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1. Preface

1.1. Conventions

Our guides use several conventions to highlight certain words and phrases and draw attention to specific pieces of information.

1.1.1. Notes & Warnings

We use the following visual styles to draw attention to information that might otherwise be overlooked:

- **Notes**
  - Notes are tips, shortcuts or alternative approaches to the task at hand. Ignoring a note should have no negative consequences, but you might miss out on a trick that makes your life easier.

- **Important boxes**
  - Important boxes detail things that are easily missed: configuration changes that only apply to the current session, or services that need restarting before an update will apply. Ignoring the information will not cause data loss, but may cause irritation and frustration.

- **Warnings**
  - Warnings should not be ignored. Ignoring warnings will most likely cause data loss.

1.2. We Need Feedback

If you find a typographical error in this guide, or if you have thought of a way to make this guide better, we would love to hear from you.


If you have a suggestion for improving the guide, then try to be as specific as possible when describing your suggestion. Otherwise, if you have found an error, please include the section number and some of the surrounding text so we can find it easily.
2. Introduction

2.1. About This Guide

This is a generic deployment guide for Total Recall VR - a professional audio logging and call recording system.

The guide is intended for IT and communication solution designers and pre-sales engineers. It helps decisions on how to best deploy and integrate Total Recall VR with business IT and telephony environments.

2.2. What is Total Recall VR?

Total Recall VR is a professional audio logging and call recording system which is self-contained, fully featured and cost-effective. Enterprises and governments worldwide use it to create electronic records of many forms of audio communication including telephone, 2-way radio, broadcast radio, public address, room microphones and much more.

Total Recall VR is the ideal solution for:

- Recording business telephone conversations;
- Recording agent calls in contact centres;
- Logging emergency response communication;
- Logging business operations communication;
- Logging radio broadcasts;
- Logging public announcements;
- Creating audio records of meetings, legal proceedings, public enquiries and similar events; and
- Creating compliance records to meet duty of care and legal requirements.

Total Recall VR captures all audio in digital format and stores it in a proprietary, secure and tamper proof file format in its on-board hard drive storage. The file format preserves the originality of the audio that it stores and has a number of built-in mechanisms that aid quick and reliable detection of tampering. However, for ease of access, Total Recall

[Image of Total Recall VR]

Professional Audio Logging and Call Recording Systems
VR client applications can generate copies of recordings in a number of popular and everyday formats such as Microsoft’s Wave (.wav) and MPEG Layer-3 (.mp3).

Storing audio by itself does not help when looking for one recording in a store that can hold hundreds of thousands of recordings. That is why, in addition to audio, Total Recall VR captures and then stores information related to each recording and audio source in its database such as start time, end time and duration of recordings, calling and called numbers on telephone calls, DTMF digits during calls, user configurable notes and much more. This information is the backbone of a powerful search capability which can pinpoint a single recording in a set of hundreds of thousands of recordings which reside either on the on-board hard drives of a Total Recall VR or in one of many types of off-system archives of recordings.

In addition to the audio recorder and the hard drive storage, each Total Recall VR system comes with a built-in media player with comprehensive player controls (start, stop, fast-forward, rewind …). The player can play audio stored in files directly on the system or stream audio to a remote client application which then outputs the sound to the PC speakers of the PC that it runs on.

While audio recording, storage and re-play are the main functions of Total Recall VR, every Total Recall VR offers many more advanced, professional-grade features. For example:

- Ability to capture audio from different types of audio sources (analogue, VoIP, RoIP, AoIP and ISDN), at the same time – hybrid recording.
- Live and real-time monitoring (listening) of recordings in progress on the system itself or on a remote PC with the aid of a PC client application.
- Feature-rich archiver which can create searchable archives of recordings on CD, DVD or BD discs, USB keys and network drives, either automatically or on-demand.
- Automated self-cleaning mechanism that removes obsolete recordings automatically and on regular intervals to keep the system operating endlessly.
- Automated transcoder which compresses audio to free space on the on-board hard drives.
- SNMP agent capable of generating SNMP alarms (traps).
- SMDR integration for a number of popular PBXes.
- Fully internationalised user interface; all menus and software available in multiple languages.
- Role based access control.
- On-board LCD display and control keypad on selected models.
- A number of PC client applications with unrestricted use license.

When audio records are critical to your operations, Total Recall VR delivers. It is professional, reliable and fully self-contained solution for audio logging and call recording that comes at an affordable price.
The Total Recall VR Overview [1] guide contains a comprehensive description and overview of Total Recall VR.
3. **Safety Information**

Always follow basic safety precautions when deploying and using Total Recall VR to reduce the risk of injury from electrical shock and fire.

![WARNING: Potential shock hazard. Total Recall VR must be installed by qualified person.]

Observer the following:

1. Read and understand all instructions in all Total Recall VR guides.
2. Observe all warnings and instructions marked on the product.
3. Use only grounded electrical outlet when connecting Total Recall VR to a power source. If you are unsure the outlet is grounded, then have a qualified electrician check it.
4. First connect Total Recall VR to grounded outlet, and only then connect the appropriate interface lines.
5. Do not touch the contacts on the ends of any cables used with Total Recall VR. If any cable becomes damaged, then have it replaced immediately.
6. Shut down and unplug Total Recall VR from telephone jacks, and then from power outlets, prior to moving or cleaning.
7. Do not open Total Recall VR. There are no user serviceable parts inside Total Recall VR. Refer all servicing to qualified personnel.
4. **Recording Channels**

Successful deployment of a Total Recall VR starts with the understanding of the different types of recording channels that are available on Total Recall VR.

Total Recall VR has three different types of audio recording channels:

1. Analogue recording channels, which are capable of capturing audio from different analogue sources and analogue telephone lines.
2. VoIP recording channels, which are capable of detecting, capturing and then processing SIP, H.323 and RTP packets on IP networks.
3. ISDN recording channels, which are capable of capturing and processing signalling and audio on ISDN PRI telephone links.

In summary the specification of each type of recording channel is:

**4.1. Analogue Recording Channels**

Total Recall VR uses a purpose built channel card to capture audio from different types of analogue sources and analogue telephone lines.

**Recording trigger:**

- **Off** - 6 off-hook voltage levels: 30V, 25V, 20V, 15V, 10V and 5V.
  
  The off-hook trigger is a DC voltage change trigger. Typical on-hook voltage is above 42V and off-hook is below 15V. Analogue recording channels start recording when they detect voltage that is lower than the one set by the Off-Hook level and stop recording when they detect voltage that is higher than the one set by the Off-Hook level.

- **VOX** - 6 signal levels: -20dBm (77.5mV), -24dBm (48.9mV), -28dBm (30.8mV), -32dBm (19.5mV), -36dBm (12.3mV) and -40dBm (7.75mV).
  
  The VOX trigger is a signal level trigger. Analogue recording channels start recording when they detect signal above the level set by the VOX level and stop recording when they detect signal below the VOX level, but after a user configurable grace period of seconds.

- **Manual** – manual on/off recording control.
  
  The manual trigger allows third party applications to control recording over the Total Recall VR Java™ RMI API.

- **Off** – recording trigger disabled, no recording possible on channel.
  
  Recommended setting for all analogue channels that are NOT connected to an analogue audio source or an analogue telephone line. As an alternative, use this setting to temporarily or permanently disable recording on the channel.

**Specification:**

- RJ11C/RJ12/RJ14 (6P6C) connector – 2 channels per connector.
• Interface based on the CPC5710N chip, PC357N photo-coupler and the P2769 pick-off transformer providing high-impedance input and high (>40dB) common mode rejection ratio.

• Caller ID detection: FSKR and DTMF.

• Digit detection: DTMF. Channel (on, off) selectable.

• Ring detection.

• Automatic gain control.

