would present challenges that are impractical to meet.

It is therefore proposed to use a system with a series of distributed amplifiers and signal processing, which uses a minimum number of cables to distribute and control the system.

The essential components and configurations of the loudspeakers are described in this section.

8.2. GENERAL IMPLEMENTATION REQUIREMENTS

8.2.1 Amplification / Loudspeaker Coupling

All loudspeakers, with the exception of the TOA CS154, shall be low impedance coupled to the amplifiers.

The Contractor shall provide appropriate coupling to the 100/70 volt transformer in the TOA CS154 such that power transfer is maintained and no degradation of electrical performance is introduced. No proprietary equipment shall be modified to achieve this interface. In the instance that a transformer is introduced in the circuit, it must be free standing and not installed in any amplifier or loudspeaker casing.

8.2.2 Sharing of PRAMS by Loudspeaker Drivers

Not all loudspeakers and loudspeaker drivers are required to have a single amplifier.

In the Eddy Ave, ESR and Devonshire Concourses, there are a number of loudspeakers that utilise identical time-delay and processor settings, and can be connected in parallel to a common PRAM if they are in the same Announcement Area.

For example; driver 3 in the ALA07C (the upper mid-high chain) loudspeakers 15 and 16 in the Eddy Ave Concourse are both delayed by 1.25 ms for beam steering and both have a system delay of 7T ms. Accordingly, these two drivers can be driven from the same PRAM.

Table 10, Table 11, Table 12, Table 13 and

Table 14 shows how two channel PRAMS may be used with more than one loudspeaker.

8.2.3 Loudspeakers - General

- a) The six types of loudspeakers listed in Table 7 will be supplied by the Purchaser for installation by the Contractor.

Manufacturer	Model	Description
Acoustic Technologies	CS6	Two driver system with cardioid radiation pattern
Toa	CS154	Mid range horn
Acoustic Technologies	ALA07C	Seven-driver beam-steered line-array with a tiltable high frequency horn
JBL	Control 25AV	Surface mount full range system
Atlas Soundolier	FAP42	Two way ceiling speaker
Duran Audio	ABF-260	Mid-range horn suitable for edge mounting

Table 7 - loudspeakers supplied by the Purchaser

- b) The Contractor shall set the tilt angle of each high frequency horn in the ALA07C loudspeaker and each CS154 horn speaker to the specified angle.
- c) The Contractor shall use an inclinometer to set the horns to specified angle with a tolerance of 0.5°. The use of a pre-set jig is not permitted.

8.2.4 Mounting of Loudspeakers

A. ALA07C

The ALA07C loudspeakers shall be mounted flush into the ceiling of the Eddy Ave, ESR and Devonshire St concourses as shown indicatively in Figure 1.

The ALA07C loudspeaker is supplied without a universal mounting bracket or grille. The contractor shall manufacture a suitable frame that supports the ALA07C and allows integration into the strip-format ceilings without degrading the ceiling structural integrity.

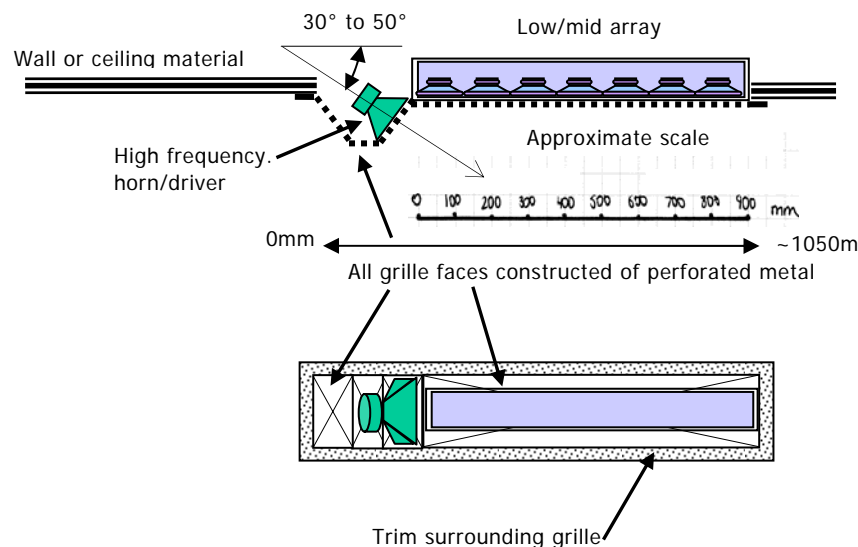


Figure 1 Indicative implementation of ALA07C loudspeaker into ceiling

The contractor shall manufacture a decorative grille, to be installed and fastened underneath the frame using concealed fixing. The perforated metal grille shall be 1.6 mm thick, 2.5 mm dia. holes and greater than 31% open area. A layer of liquid spray resistant, acoustically transparent foam shall back the perforated metal grille (minimum thickness of 10 mm). The grille (including foam) shall be painted an approved colour.

A layer of 100 mm thick polyester insulation Tontine AcoustiSorb 3 shall be fitted around the low frequency array housing on the upper side of the loudspeaker frame in order to reduce the amount of sound radiated into the ceiling cavity. The mounting method and implementation shall be approved by the Purchaser prior to installation.

The ALA07C speakers for the Passenger Tunnel walls shall be similarly mounted.

B. CS6 Loudspeakers

- The CS6 loudspeakers shall be suspended at intervals from the roof of the platforms using a rigid tube that is clamped to the roofing beam.
- The mounting tube shall be plumb.
- The CS6 loudspeaker will be supplied with a mounting bracket that provides the required tilt angle for the CS6 when attached to the mounting tube.
- Where permitted by the roofing structure, the forward-axis of the CS6 shall be parallel with the yellow line on platforms 1-3 and 16-23.

- e) On platforms 4-15, the forward-axis of the CS6 shall be directed inwards at an angle of 7.5 degrees.

C. Control 25AV

The Control 25AV loudspeakers shall be surface mounted using the integral InvisiBall mounting brackets.

8.3. PLATFORMS

Figure 2 shows the Acoustic Technologies CS6 loudspeaker as implemented in the recent Proof of Concept project undertaken by the Purchaser. Table 8 provides implementation details of the loudspeakers and their associated PRAMS for the platform systems. No loudspeakers will be connected in parallel for the platforms.



Figure 2 CS6 loudspeakers as implemented in Proof of Concept project

8.3.1 Platforms 4 to 15

For Platforms 4-15, the speakers shall be suspended from the roofing joists using a rigid tube as shown in Figure 3. All loudspeakers shall face south.



Figure 3 Fixing location for loudspeakers on Platforms 4 to 15.

Where the speakers can be fixed to the inner joist (left-hand photo), a straight rigid tube shall be used. Where only the single joist is available, the tube shall have a pre-made twist that gives the loudspeaker an inward pan angle of 7.5°.

A Toa CS154 horn shall be fixed to the southern end wall of each platform to provide some coverage for the exposed platform areas.

8.3.2 Platforms 16-23

Loudspeakers shall be suspended from the awnings at intervals along each platform, corresponding to three roof-beams.

Loudspeakers lying north of the entry door to the platform control room shall face north, with the first speaker located at the closest beam to the door. Loudspeakers lying south of the door shall face south, commencing at one beam south of the first north-facing speaker. Time zero applies to both these speakers near the door.

A number of speaker locations on each platform shall require individual assessment and a unique location of the speaker in order to:

- prevent interference with sightlines to indicator panels
- mitigate the severity of acoustic reflections from indicator panels
- prevent acoustical shadowing by the indicator panels

The Contractor shall discuss the locations on site with the Purchaser.

