Tugun Bypass Rebroadcast System
When Tyco Traffic & Transportation needed a rebroadcast system for the Tugun Bypass intelligent transport system, they chose RFI.

THE CHALLENGE

Tyco Traffic & Transportation provides traffic management and control systems in over 120 cities worldwide. As part of the Pacific Link Alliance, Tyco was tasked with the design and installation of the Tugun Bypass intelligent transport system in Queensland, Australia.

A rebroadcast system was a small, but vital, component of the total intelligent transport system. Tyco sought a partner who could design and install the rebroadcast system as a turnkey sub-contractor.

Operational requirements

The operational requirements for this project included providing rebroadcast capabilities for several wireless technologies, including AM and FM radio stations, two-way radio and cellular mobile phone.

An audio break in capability allows pre-recorded or live audio announcements to be inserted into the AM and FM rebroadcasts so drivers can hear them on their car radios.

The announcements are also fed to the in-tunnel public address system for broadcast throughout the tunnels.

Two-way radio coverage for various emergency services organisations (ESOs) was also required. As the tunnel is adjacent to the border of NSW and Queensland, the rebroadcast two-way radio coverage caters for the ESOs from both states.

As well as meeting the stringent operational requirements, Tyco needed a partner with the experience to handle the challenges of working on a major roadway site.
The Solution

Tyco selected RFI to design and install the rebroadcast system, based on RFI’s experience and expertise with this technology. RFI delivered a flexible and feature-rich rebroadcast system, utilising a comprehensive suite of their products and services, including:

- RF surveys
- Intermodulation analysis
- System design
- Equipment manufacture
- Integration
- Factory acceptance testing (FAT)
- Installation
- Commissioning
- Site acceptance testing (SAT)
- Coverage testing
- Documentation and operator training
- Maintenance

Technical details

For the AM rebroadcast system, RFI used their AMC516 Series AM repeater. Two of the AMC516 headend’s four outputs were connected to separate PA516 multi-carrier power amplifiers (MCPAs) to provide separate RF output feeds for the southbound and northbound tunnel bores. These AM RF feeds are carried to the tunnel bores via separate LDF4-50 cabling.

The FM rebroadcast system utilises the FMC88108 Series FM repeaters. RFI Control Station Combiners combine the FMC88108 units, and RFI’s high-linearity broadband MCPAs amplify the combiners’ separate southbound and northbound outputs to provide corresponding RF output feeds for the tunnel bores.

For the ESO’s two-way radio services, channelized repeaters provide on-frequency rebroadcast of the various analogue and digital protocols used by the respective agencies in the 400-420 MHz and 450-470 MHz bands. High power outputs from the UHF repeaters allow the use of internal hybrid combiners and duplexing techniques to combine the various 400-420 MHz and 450-470 MHz ESO channels (Tx and Rx).

Cross-band couplers incorporate 80 MHz and 160 MHz VHF channels into the design. The overall multiband combiner design provides combined VHF/UHF signals. These are divided by a broadband high power divider, and coupled with the separate FM RF outputs to provide a combined FM/VHF/UHF feed that’s carried to the southbound and northbound tunnel bores via separate LDF5-50 cabling.

Within each tunnel bore, the AM and FM/VHF/UHF feeds are combined using RFI’s AM/FM broadband transformer couplers. The resulting AM/FM/VHF/UHF signals are then fed into a single multiband radiating cable running the length of each tunnel bore.

An RFI Audio Control Panel interfaces the various audio break-in components of the system. These include a digital enunciator unit that can play pre-recorded messages, an audio interface that allows live audio announcements from the public address system to be inserted into the AM and FM rebroadcast channels, and a multi-track digital voice logger that records and date stamps all audio break-in messages for later retrieval as part of incident management analysis if required.
An integrated DVD recorder can manually or automatically record archives of all voice logger recordings. A DSP-based audio processor is incorporated to adapt the audio response of the system to suit the unique audio frequency response characteristics of the tunnel environment. Audio routing allows the audio break-in to be broadcast in either or both of the tunnel bores as required.

A VOIP-via-fibre audio interface provides remote interfacing from the system equipment room to the traffic management control rooms. An I/O interface to Tyco’s comprehensive intelligent traffic system allows the remote control and monitoring of the rebroadcast system and its alarms via TCP/IP and a GUI interface at each control room.

To create the cellular mobile phone rebroadcast system, several carriers installed BTS equipment near the tunnel. An RF-Over-Fibre head-end converts these services to a fibre backbone. This fibre is routed through underground conduits to the tunnel bores, where the fibre signals are converted back to RF and amplified, before being applied to a broadband, multi-antenna distribution system within each tunnel bore. Both the AM/FM/VHF/UHF and cellular rebroadcast systems have the capability for future expansion built in.

**Project Management**

RFI believes in flexible, responsive and transparent relationships with clients. So during this project, RFI’s project manager attended all of Tyco’s project management meetings. This meant RFI was able to answer any queries Tyco had, and troubleshoot any issues that arose, quickly and efficiently.

**THE RESULT**

“RFI has proven extremely easy to work with, with a thorough understanding of project management practices and standards applied to a project of this scale,” said Tyco Traffic & Transportation’s Sales and Marketing Manager, Mr Ramon Valenzuela.

“They have provided Tyco with a rebroadcast system that has met the customer’s operational requirements, whilst also providing a TCP-IP based interface that allowed Tyco to incorporate the rebroadcast system into its OMCS/PMCS applications.

“RFI performed well within the often challenging multi-disciplined environment that exists in a major project, and has delivered on-time and on-budget – assisting Tyco to deliver another successful project to its customers.”
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