• Encoding method: HQVQ, 8000Hz, 7.9Kbps, mono.

• Beep tone: 1.4KHz, channel and level (off, -30dBm, -24dBm, -18dBm) selectable.

Approvals:

• AS/NZS 60950.1:2003 INCL AMDT 1 Safety of information technology equipment

• IEC 60950-1 Information technology equipment – Safety

• EN 60950-1 Information technology equipment – Safety

• AS/ACIF S002:2005 Analogue interworking and non-interference requirements for Customer Equipment for connection to the Public Switched Telephone Network

• TBR 21 Terminal Equipment (TE); Attachment requirements for pan-European approval for connection to the analogue Public Switched Telephone Networks (PSTNs) of TE (excluding TE supporting the voice telephony service) in which network addressing, if provided, is by means of Dual Tone Multi Frequency (DTMF) signalling

• PTC 200:2006 Requirements for Connection of Customer Equipment to analogue Lines

• ANSI/TIA-968-A:2007 Technical Requirements for Connection of Terminal Equipment to the Telephone Network

• TIA-1096-A Connector Requirements for Connection of Terminal Equipment to the Telephone Network

4.2. VoIP Recording Channels

Total Recall VR uses a software based VoIP packet collector capable of detecting and collecting SIP, RTP and H.323 packets on IP networks. The packet collector uses one of the system LAN interfaces to detect and collect such packets.

This interface does not interact with the packets on the network in any way. It does not add, remove or modify packets. It simply detects and takes a copy of each packet.
Recording trigger:

- SIP session (call).
- H.323 call.
- Unicast RTP stream.
- Multicast RTP stream.

Specification:

- RJ45 (8P8C) connector.
- SIP over UDP (RFC3261, RFC2976, RFC2833).
- SDP (RFC3264).
- RTP (RFC 3550).
- Encoding method: G.711 (A or μ-law), 8000Hz, 64Kbps, mono.

To achieve best results with this interface observe the following:

1. Configure end-points and the PBX to use the G.711 (A or μ-law) codec during calls.
2. Disable silence suppression.
3. If SDP messages do not specify the ‘ptime’ parameter, then make sure each RTP packet carries exactly 20ms of audio (or 160 audio signal samples).
4. Make sure all endpoints and the PBX use the same ‘ptime’.
5. Do not use SIP encryption.
6. Do not use RTP encryption.

4.3. **ISDN Recording Channels**

Total Recall VR uses a purpose built, high-impedance, ISDN PRI link (E1 or T1) tapping card to capture signalling and audio on ISDN PRI links.

This interface does not interact with the calls and audio on links in any way.

Recording trigger:

- Q.931 calls on the D channel.

Specification:

- RJ45 (8P8C) connectors.
- ISDN protocols: ITU-T Q.931, National ISDN 1 and 2, Nortel DMS 100, AT&T 4ESS, Lucent 5ESS, Euro ISDN.
- Encoding method: G.711 (A or μ-law), 8000Hz, 64Kbps, mono.
Approvals:

- AS/NZS 60950.1:2003 INCL AMDT 1 Safety of information technology equipment
- IEC 60950-1 Information technology equipment – Safety
- AS/ACIF S016:2001 Requirements for Customer Equipment for connection to hierarchical digital interfaces
- TIA-968-A Technical Requirements for Connection of Terminal Equipment to the Telephone Network
- TIA-1096-A Connector Requirements for Connection of Terminal Equipment to the Telephone Network
5. Deployment Concepts

An understanding of a number of concepts related to deploying audio and/or call recording solutions is a prerequisite for successful deployment of a Total Recall VR in any environment.

5.1. Passive Call Recording

Passive call recording equipment is completely transparent to existing telephone systems and the way they are used. The call recorder is a separate device to the telephone system and connects to telephone lines via what is known as a “high-impedance tap” in order to capture call information and audio. There is no need to modify existing telephone system equipment in any way.

Total Recall VR is a passive audio and call recording system.

Passive call recording equipment does not interact with calls in any way. As a matter of fact, the users of the telephone system will not even know that it exists. With most passive recording equipment it is possible to control recording (start, stop, pause …) during calls by entering a pre-defined sequence of digits on the telephone key-pad, or by deploying a separate application on desktops.

5.2. Active Call Recording

Active call recording equipment is never transparent to existing telephone systems. However, just like passive call recording equipment, it can be completely transparent to the way users use the telephone system.

Total Recall VR does NOT support active call recording.

Unlike passive call recording equipment, the telephone system may have to be modified or upgraded to support what is known as Computer Telephony Integration (CTI). In addition to the CTI function, the telephone system may need additional telephone lines which will be used to connect the call recording equipment to the telephone system.

Active call recording equipment needs the CTI function and the telephone lines between the telephone system and itself in order to capture call information and conversations.

Active call recording equipment always interacts with calls. However, this interaction can be transparent to the way users make calls as it occurs in the background between the telephone system and the recorder. As with passive call recording, with most active call recording equipment it is possible to control recording (start, stop, pause …) during
calls by entering a pre-defined sequence of digits on the telephone key-pad, or by deploying a separate application on desktops.

On the other hand, the interaction can be fully non-transparent. In this case, one of the call participants needs to “invite” or “add” the call recorder to the call. This is usually done by pre-programming a button on handsets which (in the background) conferences the recording equipment with an active call.

Note that in all cases, the call recording equipment is an active participant in calls. This has its advantages, for example the recording equipment can play announcements during conversations. This is not possible with passive recording equipment.

5.3. Extension Side Recording

Extension side recording is a method of recording telephone calls by tapping the lines between the PBX and the desk phones within the enterprise.

The subsequent figure shows an example of extension side recording where a Total Recall VR taps the telephone lines between the PBX and the desk phones in order to capture call information and audio.

![Figure 1: Extension Side Recording](image)

Total Recall VR can easily determine extension numbers from the call information that it detects when used to record calls on the extension side. Both the PBX and the Total Recall VR will work independently of each other and do not need to exchange additional information about calls.

5.4. Trunk Side Recording

Trunk side recording is a method of recording telephone calls by tapping the lines between the Central Office (CO) and the PBX.
The subsequent figure shows an example of trunk side recording where a Total Recall VR taps the telephone lines between the CO and the PBX in order to capture call information and conversations.

![Figure 2: Trunk Side Recording](image)

Total Recall VR is not able to determine extension numbers from the call information that it detects when used to record calls on the trunk side without receiving additional information from the PBX (see section 5.5 SMDR Integration).

Extension numbers do not appear in the call information on the trunk side of the call. The telephone network uses Full National Numbers (FNN) in the call information instead.

However, additional information from the PBX may not be required if the enterprise is using DID numbers (see 19 Direct Inward Dial Numbers). Total Recall VR has an Extension Mapping configuration which can be used to map DID numbers to extension numbers, thus avoiding the need for additional information from the PBX.

5.5. SMDR Integration

SMDR integration is a method of receiving additional information, in the form of Station Management Detail Records (SMDRs), from a PBX about each call that the PBX handles.
SMDRs are generally used for call accounting purposes, however they contain information, in particular extension numbers, which are useful to call recording systems such as Total Recall VR.

One of the difficulties when using any passive call recording system in Trunk Side Recording scenarios (see section 5.4) is determining extension numbers for recorded calls.

Total Recall VR solves this problem in two different ways which can be used independently or in combination:

1. It can accept Station Management Detail Records (SMDRs) from the PBX, extract extension numbers from the SMDRs and then assign them to recorded calls.

2. It provides powerful Extension Mapping configuration which can be used to convert DID numbers (see section 5.6 Direct Inward Dial Numbers) to extension numbers.

Total Recall VR can accept SMDRs from a PBX on its LAN interfaces using the TCP or UDP protocol as shown on the subsequent figure.