Figure 4 shows an example of the interference caused by roofing trusses on the location of the loudspeakers. The loudspeakers shall be generally located 1.5 m (TBC) inside the yellow line



Figure 4 Example of interference of loudspeaker locations by roofing trusses

Platform	Loudspeaker Type	Qty per side of island platform	Locational info	Notes 1	Notes 2	No of PRAM channels	Location of PRAM	Location of CAPUs	No of DSP O/P Chains feeding Amp Dist'n Bus
1	Acoustic Technologies CS6	54	Every 6 m	Centre of front face of loudspeaker to be 3.4 m above platform when installed with tilt-bracket. All speakers to aim in a southerly direction with a pan of 7.5 degs towards centre of platform	Speakers tilt set at 23 degrees below horizontal by supplied bracket.	108	Near loudspeaker	Equipment Room 1	2
2		45				90			2
3		45				90			2
4		26				52			2
5		26				52			2
6		26				52			2
7		26				52			2
8		27				54			2
9		25				50			2
10		25				50			2
11		25				50			2
12		24				48			2
13		24				48			2
14		22				44			2
15		22				44			2
1	Toa CS154	1	on barge board at south end of platform	aimed towards uncovered section of the platform		1	Near loudspeaker	Equipment Room 1	1
2		1				1			1
3		1				1			1
4		1				1			1
5		1				1			1
6		1				1			1
7		1				1			1
8		1				1			1
9		1				1			1
10		1				1			1
11		1				1			1
12		1				1			1
13		1				1			1
14		1				1			1
15		1				1			1
16	Acoustic Technologies CS6	27	Every 6 m (corresponds to 3 rafters on platforms 16-23)	Centre of front face of loudspeaker to be 3.4 m above platform when installed with tilt-bracket. Speakers north of the platform control room to all aim in a northerly direction parallel with the yellow line. Speakers south of the platform control room to all aim in a southerly direction parallel with the yellow line.	Speakers tilt set at 23 degrees below horizontal by supplied bracket. Pan of speakers to be parallel to yellow line, unless obstructed by roof trusses	54	Near loudspeaker	Equipment Room 1	2
17		27				54			2
18		27				54			2
19		27				54			2
20		27				54			2
21		27				54			2
22		26				52			2
23		26				52			2

Table 8 Details of loudspeakers and associated PRAMS for all platforms

8.4. EDDY AVE CONCOURSE

Table 9 gives details of the loudspeakers that shall be used in the Eddy Ave Concourse. An example of an association scheme between the loudspeaker drivers and PRAMs is given in Table 10 and Table 11. These tables also indicate the acoustic groups of the loudspeakers.

A. Main Areas

The ALA07C loudspeakers shall be installed in the ceiling of the concourse area, according to details given in Drawing CS-004. The interval between loudspeakers shall be approximately 6 m. Note that on the northerly side of the concourse, there is distance of 14.6 m between the last speaker and the stairs leading to the ESR Concourse.

B. Elizabeth St/Eddy Ave Entry

In the retail arcade leading from Elizabeth St to Eddy Ave, Toa CS154 horn loudspeakers shall be recessed into the ceiling bulkheads at locations shown indicatively in Figure 5. The loudspeakers are to be recessed into the bulkhead, so that only the outer edges of the horn mouth protrude from the bulkhead. The horns shall be inclined at a specific angle from horizontal, which will be advised during the project. A decorative trim plate shall be fitted around the horn to conceal the gap between the horn body and the bulkhead.

A single ALA07C shall be located at the end of the arcade near door ECN-08 and aimed towards the lift.



Figure 5 Indicative locations of CS154 speakers in bulkheads of entry to Concourse from corner of Elizabeth St and Eddy Ave

C. Entry to Platforms

Sound coverage is not required for the stairwells leading to Platforms 16 to 23.

Loudspeaker Type	Qty	Locational info	Notes 1	Notes 2	No of PRAM Channels	Location of PRAM	Location of CAPU	No of DSP chains feeding speaker
Eddy Ave Concourse - paid and unpaid								
Acoustic Technologies ALA07CH	65	Generally every 6 m in a forward direction 5m in southern corridor	Speaker array to be mounted flush in ceiling, with horn section of grill protruding below as per sketch. Loudspeakers will be installed across the "grain" of the existing metal pan ceiling tiles.	Frame and grille assembly required.	298	In ceiling cavity fixed to slab near loudspeaker	Equipment Room 1	8
JBL Control 25AV Weathermax Grille	2	vertical faces above stairs leading to Chalmers St			1	contractor choice		1
TOA CS154	5	Chalmers St arcade	Recessed into bulkheads		7			1
Devonshire St Concourse Paid & Unpaid								
Acoustic Technologies ALA07CH	38	Generally every 6 m in a forward direction 5m in southern corridor	Speaker array to be mounted flush in ceiling, with horn section of grill protruding below as per sketch. Loudspeakers will be installed across the "grain" of the existing metal pan ceiling tiles.	Frame and grille assembly required.	144	In ceiling cavity fixed to slab near loudspeaker	Equipment Room 2	8
JBL Ctrl 25AV Weathermax Grille	2	stairwell	Recessed into wall		1			1
Eastern Suburbs Railway Concourse								
Acoustic Technologies ALA07CH	18	Every 8 m in a forward direction in areas with flat ceiling	Speaker array to be mounted flush in ceiling, with horn section of grill protruding below as per sketch. Loudspeakers will be installed across the "grain" of the existing metal pan ceiling tiles.	Frame and grille assembly required.	56	In ceiling cavity fixed to slab near loudspeaker	Equipment Room 2	8
Soundolier FAP42	9	in Paid area	between ticket barrier and first column		3	contractor choice		1
TOA CS154	3	above and in stairwell	flush mounted into wall & ceiling		3			1
TOA CS154	10	articulated ceiling and bulkheads	2 x 154 recessed into face of each bulkhead		5	Inside bulkhead		1

Table 9 Details of loudspeakers and associated PRAMS for Eddy Ave, ESR and Devonshire St concourses