![Figure 3: SMDR Integration](image)

Some PBXes have a serial interface instead of an Ethernet interface for SMDR integration. If this is the case, then it is mandatory to use a Serial Device Server (which acts as a serial to IP protocol converter).

Most PBXes can send SMDRs to only one external device. If this is the case, and if SMDRs are already being sent to a call accounting application, then it is mandatory to use the Prolancer IP Packet Multicaster to send copies of the SMDRs to multiple devices as shown on the subsequent figure.
Figure 4: SMDR Integration with IP Packet Multicaster

At this stage Total Recall VR can accept and process SMDRs from the following PBXes:

- Avaya IP Office v4.2+
- Panasonic KX-TDA100 and KX-TDA200
- Samsung iDCS-500
- Siemens HiPath 3000/5000
- Asterisk

5.6. **Direct Inward Dial Numbers**

Direct Inward Dial (DID) numbers is a service provided by telephone companies that allows enterprises to have numerous individual Full National Numbers (FNNs), typically one per desk phone.

If an enterprise has this service, then the PBX can be configured to route calls to FNNs directly to extensions associated with desk phones.

One of the difficulties when using any passive call recording system in Trunk Side Recording scenarios (see section 5.4) is determining extension numbers for recorded calls.

Total Recall VR solves this problem in two different ways which can be used independently or in combination:

1. It can accept Station Management Detail Records (SMDRs) from the PBX, extract extension numbers from the SMDRs (see section 5.5 SMDR Integration) and then assign them to recorded calls.
2. It provides powerful Extension Mapping configuration which can be used to convert DID numbers to extension numbers. Total Recall VR can automatically convert DID numbers to extension numbers by using information in its Extension Mapping configuration. The Extension Mapping configuration captures the mapping between DID numbers and extension numbers. A DID service in combination with the Total Recall VR Extension Mapping configuration eliminates the need for SMDR integration (see section 5.5) between the PBX and Total Recall VR. In most cases this makes the whole deployment more affordable as most PBXes require additional licenses for SMDR generation and IP network connectivity.

5.7. Total Recall VR Extensions
Total Recall VR Extensions are a Total Recall VR concept and should not be confused with PBX extension numbers which are used for desk phones (or mobile devices) within an enterprise.

Total Recall VR Extensions are one of the three different identifiers that can be assigned to the source and the destination of recordings, irrespective of whether the recordings are of a telephone call or another audio source (such as radio program for example).

The other two identifiers are Total Recall VR Raw and Total Recall VR Mapped Numbers which do not have the same effect as Total Recall VR Extensions to the availability of various features.

As identifiers, Total Recall VR Extensions are fundamental to most Total Recall VR features and if not present for a recording, then most features will not work at all for that recording.

For example, it will not be possible to find recordings by using the ‘Extension’ search criteria.

In addition, most of the Total Recall VR client applications will work with reduced functionality (or not at all in the case of the RoD Client application) without Total Recall VR Extensions.

Total Recall VR can classify calling and called numbers (or PBX extensions) as Total Recall VR Extensions when recording calls. As a matter of fact in most deployments PBX extensions map directly to Total Recall VR Extensions.

However, depending on Total Recall VR configuration, Total Recall VR Extensions can be any free text identifiers. For example, Total Recall VR Extension “Tanya’s Desk Phone” can represent actual PBX extension 100, while “Tanya’s Softphone” can represent (the human form of) PBX extension 200 (which incidentally the PBX may know as “sip:ext200@myenterprise.com”).
Total Recall VR Extensions may (and should) be used on deployments where Total Recall VR is used to record audio sources other than telephone calls. For example Total Recall VR Extensions “2Day FM” can be assigned to recordings created on an analogue recording channel which is used to log the radio program from a radio station called 2Day FM.

Total Recall VR configuration determines Total Recall VR Extensions for recordings. Here is how Total Recall VR uses its configuration to classify identifiers as Total Recall VR Extensions:

1. When recording calls, Total Recall VR extracts the calling and called numbers from call signalling.

   When recording RTP streams, Total Recall VR starts with the <IP address:Tx port> combination as a starting point for the source of the audio identifier and the <IP address:Rx port> combination as a starting point for the destination of the audio identifier.

   When recording other audio sources on analogue recording channels Total Recall VR uses the “Extension” value, which appears in the configuration for each analogue recording channel, as a starting point (as a suggestion of what the extension should be).

   All of the above identifiers are known as Total Recall VR Raw identifiers for the source and destination of recordings.

2. Total Recall VR then converts the Raw identifiers to Total Recall VR Mapped identifiers by applying identifier conversion rules that are present in the Signalling Mapping configuration to each of the Raw identifiers.

   The mapping rules are regular expressions which specify how to convert a Raw identifier to a Mapped identifier. For example, a mapping rule can convert the Raw identifier “sip:ext200@myenterprise.com” to Mapped identifier “Extension 200”

3. Finally, Total Recall VR attempts to match Mapped identifiers to matching rules that are present in the Internal Dial Plan configuration and if, and only if, it finds a rule that matches a Mapped identifier, then it classifies that identifier as a Total Recall VR Extension.

   Continuing from the previous example, if the Internal Dial Plan configuration has an entry that matches the Mapped identifier “Extension 200”, then, and only then, the identifier “Extension 200” will be classified as a Total Recall VR Extension.

5.8. **Total Recall VR Recording Policies**

Total Recall VR recording policies are a Total Recall VR configuration which controls the method of recording which can be:

- Record by default - Total Recall VR will automatically record all audio sources and telephone calls and keep recordings unless instructed otherwise during recording.
- Don’t record by default - Total Recall VR will automatically record all audio sources and telephone calls, but at the end of the recording it automatically discards recordings unless instructed otherwise during recording.

- Record partial calls – Total Recall VR will record only parts of all audio sources and telephone calls, as instructed during recording, and keep all parts concatenated in a single recording.

In addition to the method of recording, policies specify whether real-time monitoring is allowed or not while recording is in progress.

Policies can be one of two types:

- Global – a single system wide policy which applies to recordings from all audio sources and telephone calls on all recording channels.

- Extension – apply only to recordings from audio sources and telephone calls which have been assigned Total Recall VR Extension identifiers. These policies have precedence over the global policy.

Total Recall VR Recording Policies depend on Total Recall VR Extension identifiers. See section 5.3 Extension Side Recording for more information.

Recording policies are useful in a number of ways. For example, policies can be used to:

1. Selectively record (or not) telephone calls to specific telephones.

2. Decide in real-time, while recording, whether to keep a recording of important conversations.

3. Control access to real-time monitoring (listen in) during recording.

4. Allow remote client applications to control (start, stop …) recording.
6. **VoIP Deployment**

6.1. **Overview**

To record VoIP calls, Total Recall VR uses a software based VoIP packet collector which is capable of detecting, extracting and then processing SIP, RTP and H.323 packets when connected to an Ethernet link.

The packet collector does not interact with the packets on the Ethernet link in any way. It does not add, remove or modify packets. It simply detects and takes a copy of each packet for further processing.

Each Total Recall VR is equipped with a single VoIP packet collector capable of collecting VoIP packets from a single Ethernet link. A separate appliance, Total Recall VR Traffic Collector, enables Total Recall VR to collect packets from up to four Ethernet links.

6.2. **Interface**

Total Recall VR uses one of its two LAN interfaces to collect VoIP packets. The configuration of the VoIP packet collector specifies which LAN interface.

Traffic Collector uses up to four of its LAN interfaces to collect VoIP packets. It also uses one of the four LAN interfaces to send packets that it collects to one of up to four Total Recall VRs.

The Total Recall VR Classic Desktop and Classic Rack models have a single LAN interface: LAN 1. As a result, this is the interface that the packet collector will use, if activated. Note that the system will use the same interface for other network communication, for example communication with Remote Manager. This does not interfere with the operation of the packet collector.