Area	Location	Type	Speaker No	Delay Segme	Comment	PRAM associated with Driver No in ALA07C								PRAMs for CS154
						1 - HF	2 - High	3 - Upper Mid High	4 - Upper Mid Low	5 - Lower Mid High	6 - Lower Mid low	7 - Low	8 - Ultra Low	
Unpaid Concourse	north row	ALA07C	1	0	identical drivers with same delay segment are paralled in PRAM	1a	1b	2a	2b	3a	3b	4a	4b	
	south row		2	0		1a	1b	2a	2b	3a	3b	4a	4b	
	north row		3	T		5a	5b	6a	6b	7a	7b	8a	8b	
	south row		4	T		5a	5b	6a	6b	7a	7b	8a	8b	
	north row		5	2T		9a	9b	10a	10b	11a	11b	12a	12b	
	south row		6	2T		9a	9b	10a	10b	11a	11b	12a	12b	
	north row		7	3T		13a	13b	14a	14b	15a	15b	16a	16b	
	south row		8	3T		13a	13b	14a	14b	15a	15b	16a	16b	
	north row		9	4T		17a	17b	18a	18b	19a	19b	20a	20b	
	south row		10	4T		17a	17b	18a	18b	19a	19b	20a	20b	
	north row		11	5T		21a	21b	22a	22b	23a	23b	24a	24b	
	south row		12	5T		21a	21b	22a	22b	23a	23b	24a	24b	
	north row		13	6T		25a	25b	26a	26b	27a	27b	28a	28b	
	south row		14	6T		25a	25b	26a	26b	27a	27b	28a	28b	
	south row		15	7T		29a	29b	30a	30b	31a	31b	32a	32b	
	north row		16	7T		29a	29b	30a	30b	31a	31b	32a	32b	
	south row		17	8T		33a	33b	34a	34b	35a	35b	36a	36b	
	north row		18	8T		33a	33b	34a	34b	35a	35b	36a	36b	
	south row		19	9T		37a	37b	38a	38b	39a	39b	40a	40b	
	north row		20	9T		37a	37b	38a	38b	39a	39b	40a	40b	
	north row		21	10T		41a	41b	42a	42b	43a	43b	44a	44b	
	south row		22	10T		41a	41b	42a	42b	43a	43b	44a	44b	
	door ECN08		23	11T		45a	45b	46a	46b	47a	47b	48a	48b	
	video disp		24	0		46a	46b	47a	47b	48a	48b	49a	49b	
	video disp		25	0		46a	46b	47a	47b	48a	48b	49a	49b	
	video disp		26	T		50a	50b	51a	51b	52a	52b	53a	53b	
	video disp		27	T		50a	50b	51a	51b	52a	52b	53a	53b	
	west nth		28	T		54a	54b	55a	55b	56a	56b	57a	57b	
	west middle		29	T		54a	54b	55a	55b	56a	56b	57a	57b	
	west sth		30	T		54a	54b	55a	55b	56a	56b	57a	57b	
	west nth		31	2T		58a	58b	59a	59b	60a	60b	61a	61b	
	west middle		32	2T		58a	58b	59a	59b	60a	60b	61a	61b	
	west sth		33	2T		58a	58b	59a	59b	60a	60b	61a	61b	
Paid Concourse - westerly area up to escalators	north row	ALA07C	34	0T	identical drivers with same delay segment are paralled in PRAM	62a	62b	63a	63b	64a	64b	65a	65b	
	middle row		35	0T		62a	62b	63a	63b	64a	64b	65a	65b	
	south row		36	0T		62a	62b	63a	63b	64a	64b	65a	65b	
	north row		37	0T+8		66a	66b	67a	67b	68a	68b	69a	69b	
	middle row		38	0T+8		66a	66b	67a	67b	68a	68b	69a	69b	
	south row		39	0T+8		66a	66b	67a	67b	68a	68b	69a	69b	
	north row		40	T		70a	70b	71a	71b	72a	72b	73a	73b	
	middle row		41	T		70a	70b	71a	71b	72a	72b	73a	73b	
Paid Concourse area between barrier and wall/stairs	south row	ALA07C	42	T	cable runs preclude parallel connection of drivers	70a	70b	71a	71b	72a	72b	73a	73b	
	north row		43	2T		74a	74b	75a	75b	76a	76b	77a	77b	
	south row		44	2T		74a	74b	75a	75b	76a	76b	77a	77b	
	south row		45	3T		78a	78b	79a	79b	80a	80b	81a	81b	
	south row		46	4T		82a	82b	83a	83b	84a	84b	85a	85b	
	south row		47	5T		86a	86b	87a	87b	88a	88b	89a	89b	
	north row		48	5T		90a	90b	91a	91b	92a	92b	93a	93b	
	south row		49	6T		94a	94b	95a	95b	96a	96b	97a	97b	
Paid Concourse - Southerly corridor	south row	ALA07C	50	7T	cable runs preclude parallel connection of most drivers	98a	98b	99a	99b	100a	100b	101a	101b	
	south row		51	8T		102a	102b	103a	103b	104a	104b	105a	105b	
	north row		52	8T		102a	102b	103a	103b	104a	104b	105a	105b	
	row		53	2T		106a	106b	107a	107b	108a	108b	109a	109b	
	row		54	3T		110a	110b	111a	111b	112a	112b	113a	113b	
	row		55	4T		114a	114b	115a	115b	116a	116b	117a	117b	
	row		56	5T		118a	118b	119a	119b	120a	120b	121a	121b	
	row		57	6T		122a	122b	123a	123b	124a	124b	125a	125b	
	row		58	7T		126a	126b	127a	127b	128a	128b	129a	129b	
	row		59	8T		130a	130b	131a	131b	132a	132b	133a	133b	
	row	ALA07C	60	9T		134a	134b	135a	135b	136a	136b	137a	137b	
	row		61	10T		138a	138b	139a	139b	140a	140b	141a	141b	
	row		62	11T		142a	142b	143a	143b	144a	144b	145a	145b	

Table 10 – example of association between PRAMs and the different driver chains in the ALA07C loudspeakers for Eddy Ave Concourse. Note that two-channel PRAMs are used in this example.

a=Channel of PRAM, b=Channel 2 of PRAM

Area	Location	Type	Speaker No	Delay Segment	Comment	PRAM associated with Driver No in ALA07C								PRAMs for CS154 or Ctrl25
						1 - HF	2 - High	3 - Upper Mid High	4 - Upper Mid Low	5 - Lower Mid High	6 - Lower Mid low	7 - Low	8 - Ultra Low	
Paid Concourse area ramp between north and south corridors	west wall	ALA07C	63	5T	share	90a	90b	91a	91b	92a	92b	93a	93b	
			64	6.5T		146a	146b	147a	147b	148a	148b	149a	149b	
					share									
			65	8T		126a	126b	127a	127b	128a	128b	129a	129b	
Retail arcade	tiered bulkheads	CS154	1	13T	identical									150a
			2	13T	drivers with									150a
			3	14T	same delay									150b
			4	14T	segment are									150b
			5	15T	paralleled in									151a
			6	15T	PRAM									151a
Chalmers St Entry	wall above stair	Ctrl25AV	1	0	share									152a
			2	0										

Table 11 Example of association between PRAMs and the different driver chains in the ALA07C, CS154 and Control 25AV loudspeakers for Eddy Ave Concourse. Note that two-channel PRAMs are used in this example.

8.5. ESR CONCOURSE

Table 9 gives details of the loudspeakers that shall be used in the ESR Concourse. An example of an association scheme between the loudspeaker drivers and PRAMs is given in Table 12. This table also indicates the acoustic groups of loudspeakers.

8.5.1 Southern Section

In the southern half of this concourse is an articulated ceiling with bulkheads. Pairs of Toa CS154 horn loudspeakers shall be installed into the ceiling bulkheads at various distances along the concourse as shown in Figure 6. The loudspeakers shall aim in a southerly direction.

The loudspeakers shall be recessed into the bulkhead, so that only the outer edges of the horn protrude from the bulkhead. A decorative trim plate shall be fitted around the horn to conceal the gap between the horn body and the bulkhead.

Note that RailCorp proposes to reduce the width of the concourse, by moving the eastern wall inwards. The extent of the coverage area is therefore bounded by the western wall and the line of columns.

Area		Type	Speaker No	Delay Segment	Comment	PRAM channels for ALA07C Driver No							
						1 - HF	2 - High	3 - Upper Mid High	4 - Upper Mid Low	5 - Lower Mid High	6 - Lower Mid low	7 - Low	8 - Ultra Low
Concourse with flat ceiling	ALA07C	1	0	identical drivers with same delay segment are paralled in PRAM	1a	1b	2a	2b	3a	3b	4a	4b	
		2	0T		1a	1b	2a	2b	3a	3b	4a	4b	
		3	0T		1a	1b	2a	2b	3a	3b	4a	4b	
		4	1T		5a	5b	6a	6b	7a	7b	8a	8b	
		5	1T		5a	5b	6a	6b	7a	7b	8a	8b	
		6	1T		5a	5b	6a	6b	7a	7b	8a	8b	
		7	2T		9a	9b	10a	10b	11a	11b	12a	12b	
		8	2T		9a	9b	10a	10b	11a	11b	12a	12b	
		9	3T		13a	13b	14a	14b	15a	15b	16a	16b	
		10	3T		13a	13b	14a	14b	15a	15b	16a	16b	
		11	4T		17a	17b	18a	18b	19a	19b	20a	20b	
		12	4T		17a	17b	18a	18b	19a	19b	20a	20b	
		13	4T		17a	17b	18a	18b	19a	19b	20a	20b	
		14	5T		21a	21b	22a	22b	23a	23b	24a	24b	
		15	5T		21a	21b	22a	22b	23a	23b	24a	24b	
		16	5T		21a	21b	22a	22b	23a	23b	24a	24b	
		17	6T		25a	25b	26a	26b	27a	27b	28a	28b	
		18	6T		25a	25b	26a	26b	27a	27b	28a	28b	
Area	Type	Speaker No	Delay Segment	Comment	PRAM channel								
near ticket barrier	FAP42	1	2T-1	triples are paralleled	29a								
		2	2T-1		29a								
		3	2T-1		29a								
		4	2T-2		29b								
		5	2T-2		29b								
		6	2T-2		29b								
		7	2T-3		30a								
		8	2T-3		30a								
		9	2T-3		30a								
Entry area at Chalmers St	Control 25AV	1	0	paralleled in PRAM	31a								
		2	0		31a								
Area	Type	Speaker No	Delay Segment	Comment	PRAM ch for left horn	PRAM ch for right horn							
Concourse with bulkhead ceilings	CS154	1	7T	horns with same delay segment are paralleled in PRAM	32a								
		2	7T			32a							
		3	8T		32b								
		4	8T			32b							
		5	9T		33a								
		6	9T			33a							
		7	10T		33b								
		8	10T			33b							
		9	11T		34a								
		10	11T			34a							
Area	Type	Speaker No	Delay Segment	Comment	PRAM channel								
Stairwell	CS154	1	12T		35a								
		2	13T		35b								
		3	14T		36a								
Sth Escalators		1	15T		37a								
		2	16T		37b								
Nth Escalators		1	17T		38a								
		2	18T		38b								
		3	19T		39a								

Table 12 Example of association between PRAMs and the different driver chains for ESR Concourse.