All other models have two LAN interfaces: LAN 1 and LAN 2. It is recommended to configure the packet collector to use the LAN 2 interface on these models. This leaves the LAN 1 interface free to use for all other network communication, for example communication with Remote Manager.

6.3. **Supported Protocols**

Total Recall VR supports the following protocols and media codecs when recording VoIP telephone calls:

- SIP over UDP (RFC3261, RFC2976, RFC2833).
- SDP (RFC3264).
- RTP (RFC 3550).
- Encoding method: G.711 (A or μ-law), 8000Hz, 64Kbps, mono.

6.4. **Deployment Rules**

The following rules apply when deploying a Total Recall VR on a VoIP network for the purpose of recording VoIP telephone calls:
1. All end-points and the PBX must use the G.711 (A or μ-law) codec during calls.

2. Silence suppression must be disabled.

3. If SDP messages do not specify the ‘ptime’ parameter, then each RTP packet must carry exactly 20ms of audio (or 160 audio signal samples).

4. All endpoints and the PBX must use the same ‘ptime’.

5. SIP encryption must be disabled.

6. RTP encryption must be disabled.

### 6.5. VoIP Extensions

Section 5.7 Total Recall VR Extensions explained the importance of Total Recall VR Extensions to the operation of Total Recall VR.

Total Recall VR uses calling and called party identifiers as a starting point (or Raw identifiers) in the process of determining Total Recall VR Extensions for calls on VoIP networks.

For SIP networks it uses the values of the “From” and “To” header fields in the 200 response to the INVITE message. For example, Total Recall VR will use “sip:alice@atlanta.example.com” and “sip:bob@biloxi.example.com” as Raw identifiers if it receives the subsequent message:

1. SIP/2.0 200 OK
2. Via: SIP/2.0/TCP client.atlanta.example.com:5060;branch=z9hG4bK74bf9
3. From: Alice <sip:alice@atlanta.example.com>;tag=9fxced76s1
4. To: Bob <sip:bob@biloxi.example.com>;tag=8321234356
5. Call-ID: 3848276298220188511@atlanta.example.com
6. CSeq: 1 INVITE
7. Contact: <sip:bob@client.biloxi.example.com;transport=tcp>

For H.323 networks Total Recall VR first extracts the values in the ‘Calling Party Number’ and ‘Called Party Number’ information elements, if present, which appear in the SETUP message. Then it replaces these with the first alias that appear in the ‘sourceAddress’ and ‘destinationAddress’ elements, if present, which appear in the ‘User to User’ information element of the SETUP message.

When recording RTP streams that are set-up without SIP or H.323 signalling, then Total Recall VR uses the source IP address and port and the destination IP address and power as Raw identifiers. For example, if a RTP packet has source IP address 129.168.20.2 and UDP port 5000 and a destination IP address 192.168.30.9 and UDP port 7000, the Total Recall VR will use 192.168.20.2:5000 and 192.18.30.9:7000 as Raw identifiers.

The Raw identifiers then go through the mapping process explained in section 5.7 to determine first Mapped identifiers and then Extensions.

### 6.6. Packet Capture Methods

Total Recall VR must be deployed in such a way so that all SIP, H.323 and RTP packets for VoIP calls that should be recorded are presented to the LAN interface that is used by the VoIP packet collector.

There are a number of ways to achieve this.
6.6.1. Ethernet Hub

Ethernet hubs are devices which connect multiple Ethernet devices together and make them act as a single network segment.

Hubs have multiple ports. An important aspect of their operation is how they distribute copies of Ethernet frames to ports. Namely, a frame that is introduced on one port is simply replicated to all other ports. This makes them ideal for presenting VoIP packets to the Total Recall VR interface.

![Figure 5: Ethernet Hub as a Link Tapping Device](image)

Unfortunately, hubs are becoming harder and harder to purchase. As a result, hubs are being replaced by Ethernet link taps.

6.6.2. Aggregating Ethernet Tap

Aggregating Ethernet link taps are becoming very popular now that Ethernet hubs are almost extinct.

They are plug-and-play devices with 3 ports: 2 used to tap an Ethernet link while the remaining port acts as a monitoring port. The tap simply copies all packets that appear on the Ethernet link to the monitoring port when connected across an Ethernet link.

As a result, a Total Recall VR can receive all VoIP packets that appear on an Ethernet link if connected to the monitoring port of the tap.
One disadvantage of the Ethernet link taps is their price. They cost hundreds of dollars. However, most offer internal memory buffers for zero packet loss and zero copy delay when extracting packets from the Ethernet link and presenting them to the monitoring port.

6.6.3. SPAN Port

Switch Port Analyser (SPAN) port is a feature of most modern Ethernet switches. It was introduced to connect network monitoring and troubleshooting devices to Ethernet switches.

SPAN ports are used for port mirroring where the packets that appear on one switch port are blindly presented to another port (the SPAN port) bypassing the standard Ethernet switch logic which decides which ports to send packets to.

SPAN ports are also known as Roving Analysis Ports (RAP), or simply mirror ports.

SPAN ports are by far the cheapest way to connect a Total Recall VR to a VoIP network for the purpose of recording. Even if the current switch on-site does not support it, myriad other switches which cost few hundred dollars do.
But, as the saying goes “You get what you pay for”, beware of the limitations of SPAN ports when deploying Total Recall VR on networks where 20 or more simultaneous VoIP calls need to be recorded:

1. Spanning changes the timing of frame interaction. As a result recording time stamps may be as much as a second late.

2. The spanning function is not the primary switch function. So if replicating a frame becomes an issue, the switch will drop it in order to allocate resources to the switching function. Dropped frames do not appear on the Total Recall VR LAN interface that is connected to the SPAN port and as a result they will not be processed by Total Recall VR.

3. If the SPAN port gets overloaded, which can easily be done by mirroring a number of switch ports to a single SAPN port, then the switch will drop frames on the SPAN port. Dropped frames do not appear on the Total Recall VR LAN interface that is connected to the SPAN port and as a result they will not be processed by Total Recall VR.

4. SPAN ports drop all Ethernet frames that are corrupt and those that are below a specified minimum length.

Use an Aggregating Ethernet Link Tap (see section 6.6.2) in scenarios where 20 or more VoIP calls must be recorded at the same time for reliable VoIP call recording.

This is not a limitation of Total Recall VR. Rather, it is a limitation of the Ethernet switch.
6.6.4. Traffic Collector

All previous packet capture methods show how to collect packets on a single Ethernet link. However, in many cases it is necessary to collect packets from multiple links in order to record VoIP calls.

The Total Recall VR Traffic Collector is a high performance VoIP packet capture appliance which, when strategically placed on a network, can capture VoIP packets and send them to one or more Total Recall VRs.

It eliminates the need for multiple Total Recall VRs on complex VoIP networks.

![Traffic Collector as a Link Tapping Device](image)

**Figure 8: Traffic Collector as a Link Tapping Device**

Note that the Traffic Collector depends on one of the other link tapping technologies (see sections 6.6.1, 6.6.2 and 6.6.3) to present packets to its LAN interfaces (the prior diagram shows the use of SPAN ports for example). However, a single device can collect packets from four different Ethernet links on the enterprise network.

Traffic Collectors use a proprietary protocol over TCP, or UDP, to send collected packets to Total Recall VRs for processing.

6.7. VoIP Deployment

It is important to identify the correct Ethernet link, or links, on a VoIP network to tap in order to successfully deploy Total Recall VR to record VoIP calls.

In this section we look at a number of VoIP deployments and focus on the different routes that VoIP packets can take in a VoIP network.
The diagrams in this section use green and red lines to show logical flow of VoIP packets, rather than the actual physical route that packets take.

For example, in the subsequent diagram (Figure 9), the signalling and voice packets actually pass through the Ethernet switch, even though that is not what is explicitly shown.

6.7.1. Simple VoIP Networks

Simple VoIP network featuring a single PBX and a small number of VoIP telephones that are connected to a single Ethernet switch are very common.

In most cases the signalling (SIP or H.323) and media (RTP) packets will be present on the link between the PBX and the Ethernet switch. As a result, the same link is the obvious tapping point. This is shown on the subsequent diagram.

![Figure 9: All Packets Pass Through the PBX](image)

However, beware of PBXes that shuffle the media packet flow to free up media processing resources.

Media shuffling is a method of freeing resources, and in particular media processing resources, on the PBX when it is not necessary for media packets to pass through the PBX during calls. At call start all packets pass through the PBX as shown on the previous diagram. However, soon after the start of the call the PBX instructs the end-points involved in a call to send media packets directly to each other as shown on the subsequent diagram. In addition, the PBX can instruct the end-points to send media packets back to it at any time during the call.

In this case it is mandatory to tap all end-point links in order to record VoIP calls as shown on the subsequent diagram.
In contrast, in some cases only the signalling packets are present on the link between the PBX and the Ethernet switch. Media packets do not appear on this link at all as shown on the subsequent figure.

**Figure 10: Media Shuffling**

In this case it is mandatory to tap all end-point links, as shown on the previous diagram in order to record VoIP calls.

Previous diagrams show the packet flow for internal calls. Packets for external calls always pass through the link that connects a Media Gateway (which can be the PBX itself) to an Ethernet switch as shown on the subsequent figure.

**Figure 11: Only Signalling Packets Through the PBX**
As a result, a tap on the link that connects the Media Gateway to an Ethernet switch is sufficient to record all outgoing and incoming calls as shown on the previous diagram.

6.7.2. Peer-to-peer VoIP Networks

Peer-to-peer SIP (P2PSIP) networks do not use a PBX. Instead such networks leverage the distributed nature of P2P for distributed resource discovery, thus eliminating the need for a centralised PBX.


The signalling and media packets flow directly between end-points on such networks as shown on the subsequent diagram.
So it is mandatory to tap all end-point links as shown on the previous diagram in order to record VoIP calls on P2PSIP networks.

6.7.3. Hosted VoIP Networks

The number of hosted VoIP solutions increased dramatically over the past couple of years. New businesses are opting for hosted VoIP solution when it is time to replace legacy PBX equipment more often than ever. As a result Total Recall VR is, and will be, deployed in organisations with hosted VoIP solution more often.

An interesting aspect of hosted VoIP solutions is that all signalling and media packets always travel to the hosted VoIP service provider. This may appear unusual at first for internal calls (after all, why send all media packets to the VoIP service provider and back). However, it is necessary as it enables the service providers to offer a range of services which it cannot if the media packets do not travel through its equipment.

![Internal Call Packet Flow Diagram]

**Figure 14: Internal Call Packet Flow**

This ‘oddity’ is an advantage when it comes to recording VoIP calls. It is only necessary to tap the link that connects the VoIP service provider router (a.k.a. ITSP router) to the Ethernet switch inside the organisation in order to record all internal VoIP calls as shown on the previous diagram.

Avoid tapping the link between the ITSP router and the ITSP network. VoIP and other packets may be encrypted on this link as VoIP providers use Virtual Private Networks (VPNs) to connect customer sites to their network.

It is important to recognise that technologies (such as STUN and ICE) exist which enable end points to send media packets directly to each other on this type of networks as shown on the subsequent diagram.
If this is the case, then it is necessary to tap all end-point links to record VoIP calls as shown on the previous diagram.

All external calls will be recorded by tapping the link that connects the VoIP service provider router to the Ethernet switch inside the organisation as all VoIP packets for external calls are always sent to the VoIP service provider.

![Diagram of Direct Media Packet Flow](image)

**Figure 15: Direct Media Packet Flow**

The VoIP service provider acts a Media Gateway and provides connections to other telephone networks (in particular the PSTN).

**6.7.4. Complex VoIP Networks**

Complex VoIP networks use separate signalling and media servers. Some actually use multiple signalling and media servers, depending on the geographic locations of the enterprise.

In such networks it is best to tap all end-point links in order to record internal VoIP calls as shown on the following diagram.

![Diagram of External Call Packet Flow](image)

**Figure 16: External Call Packet Flow**
The same strategy works for external calls as shown on the following diagram.

\[\text{Figure 17: Internal Call Packet Flow}\]

\[\text{Figure 18: External Call Packet Flow}\]
7. ISDN Deployment

7.1. Overview

Total Recall VR uses a purpose built high-impedance tapping card to capture signalling and audio on ISDN PRI links.

Each card is capable of tapping a single E1 or T1 ISDN PRI link. Total Recall VR Max Rack supports four tapping cards which enable it to tap up to four ISDN PRI links. Total Recall VR Max Desktop supports up to two tapping cards which enable it to tap up to two ISDN PRI links.

Tapping cards do not interact with the signalling and audio on links that they tap in any way. In addition, tap cards do not degrade the signal on links in any way.

7.2. Interface

Tapping cards use two RJ45 (8P8C) connectors to connect to an ISDN PRI link. The connectors are labelled ISDN IN and ISDN OUT.

Pins 1, 2, 4 and 5 of each ISDN IN connector are connected directly to pins 1, 2, 4, and 5 of the corresponding ISDN OUT on the tap card. This provides a pass-through connection for the ISDN link when connected to a tapping card.

To connect an ISDN link to a tap card on a Total Recall VR:

1. Connect the power cable to the Total Recall VR. This ensures that the earthing protection is in place during the rest of the procedure.
2. Disconnect the ISDN cable from the PBX by unplugging the cable from the port that it connects to on the PBX.
3. Connect the cable to the ISDN IN port on a tap card.
4. Using a straight-through cable, connect the ISDN OUT port on the same tap card to the PBX port referred to in step 2.

7.3. Supported Protocols

Total Recall VR supports the following protocols and media codecs when recording ISDN telephone calls:

- ITU-T Q.931
- National ISDN 1 and 2, Nortel DMS 100, AT&T 4ESS, Lucent 5ESS, Euro ISDN.
- Encoding method: G.711 (A or μ-law), 8000Hz, 64Kbps, mono.

7.4. ISDN Extensions

Section 5.7 Total Recall VR Extensions explained the importance of Total Recall VR Extensions to the operation of Total Recall VR.
Total Recall VR uses calling and called party identifiers as a starting point (or Raw identifiers) in the process of determining Total Recall VR Extensions for calls on ISDN networks.

Total Recall VR extracts values in the ‘Calling Party Number’ and ‘Called Party Number’ information elements, if present, which appear in the SETUP message. In addition, Total Recall VR can deduce calling identifiers from INFORMATION messages in overlap dialling scenarios.

The Raw identifiers then go through the mapping process explained in section 5.7 to determine first Mapped identifiers and then Extensions.

As ISDN links are almost always trunk side connections (see section 5.4 Trunk Side Recording) it may be necessary to use SMDR integration (see section 5.5 SMDR Integration) to extract PBX extension numbers during calls and use these to create Total Recall VR Extensions.

### 7.5 Deployment Scenarios

#### 7.5.1 Trunk Side ISDN Link

In most cases organisations have a single (or multiple) ISDN PRI links on the trunk side of the PBX. If this is the case, then Total Recall VR simply connects to the ISDN links as shown on the following diagram.