Note that two -channel PRAMs are used in this example. a=Channel of PRAM, b=Channel 2 of PRAM



Figure 6 Indicative locations of CS154 horns in bulkheads of ESR concourse

8.5.2 Northern Section - Paid

In the northern half of the PAID concourse with a flat ceiling, Acoustic Technologies ALA07C loudspeakers are to be installed in the ceiling. Acoustic pairs of loudspeakers shall be located at various distances along the concourse at intervals equal to the grey tiled lines on the floor as shown in Figure 7. The high frequency driver of the ALA07C shall be located 300 mm in southerly direction from the northern edge of each grey line. The Contractor shall ensure that this location is greater than 200 mm way from the lighting trough.

Note that RailCorp proposes to reduce the width of the concourse, by moving the eastern wall inwards. The extent of the coverage area is therefore bounded by the western wall and the line of columns. However, three array loudspeakers are required at the grey line that relates to the entry to the northern escalator.



Figure 7 Grey lines on floor indicating quantity of loudspeakers at each line.

8.5.3 Northern Section – Unpaid

Two rows of (three) ALA07C loudspeakers shall be located in the northern unpaid concourse. Each row can be regarded as an acoustic group.

The first row shall be located 2 m from the northern wall of the concourse, and the second row shall be located as shown in Figure 8.



Figure 8 Indicative locations of second row of ALA07C speakers in northern unpaid area.

8.5.4 Stairs and Escalators

A. Stairs

The stairs leading to Platforms 24/25 shall be covered using Toa CS154 horns, mounted essentially flush into the green panels, so that only the outer edges of the horn protrude from the mounting surface. Figure 9 shows the indicative locations.

Figure 9 Indicative locations of Toa CS154 horns in stairwell leading to Platforms 24/25.



The relative orientation of the white rectangle indicates the orientation of the horn mouth.

B. Escalators

Three Toa CS154 loudspeakers shall be fixed to ceiling of the northerly escalator tube. The horns shall mount with one long edge touching the ceiling.

In the southerly escalator tube, two CS154 speakers are to be used as shown in Figure 10.

8.5.5 Paid Area Above and South of Ticket Barriers

In the Paid area between the ticket barrier and the first grey line on the floor, FAP42 ceiling speakers shall be used, arranged in three rows of three speakers. These speakers can be regarded as one acoustic group, without time sequencing.

8.5.6 Northern Entry to Chalmers St



Figure 10 Indicative locations of CS154 loudspeakers in southern escalator tube

In the entry opposite the Dental Hospital, two JBL Control 25AV loudspeakers shall be fixed to the two vertical faces above the stairs as shown in Figure 11.



Figure 11 Indicative locations of Control 25AV loudspeakers at entry from Chalmers St

8.6. DEVONSHIRE ST CONCOURSE

Table 9 gives details of the loudspeakers that shall be used in the concourses in the Devonshire St Concourse. An example of an association scheme between the loudspeaker drivers and PRAMs is given in Table 13. This table also indicate the acoustic groups of loudspeakers.

8.6.1 Paid Area

ALA07C loudspeakers shall be installed in the ceiling of the concourse area, according to details given in Drawing CS-004. The interval between loudspeakers shall be approximately 6 m.

8.6.2 Unpaid Area and Entry from Devonshire St

ALA07C loudspeakers shall be installed in the ceiling of the concourse area. Three ALA07C loudspeakers shall be used to cover the stairs, as shown in Figure 13 and Figure 13.



Figure 13 ALA07C in Dev. Concourse near tunnel



Figure 13 Indicative location of ALA07C leading up to first landing on steps leading to ticket barrier

Control 25AV speakers shall be located in the wall above the stairs as shown in Figure 14.



Figure 14 Indicative locations of Control 25AV speakers in wall above stairs to Devonshire St

Area	Type	Speaker No	Delay Segment	Comment	PRAM channels for ALA07C Driver No							
					1 - HF	2 - High	3 - Upper Mid High	4 - Upper Mid Low	5 - Lower Mid High	6 - Lower Mid low	7 - Low	8 - Ultra Low
Paid Area	ALA07C	1	0	identical drivers with same delay segment are paralalled in PRAM	1a	1b	2a	2b	3a	3b	4a	4b
		2	0T		1a	1b	2a	2b	3a	3b	4a	4b
		3	0T		1a	1b	2a	2b	3a	3b	4a	4b
		4	1T		5a	5b	6a	6b	7a	7b	8a	8b
		5	1T		5a	5b	6a	6b	7a	7b	8a	8b
		6	1T		5a	5b	6a	6b	7a	7b	8a	8b
		7	2T		9a	9b	10a	10b	11a	11b	12a	12b
		8	2T		9a	9b	10a	10b	11a	11b	12a	12b
		9	2T		9a	9b	10a	10b	11a	11b	12a	12b
		10	3T		13a	13b	14a	14b	15a	15b	16a	16b
		11	3T		13a	13b	14a	14b	15a	15b	16a	16b
		12	4T		17a	17b	18a	18b	19a	19b	20a	20b
		13	4T		17a	17b	18a	18b	19a	19b	20a	20b
		14	1T		21a	21b	22a	22b	23a	23b	24a	24b
		15	1T		21a	21b	22a	22b	23a	23b	24a	24b
		16	2T		25a	25b	26a	26b	27a	27b	28a	28b
		17	3T		25a	25b	26a	26b	27a	27b	28a	28b
		18	3T		25a	25b	26a	26b	27a	27b	28a	28b
Unpaid Area	ALA07C	19	0T	identical drivers with same delay segment are paralalled in PRAM	29a	29b	30a	30b	31a	31b	32a	32b
		20	0T		29a	29b	30a	30b	31a	31b	32a	32b
		21	0T		33a	33b	34a	34b	35a	35b	36a	36b
		22	0T		33a	33b	34a	34b	35a	35b	36a	36b
		23	1T		37a	37b	38a	38b	39a	39b	40a	40b
		24	1T		37a	37b	38a	38b	39a	39b	40a	40b
		25	1T		41a	41b	42a	42b	43a	43b	44a	44b
		26	1T		41a	41b	42a	42b	43a	43b	44a	44b
		27	2T		45a	45b	46a	46b	47a	47b	48a	48b
		28	2T		45a	45b	46a	46b	47a	47b	48a	48b
		29	2T		49a	49b	50a	50b	51a	51b	52a	52b
		30	2T		49a	49b	50a	50b	51a	51b	52a	52b
above stair near Newslink near Dev tunnel near Dev tunnel entry to Dev tunnel	ALA07C	31	2.5T		53a	53b	54a	54b	55a	55b	56a	56b
		32	3T		57a	57b	58a	58b	59a	59b	60a	60b
		33	3T		61a	61b	62a	62b	63a	63b	64a	64b
		34	3T		61a	61b	62a	62b	63a	63b	64a	64b
		35	3T+8		65a	65b	66a	66b	67a	67b	68a	68b
		36	3T+8		65a	65b	66a	66b	67a	67b	68a	68b
		37	4T		69a	69b	70a	70b	71a	71b	72a	72b
		38	4T		69a	69b	70a	70b	71a	71b	72a	72b
Area	Type	Speaker No	Delay Segment	Comment	PRAM ch for left lsp	PRAM ch for right lsp						
stairs	Ctrl 25AV	1	5T	identical	73a							
		2	5T			73a						

Table 13 Example of association between PRAMs and the different driver chains in the ALA07C and Ctrl 25AV loudspeakers for Devonshire St Concourse. Note that two-channel PRAMs are used in this example. a=Channel of PRAM, b=Channel 2 of PRAM

8.7. DEVONSHIRE ST TO RAILWAY SQUARE TUNNEL

Duran Audio ABF-260 loudspeakers shall be installed at intervals of approximately 23 m. A pictorial view of the ABF-260 is shown in Figure 15.