![Figure 19: Trunk Side ISDN Link](image-url)

Note that in this case Total Recall VR will not be able to determine PBX extension numbers assigned to the desk phones unless:

1. It receives additional information from the PBX via SMDR integration (see section 5.5 SMDR Integration).
2. The organisation has a DID service (see section 5.6 Direct Inward Dial Numbers) and the following Total Recall VR configuration is in place: Signalling Mapping and Internal Dial Plan.
7.5.2. Multi-Site ISDN Links
Many organisations use ISDN links to connect different sites, where they have employees, to a central site, where they house the gateway to the PSTN. If this is the case, then Total Recall VR can connect to all ISDN links as shown on the following diagram.

![Diagram of Multi-Site ISDN Links]

Figure 20: Multi-Site ISDN Links

A single Total Recall VR can capture calls on up to 3 site-to-site ISDN links in addition to the ISDN link to the PSTN, or 4 links in total.

Note that in this case Total Recall VR will not be able to determine PBX extension numbers assigned to the desk phones for external calls unless:

1. It receives additional information from the PBX via SMDR integration (see section 5.5 SMDR Integration).

2. The organisation has a DID service (see section 5.6 Direct Inward Dial Numbers) and the following Total Recall VR configuration is in place: Signalling Mapping and Internal Dial Plan.

7.5.3. ISDN BRI Links
Total Recall VR cannot tap ISDN BRI (2B + D) links directly. It is necessary to use a digital-to-analogue converter (DAC) to convert the ISDN BRI link to two analogue links in order to record calls with Total Recall VR as shown on the following diagram.
Figure 21: ISDN BRI Links

Note that in this case it is not possible to use SMDR integration (see section 5.5 SMDR Integration) to determine extension information. Instead, use the “Extension” parameter of the analogue recording channel configuration to specify the extensions assigned to each of the ISDN phones.
8. **Analogue Deployment**

8.1. **Overview**

Total Recall VR uses a purpose built DSP card to capture audio from different types of analogue sources and analogue telephone lines.

DSP cards can have 4, 8 or 12 analogue recording channels. Different Total Recall VR models support different number of DSP cards as shown on the following table:

<table>
<thead>
<tr>
<th>Model</th>
<th>Max DSP Cards</th>
<th>Max Channels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classic Desktop</td>
<td>2</td>
<td>24</td>
</tr>
<tr>
<td>Classic Rack</td>
<td>5</td>
<td>60</td>
</tr>
<tr>
<td>Max Rack</td>
<td>5</td>
<td>60</td>
</tr>
</tbody>
</table>

Each channel can connect to a single analogue source which may be:

1. Analogue telephone line.
2. Output of a digital-to-analogue converter (DAC).
3. Any analogue source with 2-wire output.

Total Recall VR does not interact with the analogue signal on the lines connected to its analogue recording channels in any way, unless its configuration specifies to inject a recording ‘beep’ tone.

8.2. **Interface**

DSP cards use RJ11C/RJ12/RJ14 (6P6C) connectors. Each connector has two input lines, one line on pins 3 and 4 and another on pins 2 and 5.

![Analogue Recording Channel Wiring](image)

**Figure 22: Analogue Recording Channel Wiring**

Analogue recording channel numbering starts with the lines on the left-most connector where recording channel 1 and 2 map to line 1 and 2 on the first connector. The numbering then continues in lots of 2 with every adjacent connector.
8.3. **Supported Protocols**

Total Recall VR supports the following protocols and media codecs when recording telephone calls on analogue telephone lines:

- Caller ID detection: FSKR and DTMF.
- Digit detection: DTMF.
- Encoding method: HQVQ, 8000Hz, 7.9Kbps, mono.

8.4. **Analogue Extensions**

Section 5.7 Total Recall VR Extensions explained the importance of Total Recall VR Extensions to the operation of Total Recall VR.

Total Recall VR uses calling and called party identifiers as a starting point (or Raw identifiers) in the process of determining Total Recall VR Extensions for calls on analogue networks.

Total Recall VR detects FSKR and DTMF signals which deliver Caller ID to analogue telephones. In addition it detects DTMF digits as dialled on an analogue phone. It uses both as Raw identifiers.

The Raw identifiers then go through the mapping process explained in section 5.7 to determine first Mapped identifiers and finally Extensions.

If FSKR and DTMF signalling is not available on the analogue lines that are connected to analogue recording channels, then Total Recall VR will not be able to determine Raw identifiers for calls, hence it will not be able to establish Total Recall VR Extensions. If this is the case, and if Total Recall VR Extensions are required, then it is mandatory to:

1. set the “Extension” parameter, which appears in the configuration of every analogue recording channel; and
2. Disable DTMF detection for every analogue recording channel.

---

Due to differences in international standards for CLI and off-hook, Caller ID captured for an unanswered call is held for five seconds after the last ring.

As a result, if a new call arrives within the five second period, and the new call does not present a Caller ID, then the previous Call ID will be used as a calling Raw identifier for the new call.
8.5. Analogue Deployment

8.5.1. Analogue Trunk Lines
In most cases organisations have multiple analogue telephone lines on the trunk side of the PBX. If this is the case, then Total Recall VR simply connects to the analogue telephone lines as shown on the following diagram.

![Diagram of Analogue Trunk Lines](image)

*Figure 23: Trunk Side Analogue Telephone Lines*

Note that in this case Total Recall VR will not be able to determine PBX extension numbers assigned to the desk phones unless:

1. It receives additional information from the PBX via SMDR integration (see section 5.5 SMDR Integration).
2. The organisation has a DID service (see section 5.6 Direct Inward Dial Numbers) and the following Total Recall VR configuration is in place: Signalling Mapping and Internal Dial Plan.

In addition, Total Recall VR will not be able to record any internal calls, or calls between desk phones.

8.5.2. Analogue Extension Lines
Many organisations use analogue telephone devices as their desk phones. If this is the case, then Total Recall VR simply connects to the analogue telephone lines as shown on the following diagram.
Note that in this case Total Recall VR will record all internal calls (calls between the desk phones) as well as all external calls.

SMDR integration (see section 5.5 SMDR Integration) is not needed in this case as Total Recall VR is able to determine extension numbers from the signalling information on the telephone lines.

8.5.3. Digital Desk Telephones

Many organisations use digital desk telephones. Total Recall VR cannot record telephone conversations via direct connections to digital telephone lines. However, it is possible to use the analogue recording channels to record calls after the signal on the digital telephone lines undergoes a digital to analogue (D/A) conversion.

![Diagram showing connection of a digital to analogue converter (DAC) to a digital telephone line.]

Figure 24: Extension Side Analogue Telephone Lines

Total Recall VR does not provide D/A conversion. A third party DAC product is required for this function.

The following diagram shows how to connect a digital to analogue converter (DAC) to a digital telephone line so it can be recorded by Total Recall VR.
Note that the DACs may connect in series with the telephone line, as shown on the above diagram, or in parallel.

An alternative to DACs are the Total Recall VR Logger Patch accessories. Most digital telephones have analogue audio signal in the headpiece. If this is the case, then a Logger Patch can be used to connect the signal sent to the speaker (earpiece) and received from the microphone (mouthpiece) to a Total Recall VR analogue recording channel.

See section 9 Logger Patch Deployment for details on how to deploy Total Recall VR Logger Patches.
It is sometimes the case that there is a signal level difference between the speaker and microphone, and therefore, in a recorded conversation, one party may be heard more clearly than the other. (This is a limitation of recording via Logger Patches, and not a Total Recall VR recorder limitation).

**Warning**: Total Recall VR is not able to determine Call ID and DTMF information when using Logger Patches because this information is not presented to the handset.

It is mandatory to set the “Extension” parameter and disable DTMF detection in the configuration of every analogue recording channel to enable Total Recall VR to determine Total Recall VR Extensions.
9. **Logger Patch Deployment**

9.1. **Overview**

The Total Recall VR Logger Patch enables recording from digital telephone handsets where there is no-side tone or the level of the microphone is too low to trigger recording.

![Figure 27: Total Recall VR Logger Patch](image)

The Logger Patch requires a 12VDC power pack to power the amplifier which will give up to 30dB gain on the microphone and 10dB gain on the earpiece. This power pack is NOT supplied with the Logger Patch.

9.2. **Installation**

The Logger Patch is simply connected to the telephone handset curly cord and then wired to an analogue port on a Total Recall VR as shown on the subsequent figure.

![Figure 28: Digital Desk Phone with Logger Patch](image)

Some phone handsets have different microphone and earpiece outputs to the RJ11 (4P4C) plug. Normally the centre two wires on the handset jack are the earpiece circuit and the outer two wires are the microphone. If your telephone does not use standard connections, there is a splitter included in the pack to reverse the input connections to the Logger Patch.

There are two ways to determine which configuration your handset is:

1. Unplug the handset from the telephone and using a multimeter set to ‘ohms’ and the ear piece next to your ear, touch the meter probes first on the centre two connectors of the plug. If you hear a click in the earpiece when you make contact the handset is standard. If not, try to probe the outer two contacts. If nothing is heard on either you may not be making contact with the probes.
2. Connect the Logger Patch the standard way. If Total Recall VR only records one side of a call try the non-standard connection.

9.3. **Standard Handset Wiring**

Handsets with standard wiring use the centre two wires for the earpiece and the outer two wires for the microphone.

To install a Total Recall VR Logger Patch on a desk telephone with standard handset wiring:

1. Unplug the handset cord from your telephone and plug it into the Headset jacks on the Logger Patch.

2. Using the short cable which is supplied with the Logger Patch:
   a. Plug the end with a RJ11 (4P4C) connector into the handset jack on your telephone.
   b. Then, plug the end with a RJ12 (6P4C) into the Phone jack on the Logger Patch.

3. Your telephone should now function normally as you have simply connected a short extension into the handset cord.

4. Plug an AC adapter into the "Power (12vDC)" jack and AC power.

5. There are two small screwdriver adjustable controls on the Logger Patch. One adjusts the level of microphone audio output (up to 30db gain), and the other adjusts the earpiece audio (up to 10db gain). Adjust clockwise to decrease and anti-clockwise to increase the output level as needed.

![Figure 29: Logger Patch Wiring - Standard Headset](image-url)
9.4. **Non-Standard Handset Wiring**

Handsets with non-standard wiring use the centre two wires for the microphone and the outer two wires for the earpiece.

To install a Total Recall VR Logger Patch on a desk telephone with a non-standard handset wiring:

1. Unplug the handset cord from your telephone and plug it into the Headset jacks on the Logger Patch.
2. Using the supplied Splitter:
   a. Plug the short cable from the Splitter into the handset jack on your telephone.
   b. Plug the handset curly cord into the Headset socket of the Splitter.
3. Using the short cable which is supplied with the Logger Patch:
   a. Plug the end with a RJ11 (4P4C) connector into the Logger socket of the Splitter.
   b. Plug the end with a RJ12 (6P4C) into the Phone jack on the Logger Patch.
4. Your telephone should now function normally as you have simply connected a short extension into the handset cord.
5. Plug an AC adapter into the “Power (12vDC)” jack and AC power.
6. There are two small screwdriver adjustable controls on the Logger Patch. One adjusts the level of microphone audio output (up to 30db gain), and the other adjusts the earpiece audio (up to 10db gain). Adjust clockwise to decrease and anti-clockwise to increase the output level as needed.

![Figure 30: Logger Patch Wiring - Non-Standard Headset](image-url)
10. Radio Mixer Deployment

10.1. Overview

The Total Recall VR Radio Mixer is designed to mix the output from the transmit (Tx) and the receive (Rx) of a 2-way radio base station and produce a two-wire analogue output that is suitable for the Total Recall VR.

![Total Recall VR radio Mixer](image)

*Figure 31: Total Recall VR radio Mixer*

How these connections are achieved will depend on the brand of base station. Some brands and models can be programmed to give both of these outputs from an auxiliary plug on the rear of the base station. The outputs for the base station can be either balanced or unbalanced.

Both the Tx and the Rx inputs have gain control so they can equalise the input levels.

The Rx input should be a two-wire output from the speaker. If possible, it is preferable if this output is connected before the volume control of the base station. If it is not and the volume control is turned down, then the Rx will not be recorded.

The Tx input should be a two-wire output from the transmitter. This can be a parallel tap from the microphone.

The Radio Mixer requires a 9-15VDC @ 20mA, centre pin positive power pack to power it. This power pack is NOT supplied with the unit.

10.2. Installation

The Radio Mixer has four connectors:

1. **Recorder**: An RJ12 connector which provides output suitable to connect to an analogue channel of a Total Recall VR.
2. **Power**: DC power supply connector.
3. **Tx Input**: An RJ12 connector with signal/ground pins for the Tx output from radios.
4. **Rx Input**: An RJ12 connector with signal/ground pins for the Rx output from radios.

<table>
<thead>
<tr>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input impedance:</td>
</tr>
<tr>
<td>Output impedance:</td>
</tr>
<tr>
<td>Frequency response:</td>
</tr>
<tr>
<td>Gain (adjustable):</td>
</tr>
<tr>
<td>Power:</td>
</tr>
</tbody>
</table>
The following figure shows the pin assignment for each of the connectors.

![Radio Mixer Connectors and Pin Assignment](image)

**Figure 32: Radio Mixer Connectors and Pin Assignment**

To install the Radio Mixer simply connect the Tx and Rx outputs of the radio to the respective inputs on the Radio Mixer. Then connect the Recorder output of the Radio Mixer to an analogue recording channel on a Total Recall VR.

The following are examples of deploying the Radio Mixer with some radios.

### 10.2.1. Motorola TETRA MTM800

The Tx and Rx outputs are available from the accessory connector at the back of the transceiver. The following figure, which is reproduced here from the MTM800 installation manual, shows the location of the connector.

![Location of Accessory Connector - Rear Side](image)

Connections:

<table>
<thead>
<tr>
<th><strong>MTM800</strong></th>
<th><strong>Radio Mixer</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Accessory Connector</strong></td>
<td><strong>Tx Input</strong></td>
</tr>
<tr>
<td>5</td>
<td>1 or 2</td>
</tr>
<tr>
<td>11</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>3 or 4</td>
</tr>
</tbody>
</table>
10.2.2. Motorola PMR GM3xx
The Tx and Rx outputs are available from the accessory connector at the back of the transceiver. The following figure, which is reproduced here from the GM360 installation manual, shows the location of the connector.

Connections:

<table>
<thead>
<tr>
<th>GM3xx</th>
<th>Radio Mixer</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Accessory Connector</td>
<td>Tx Input</td>
<td>Rx Input</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>1 or 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
<td>1 or 2</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>3 or 4</td>
<td>3 or 4</td>
<td></td>
</tr>
</tbody>
</table>

10.2.3. Motorola DMR DM3xxx
The Tx and Rx outputs are available from the rear connector of the mobile radio unit.

Connections:

<table>
<thead>
<tr>
<th>DM3xxx</th>
<th>Radio Mixer</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Rear Connector</td>
<td>Tx Input</td>
<td>Rx Input</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>1 or 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td></td>
<td>1 or 2</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>3 or 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td></td>
<td>3 or 4</td>
<td></td>
</tr>
</tbody>
</table>
11. Remote Manager Interface Application Deployment

11.1. Overview

Total Recall VR provides a Java RMI based interface (a.k.a. Remote Manager Interface) that allows client applications, such as Total Recall VR Remote Manager, RoD Client and Supervisor Client, to manage and control it.

This interface depends on a TCP/IP network to connect clients and Total Recall VR systems. The network can be either an enterprise LAN or a dialup link.