The loudspeakers shall be fixed to a 16 mm thick waterproof board of approximate dimensions 2.2 m x 1.5 m, which is in turn fixed to the structural ribs that run down the length of the tunnel, as shown indicatively in Figure 16. The board shall be painted an approved colour.

The long dimension of the board shall extend 700 mm beyond the mouth of the horn to provide a smooth acoustical transition to the tunnel ceiling. The board shall be shaped around the light fittings as required.

The PRAMs for the loudspeakers shall also to be fixed to this plate.

Table 14 gives an example of an association between PRAMs and the ABF 260 horn. Table 15 provides details of the loudspeakers.



Figure 15 Sketch of ABF-260



The power and bus cables shall be installed in a suitable conduit running down the length of the tunnel.

Figure 16 Indicative location of speaker-mounting board in Devonshire St Tunnel

Area	Spkr	Speaker No	Delay Segment	PRAM ch
Devonshire to Lee St tunnel	ABF-260	1	0T	1a
	ABF-260	2	1T	1b
	ABF-260	3	2T	2a
	ABF-260	4	3T	2b
	ABF-260	5	4T	3a
	ABF-260	6	5T	3b
	ABF-260	7	6T	4a
	ABF-260	8	7T	4b
	ABF-260	9	8T	5a

Table 14 Example of association between PRAMs and the different ABF260 horns.

Note that two-channel PRAMs are used in this example. a=Channel of PRAM, b=Channel 2 of PRAM

8.8. PEDESTRIAN TUNNELS

Table 15 gives details of the loudspeakers and associated PRAMS for the Passenger Tunnels. Table 16 gives an example of an association between the loudspeaker drivers and PRAMs.

Sound coverage is not required for the stairwells leading to Platforms.

8.8.1 Tunnel 1 - ESR to Country Concourse

ALA07C loudspeakers shall be mounted into the upper section of northern side wall as shown in Figure 17. The loudspeakers shall be installed flush the north wall at intervals of 8 m and trimmed according to details given in Section 0 above.

There appears to be some 400 mm between the wall and the solid wall behind space to recess the array into the wall, leaving only the raised horn section to protrude from the wall.



Figure 17 Indicative location of ALA07C loudspeaker in side wall of Tunnel 1.

8.8.2 Tunnel 2 - ESR to Suburban

Loudspeakers shall be mounted in the ceiling at intervals of 8 m, in a similar manner to the method specified above for the Devonshire Concourse.

8.8.3 Tunnel 3 - ESR to Country Platforms

A. East Section

Loudspeakers shall be mounted in the ceiling at intervals of 8 m, in a similar manner to the method specified above for the Devonshire St Concourse.

B. West Section

Loudspeakers shall be mounted in the oblique side walls at intervals of 8 m, in a similar manner to the method specified above for Tunnel 1. Figure 18 shows an indicative location for the loudspeakers.



Figure 18 Indicative location of ALA07C loudspeakers in side wall of west section of Tunnel 3

C. Tunnel 4 - side branch of Tunnel 3

ALA07C loudspeakers are to be mounted into the upper section of northern side wall as shown in Figure 17. The loudspeakers are to be installed flush the north wall at intervals of 8 m and trimmed according to details given for Tunnel 1.

There appears to be some 400 mm between the wall and the solid wall behind space to recess the array into the wall, leaving only the raised horn section to protrude from the wall.

Loudspeaker Type	Description	Qty	Locational info	Notes 1	Notes 2	No of PRAM Channels	Location of PRAM	Local signal processing available in PRAM (per channel)	Location of CAPU	No of DSP chains feeding speaker	DSP req'd for Loudspeaker
Pedestrian Tunnel 1 ESR to Country Concourse - Eddy Ave end											
Acoustic Technologies ALA07CH	7x driver line array with 1x high frequency horn	23	Every 8 m in a forward direction	Speaker array to be mounted flush in wall near junction with ceiling with horn section of grill protruding outward as per sketch.	Frame and grille assembly required.	184	In wall cavity near loudspeaker	Delay up to 600 ms level, 4 X parametric filters	Equipment Room 3	8	8 x 2 ms delays 8 x 2nd order LPFs 8 x 2nd order APFs 2 x 8th Order Butterworth HPF/LPF crossover 8 x Param filters for LSP eq 8 x Param filters for system eq
Pedestrian Tunnel 2 ESR to Suburban											
Acoustic Technologies ALA07CH	7x driver line array with 1x high frequency horn	9	Every 7 m in a forward direction	Speaker array to be mounted flush in wall near junction with ceiling with horn section of grill protruding outward as per sketch.	Frame and grille assembly required.	72	In wall cavity near loudspeaker	Delay up to 600 ms level, 4 X parametric filters	Equipment Room 3	8	8 x 2 ms delays 8 x 2nd order LPFs 8 x 2nd order APFs 2 x 8th Order Butterworth HPF/LPF crossover 8 x Param filters for LSP eq 8 x Param filters for system eq
Pedestrian Tunnel 3 ESR to Country Concourse											
Acoustic Technologies ALA07CH	7x driver line array with 1x high frequency horn	25	Every 8 m in a forward direction	Speaker array to be mounted flush in wall near junction with ceiling with horn section of grill protruding outward as per sketch.	Frame and grille assembly required.	200	In wall cavity near loudspeaker	Delay up to 600 ms level, 4 X parametric filters	Equipment Room 3	8	8 x 2 ms delays 8 x 2nd order LPFs 8 x 2nd order APFs 2 x 8th Order Butterworth HPF/LPF crossover 8 x Param filters for LSP eq 8 x Param filters for system eq
Pedestrian Tunnel 4 Side branch of tunnel 3											
Acoustic Technologies ALA07CH	7x driver line array with 1x high frequency horn	7	Every 8 m in a forward direction	Speaker array to be mounted flush in wall near junction with ceiling with horn section of grill protruding outward as per sketch.	Frame and grille assembly required.	56	In wall cavity near loudspeaker	Delay up to 600 ms level, 4 X parametric filters	Equipment Room 3	8	8 x 2 ms delays 8 x 2nd order LPFs 8 x 2nd order APFs 2 x 8th Order Butterworth HPF/LPF crossover 8 x Param filters for LSP eq 8 x Param filters for system eq
Pedestrian Tunnel Devonshire St to Lee St											
Duran ABF260	large format horn	9	Every 23 m	Loudspeakers to be mounted on a flat, painted timber plate, that is fixed hard up against the roof of the tunnel.		5	on plate behind every second loudspeaker	Delay up to 600 ms level, 4 X parametric filters	Equipment Room 3	1	8 x Param filters for system eq

Table 15 Details of loudspeakers and PRAMS for tunnels

				PRAM channels for ALA07C Driver No							
Area	Spkr	Speaker No	Delay Segment	1 - HF	2 - High	3 - Upper Mid High	4 - Upper Mid Low	5 - Lower Mid High	6 - Lower Mid Low	7 - Low	8 - Ultra Low
Pedestrian Tunnel 1 ESR to Country Concourse	ALA07C	1	0	1a	1b	2a	2b	3a	3b	4a	4b
	ALA07C	2	1T	5a	5b	6a	6b	7a	7b	8a	8b
	ALA07C	3	2T	9a	9b	10a	10b	11a	11b	12a	12b
	ALA07C	4	3T	13a	13b	14a	14b	15a	15b	16a	16b
	ALA07C	5	4T	17a	17b	18a	18b	19a	19b	20a	20b
	ALA07C	6	5T	21a	21b	22a	22b	23a	23b	24a	24b
	ALA07C	7	6T	25a	25b	26a	26b	27a	27b	28a	28b
	ALA07C	8	7T	29a	29b	30a	30b	31a	31b	32a	32b
	ALA07C	9	8T	33a	33b	34a	34b	35a	35b	36a	36b
	ALA07C	10	9T	37a	37b	38a	38b	39a	39b	40a	40b
	ALA07C	11	10T	41a	41b	42a	42b	43a	43b	44a	44b
	ALA07C	12	11T	45a	45b	46a	46b	47a	47b	48a	48b
	ALA07C	13	12T	49a	49b	50a	50b	51a	51b	52a	52b
	ALA07C	14	13T	53a	53b	54a	54b	55a	55b	56a	56b
	ALA07C	15	14T	57a	57b	58a	58b	59a	59b	60a	60b
	ALA07C	16	15T	61a	61b	62a	62b	63a	63b	64a	64b
	ALA07C	17	16T	65a	65b	66a	66b	67a	67b	68a	68b
	ALA07C	18	17T	69a	69b	70a	70b	71a	71b	72a	72b
	ALA07C	19	18T	73a	73b	74a	74b	75a	75b	76a	76b
	ALA07C	20	19T	77a	77b	78a	78b	79a	79b	80a	80b
	ALA07C	21	20T	81a	81b	82a	82b	83a	83b	84a	84b
	ALA07C	22	21T	85a	85b	86a	86b	87a	87b	88a	88b
	ALA07C	23	22T	90a	90b	91a	91b	92a	92b	93a	93b
Tunnel 2 ESR to Suburban	ALA07C	1	0T	1a	1b	2a	2b	3a	3b	4a	4b
	ALA07C	2	1T	5a	5b	6a	6b	7a	7b	8a	8b
	ALA07C	3	2T	9a	9b	10a	10b	11a	11b	12a	12b
	ALA07C	4	3T	13a	13b	14a	14b	15a	15b	16a	16b
	ALA07C	5	4T	17a	17b	18a	18b	19a	19b	20a	20b
	ALA07C	6	5T	21a	21b	22a	22b	23a	23b	24a	24b
	ALA07C	7	6T	25a	25b	26a	26b	27a	27b	28a	28b
		8	7T	29a	29b	30a	30b	31a	31b	32a	32b
	ALA07C	9	8T	33a	33b	34a	34b	35a	35b	36a	36b
Tunnel 3 ESR to Country Platform	ALA07C	1	0	1a	1b	2a	2b	3a	3b	4a	4b
	ALA07C	2	1T	5a	5b	6a	6b	7a	7b	8a	8b
	ALA07C	3	2T	9a	9b	10a	10b	11a	11b	12a	12b
	ALA07C	4	3T	13a	13b	14a	14b	15a	15b	16a	16b
	ALA07C	5	4T	17a	17b	18a	18b	19a	19b	20a	20b
	ALA07C	6	5T	21a	21b	22a	22b	23a	23b	24a	24b
	ALA07C	7	6T	25a	25b	26a	26b	27a	27b	28a	28b
	ALA07C	8	7T	29a	29b	30a	30b	31a	31b	32a	32b
	ALA07C	9	8T	33a	33b	34a	34b	35a	35b	36a	36b
	ALA07C	10	9T	37a	37b	38a	38b	39a	39b	40a	40b
	ALA07C	11	10T	41a	41b	42a	42b	43a	43b	44a	44b
	ALA07C	12	11T	45a	45b	46a	46b	47a	47b	48a	48b
	ALA07C	13	12T	49a	49b	50a	50b	51a	51b	52a	52b
	ALA07C	14	13T	53a	53b	54a	54b	55a	55b	56a	56b
	ALA07C	15	14T	57a	57b	58a	58b	59a	59b	60a	60b
	ALA07C	16	15T	61a	61b	62a	62b	63a	63b	64a	64b
	ALA07C	17	16T	65a	65b	66a	66b	67a	67b	68a	68b
	ALA07C	18	17T	69a	69b	70a	70b	71a	71b	72a	72b
	ALA07C	19	18T	73a	73b	74a	74b	75a	75b	76a	76b
	ALA07C	20	19T	77a	77b	78a	78b	79a	79b	80a	80b
	ALA07C	21	20T	81a	81b	82a	82b	83a	83b	84a	84b
	ALA07C	22	21T	85a	85b	86a	86b	87a	87b	88a	88b
	ALA07C	23	22T	85a	85b	86a	86b	87a	87b	88a	88b
		24	23T	89a	89b	90a	90b	91a	91b	92a	92b
	ALA07C	25	24T	93a	93b	94a	94b	95a	95b	96a	96b
Tunnel 4 side branch of Tunnel 3	ALA07C	1	0T	1a	1b	2a	2b	3a	3b	4a	4b
	ALA07C	2	1T	5a	5b	6a	6b	7a	7b	8a	8b
	ALA07C	3	2T	9a	9b	10a	10b	11a	11b	12a	12b
	ALA07C	4	3T	13a	13b	14a	14b	15a	15b	16a	16b
	ALA07C	5	4T	17a	17b	18a	18b	19a	19b	20a	20b
	ALA07C	6	5T	21a	21b	22a	22b	23a	23b	24a	24b
		7	6T	25a	25b	26a	26b	27a	27b	28a	28b

Table 16 Example of association between PRAMs and the different driver chains in the ALA07C loudspeakers for pedestrian tunnels. Note that two-channel PRAMs are used in this example. a=Ch1 of PRAM, b=Ch 2 of PRAM

APPENDIX E1 - DRAWING SCHEDULE

Table 17 lists the drawings included defining the technical specification.

Drg Number	Sheet	Title	Content
AD-CS-001	1	Central Audio Processing Concept	concept signal chain schematic, front end, CAPU and overview
AD-CS-002a	1	Distributed Amplification System	concept signal chain schematic, Distributed Amplification System implementation
AD-CS-002b	2	Distributed Amplification System	concept signal chain schematic, Distributed Amplification System implementation
AD-CS-002c	3	Distributed Amplification System	concept signal chain schematic, Distributed Amplification System implementation
AD-CS-003	1	Announcement Areas	Announcement Areas defined
AD-CS-004	1	Electro-Acoustic Implementation	loudspeaker layout for Announcement Areas

Table 17 - drawing schedule

APPENDIX E2 - SAMPLE IMPLEMENTATION

The Klotz Digital Varizone system offers a working solution known to the Purchaser.

Figure 19 demonstrates the concept of the Distributed Amplification System using the Klotz Digital Varizone equipment. The following characteristics are noted:

- Signal distribution from the Equipment Room CAPU to each local amplifier via RADOX FR 2x2x0.75 cable or equivalent in fire rated containment (signals are transported on a 16 bit / 48 kHz digital bus).
- Each digital bus transmits 8 audio channels plus control data plus monitoring data from the loudspeakers returning to the CAPU.
- Utilises two leapfrogging buses with alternate loudspeakers to offer a high level of redundancy.
- Each amplifier is powered via the bus, and power and data refreshers are used as required.
- Each amplifier has a delay module and DSP on board.
- Each amplifier has status/fault reporting and supervision of the fault status of its associated loudspeakers.
- Amplifiers can be mounted adjacent to loudspeakers to avoid cable congestion.
- In the event of a fault, the amplifier module may be removed from its docking station for servicing, and a replacement substituted. Upon substitution, the control settings are automatically downloaded to the new unit.

Platform 'X' - down side

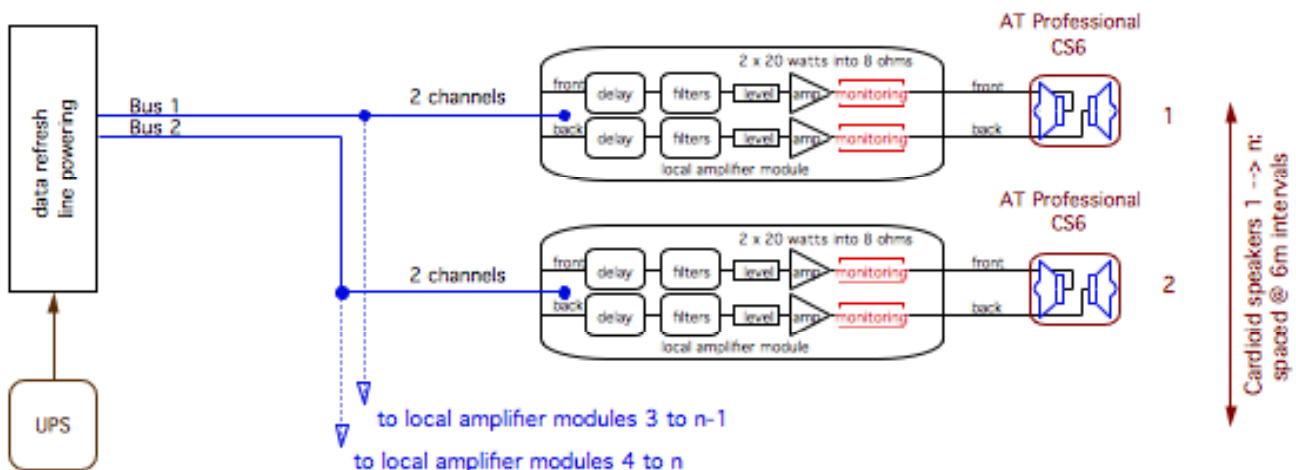


Figure 19 - amplification implementation example

APPENDIX E3 - COMBINING AMBIENT NOISE SENSING MICROPHONES.

In the CAPU, multiple ambient noise sensing microphones for individual Areas (or sub-areas) are mixed together before being sent to the AudiaFLEX units as defined in Table 18.

Equipment Room	Microphone Combination	AudiaFLEX Input
1	Platform 1: mic 1 + 2	Audia 3 / input 13
1	Platform 2: mic 1 + 2	Audia 3 / input 14
1	Platform 3: mic 1 + 2	Audia 3 / input 15
1	Platform 4: mic 1 + 2	Audia 3 / input 16
1	Platform 5: mic 1 + 2	Audia 3 / input 17
1	Platform 6: mic 1 + 2	Audia 3 / input 18
1	Platform 7: mic 1 + 2	Audia 3 / input 19
1	Platform 8: mic 1 + 2	Audia 3 / input 20
1	Platform 9: mic 1 + 2	Audia 3 / input 21
1	Platform 10: mic 1 + 2	Audia 3 / input 22
1	Platform 11: mic 1 + 2	Audia 3 / input 23
1	Platform 12: mic 1 + 2	Audia 3 / input 24
1	Platform 13: mic 1 + 2	Audia 4 / input 1
1	Platform 14: mic 1 + 2	Audia 4 / input 2
1	Platform 15: mic 1 + 2	Audia 4 / input 3
1	Platform 16: mic 1 + 2	Audia 4 / input 4
1	Platform 17: mic 1 + 2	Audia 4 / input 5
1	Platform 18: mic 1 + 2	Audia 4 / input 6
1	Platform 19: mic 1 + 2	Audia 4 / input 7
1	Platform 20: mic 1 + 2	Audia 4 / input 8
1	Platform 21: mic 1 + 2	Audia 4 / input 9
1	Platform 22: mic 1 + 2	Audia 4 / input 10
1	Platform 23: mic 1 + 2	Audia 4 / input 11
1	Passenger tunnel 1: 1 mic only	Audia 4 / input 12
1	Eddy Av UNPAID: mic 1 + 2	Audia 4 / input 13
1	Eddy Av PAID: mic 1 + 2	Audia 4 / input 14
2	Passenger tunnel 2: 1 mic only	Audia 8 / input 7
2	Passenger tunnel 3: 1 mic only	Audia 8 / input 8
2	Passenger tunnel 4: 1 mic only	Audia 8 / input 9
2	ESR Concourse UNPAID: mic 1 + 2	Audia 8 / input 10
2	ESR Concourse PAID: mic 3 + 4	Audia 8 / input 11
2	Devonshire Concourse UNPAID: mic 1 + 2	Audia 8 / input 12
2	Devonshire Concourse PAID: mic 3 + 4	Audia 8 / input 13
2	Devonshire Tunnel: mic 1 + 2	Audia 8 / input 14

Table 18 - combination of ambient noise sensing microphones

APPENDIX E4 - AUDIAFLEX I/O IN CAPU

The required I/O modules for the AudiaFLEX are given in Table 19, Table 20, Table 21, and Table 22, and program the CAPU so that the signal inputs and outputs are routed as detailed.

Equipment Room 1: Feeds from CAPU to AudiaFLEX inputs	Quantity	AudiaFLEX unit	Input number
DVA	40	1	1 – 24
		2	1 - 16
SM paging microphone	1	2	17
RPICS 1 microphone	1	2	18
SPI microphone	1	2	19
SECP EWIS panel	10	2	20 – 24
		3	1 - 5
Duty manager microphone	1	3	6
RPICS 2 microphone	1	3	7
platform announcement microphones	4	3	8 - 11
Music source	2	3	12 - 13
Ambient sensing microphones - (after summation of pairs in CAPU – see Table 18)	26	3	14 – 24
		4	1 - 15
TOTAL	87		

Table 19 - feeds from CAPU to AudiaFLEX units in Equipment Room 1

AudiaFLEX unit	Output number	Equipment Room 1: Feeds from AudiaFLEX outputs to CAPU for distribution to Announcement Areas
4	1 - 8	Pedestrian Tunnel 1: AL070CH beam steered arrays
5	1 – 24	Platforms 1 – 12: cardioid CS6 speakers
6	1 - 22	Platforms 13 – 23: cardioid CS6 speakers
6	23 - 24	Platforms 24/25: line level feed only
7	1 - 15	Platforms horns – at end of platforms 1 - 15
7	16	Eddy Ave Concourse – TOA SC154 horns
7	17 - 24	Eddy Ave Concourse – AL070CH beam steered arrays
80	TOTAL	

Table 20 - feeds from AudiaFLEX units to CAPU in Equipment Room 1

Equipment Room 2: Feeds from CAPU to AudiaFLEX inputs	Quantity	AudiaFLEX unit	Input number
DVA	6	8	1 - 6
ambient sensing microphones - (after summation of pairs in CAPU)	8	8	7 - 14
TOTAL	14		

Table 21 - feeds from CAPU to AudiaFLEX units in Equipment Room 2

AudiaFLEX unit	Output number	Equipment Room 2: Feeds from AudiaFLEX outputs to CAPU for distribution to Announcement Areas
8	1 – 8	Eastern Suburbs Railway Concourse – AL070CH beam steered arrays
8	9	Eastern Suburbs Railway Concourse – TOA SC154 horns
8	10	Eastern Suburbs Railway Concourse – Soundolier FAP42 ceiling speakers
9	1	Eastern Suburbs Railway Concourse – JBL Control 25AV
9	2	Pedestrian Tunnel: Devonshire St to Railway Square
9	3 - 12	Eastern Suburbs Railway Concourse
9	13 – 20	Devonshire St Concourse – AL070CH beam steered arrays
9	21	Devonshire St Concourse – JBL Control 25AV
10	1 - 8	Pedestrian Tunnel 2 ESR to Suburban
10	9 – 16	Pedestrian Tunnel 3 ESR to Country Concourse
10	17 - 24	Pedestrian Tunnel 4 Side branch of tunnel 3
	45	TOTAL

Table 22 - feeds from AudiaFLEX units to CAPU in Equipment Room 1

APPENDIX E5 - EQUIPMENT ROOM FIT OUT

Access to Equipment Room 1 is via a ramp and a Gantry lift. Access to Equipment Room 2 is directly off the Devonshire St Paid Concourse. Figure 20 shows the default layout of Equipment Room 1. The Contractor shall determine the suitability of the current layout, and notify the Principal if the layout is unusable.

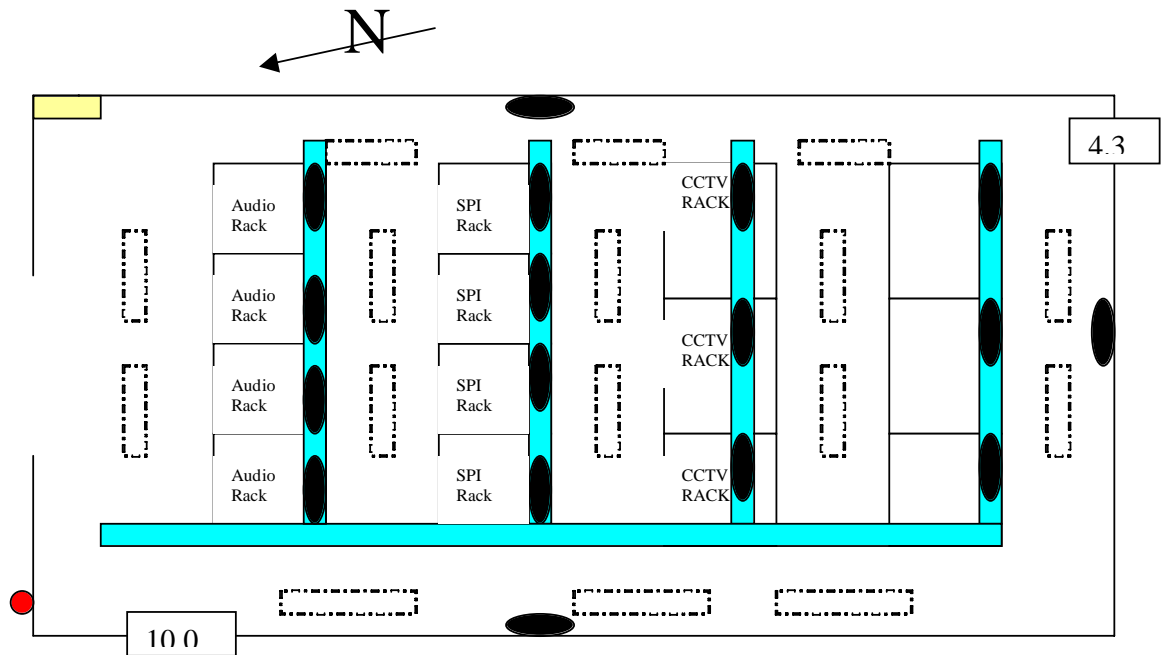


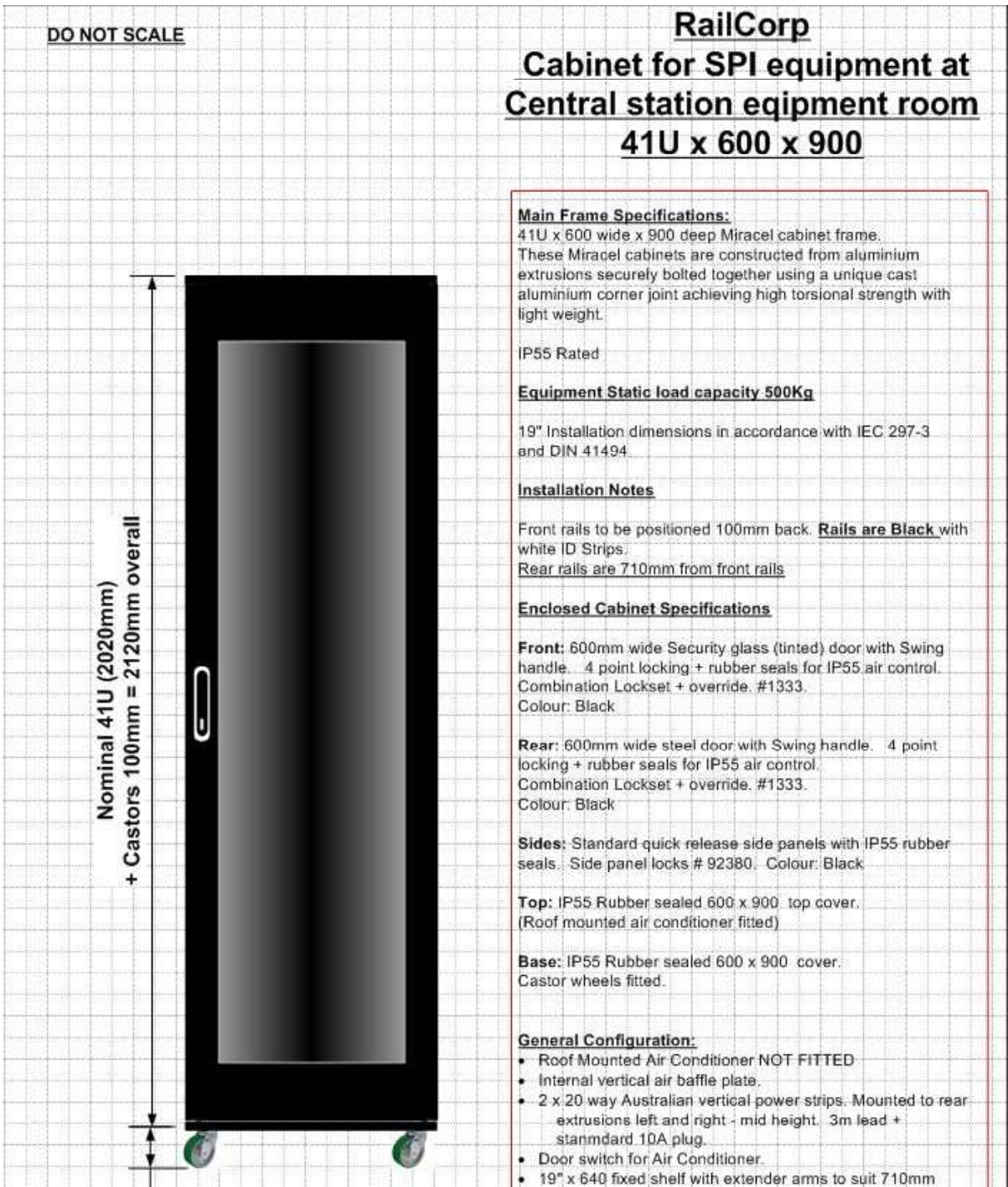
Figure 20 - Equipment Room 1 layout

Legend:

-
- The diagram shows a rectangular room with several items placed within it:
- Gas Bottle:** A red circle on a cyan rectangular base, located in the upper left area.
 - Cable Tray (300mm) on floor:** A dashed rectangular outline, located in the middle left area.
 - Double Fluoro Lights:** A black oval, located in the lower left area.
 - Double GPOs:** A black oval, located in the lower right area.
 - Sub – DB:** A yellow rectangle, located in the bottom left corner.

APPENDIX E6 - EQUIPMENT RACK SPECIFICATIONS

Figure 21 - equipment rack specifications



APPENDIX E7 RAILCORP STANDARDS

- RailCorp structured cabling standards
- RailCorp electrical installation standards
- RailCorp rail safety standards
- RailCorp rail safety systems
- RailCorp corporate safety requirements
- Railcorp Engineering Design Management Procedure - Procedure Number ED0022P - All Design areas.
- Railcorp Engineering Design Management Procedure Cad and Drafting Manual - Electrical ED 0024P.

Note: This Appendix shall be provided to all the Tenderer's at the Pre Tender meeting on a CD