In most cases the network will be an enterprise LAN.

Avoid using the dialup links. This feature is will be removed in near future.

11.2. Application Deployment

Due to the virtually infinite number of possible network configurations it is impossible to document installation solutions for all eventualities. However, the examples below should provide an idea of the principles behind deploying Total Recall VR and applications that use the Remote Manager Interface.

11.2.1. Static IP Addressing

In this example the application connects to a Total Recall VR using a static IP address that is assigned to one of the LAN interfaces of the Total Recall VR.

Configure Total Recall VR Remote Manager Interface to accept client connection on one of its IP addresses (for example 192.168.120.202, port 10010). Then, use the

![Figure 33: RMI Application using Static IP Address](image)
same IP address and port in the client application when connecting to Total Recall VR.

11.2.2. Hostname Addressing

In this example the application uses a hostname to connect to Total Recall VR. Obviously a working DNS must be available to the application.

![Diagram of RMI Application using Hostname]

**Figure 34: RMI Application using Hostname**

The necessary configuration for this example is:

1. Create an ‘A’ record in DNS that maps a hostname of your choice to an IP address that you plan to assign to Total Recall VR.

   For example, create the following DNS entry:

   ```
   192.168.130.202  A  trvr-tst-001.tsn.prolancer.com.au
   ```

2. Assign the IP address from step 1 to one of the LAN interfaces of Total Recall VR (192.168.130.202 from the example).

3. Configure the Total Recall VR Remote Manager Interface to accept client connection on the IP address (192.168.130.202) as well as the hostname (trvr-tst-011.tsn.prolancer.com.au) from step 1. In both cases the base port number (10010) will be the same.

   Note that the hostname used by the Remote Manager Interface can be different to the hostname assigned to Total Recall VR as a system on the network. However, the hostname must map to an IP address that is assigned to one of the LAN interfaces of Total Recall VR.
4. Configure the application to use the hostname (trvr-tst-011.tsn.prolancer.com.au) from step 1 and base port (10010) from step 3 to connect to Total Recall VR.

11.2.3. Firewall Traversal

In this example the application uses a hostname to connect to Total Recall VR through a firewall. Unlike previous examples, applications cannot use static IP addresses to connect to Total Recall VR through firewalls.

This scenario depends on configuration of two name (DNS) servers: one used by Total Recall VR and another by the application. It is very unlikely that both will use the same DNS. However, the DNS used by the application can be eliminated by static configuration in the ‘hosts’ file on the machine that runs the application.

The necessary configuration for this example is:

1. Create an ‘A’ record in the DNS used by Total Recall VR that maps a hostname of your choice to an IP address that you plan to assign to Total Recall VR.
   
   For example, create the following DNS entry:

2. Assign the IP address used from step 1 to one of the LAN interfaces of Total Recall VR (192.168.130.202 from the example).

3. Configure the Total Recall VR Remote Manager Interface to accept client connection on the IP address (192.168.130.202) as well as the hostname (trvr.prolancer.com.au) from step 1. In both cases the base port (10010) will be the same.

Note that the hostname used by the Remote Manager Interface can be different to the hostname assigned to Total Recall VR as a system on the network. However, the hostname must map to an IP address that is assigned to one of the LAN interfaces of Total Recall VR.

4. Configure the following port forwarding on the Internet router:

   a. External TCP ports 10010 and 10011 to the same TCP ports on the IP address assigned to Total Recall VR during step 2.

      This assumes that the Total Recall VR Remote Manager Interface configuration uses the default base port 10010. If you change the base port during step 3, then you must change the port forwarding rules accordingly. Always create port forwarding configuration for base port and base port + 1.

   b. Optionally, external port 22 to the same TCP ports on the IP address assigned to Total Recall VR during step 2.

      This allows for transfer of files from/to Total Recall VR using SCP (secure copy protocol). Note that this is the standard SSH port as well.

5. Create an ‘A’ record in the DNS used by the application that maps the SAME hostname used during step 1 to the public IP address (a.b.c.d) of the Internet router.

      For example, create the following DNS entry (replace a.b.c.d with an actual IP address):


6. Configure the application to use the hostname (trvr.prolancer.com.au) from step 5 and base port from step 3 (10010) to connect to Total Recall VR.

      In addition configure the Manager firewall to the external IP address (w.x.y.z) of the router that connects the PC that will run the application to the Internet.

      It is important to note that the same hostname (trvr.prolancer.com.au in the example) maps to different IP addresses in the two DNS. This is crucial for the correct operation of the connection between the client and Total Recall VR.

      The following screen capture shows an example configuration of a connection in the Remote Manager application.
Figure 36: Example Remote Manager Interface Connection Configuration

The screen capture was taken from a PC which uses a router to connect to Internet and this router has been assigned 20.120.1.100 as its public IP address (w.x.y.z).
12. Application Notes

The following application notes aim to explain, at high level, how to integrate Total Recall VR with equipment from other manufacturers.

12.1. Zetron DCS-5020

12.1.1. Overview

The DCS-5020 radio operator console is very popular with radio operators with smaller operations control rooms. It can control telephone lines as well as both digital and analogue radios from up to 16 operator consoles.

The following diagram shows a typical DCS-5020 solution:

![Diagram of Zetron DCS-5020 Solution]

Zetron DCS-5020 manuals explain that recording can be achieved by connecting a recorder with E1 interface to a DE1M module (see bottom of previous diagram). However, the manuals also show this note on recording via a DE1M module:

**Voice Logging Note**

E1 logging allows flexible assignment of any radio, telephone or console audio port to any of the thirty E1 time slots, and permits summing of transmit and receive audio associated with that port. E1 voice logging does not necessarily accurately reflect the exact audio present at a port — it does not include any locally generated selcall signaling, nor does it reproduce relative volume levels. For voice logging that accurately reflects the exact audio, use the analog recorder outputs of the BDRM and DCOAM modules.
Total Recall VR does NOT support recording via an E1 connection to a DE1M module as this does not accurately reflect exact audio. Instead, it is easy to connect Total Recall VR directly to BDRM, DEM and DSM modules.

12.1.2. Basic Dual Radio Module (BDRM) Recording
The BDRM provides the summed receive and transmit audio for each of the two channels on pins 4 and 5 of the LOCAL connector for the channel. The audio is available on pins 4 and 5 of the LOCAL connector regardless of whether the LOCAL or the RMT jack is used as interface to the radio.

Connect a Total Recall VR analogue channel to pins 4 and 5 of a LOCAL port to capture audio from a radio channel on the BDRM module.

12.1.3. Dual Telephone Set Module (DSM) Recording
This interface allows connection of telephones (or equipment that appear as telephone). It is a standard two wire telephone interface basically.

Connect a Total Recall VR analogue channel in parallel with the telephone capture audio from a channel on the DSM module.

12.1.4. Dual Telephone Exchange Module (DEM) Recording
This interface allows connection of standard analogue telephone subscriber (trunk) lines. It is a standard two wire telephone interface basically.

Connect a Total Recall VR analogue channel in parallel with the trunk line to capture audio from a channel on the DEM module.

12.2. Omnitrionics DX-Altus

12.2.1. Overview
The DX-Altus digital radio dispatch system is common with emergency services operators around the world. It is built on top of the Omnitrionics’ IPR (IP Radio) technology and can work with different radio technologies including DMR, P25, Tetra, PMR and SIP.

The following diagram shows a typical DX-Altus solution:
Total Recall VR supports recording of conversations in a DX-Altus system with analogue and VoIP recording channels as shown on the following figure:
12.2.2. TMU Recording
The DX-Altux server can be equipped with a number of modules including a Tape Monitoring Interface (TMU) with up to 8 analogue outputs.

Connect Total Recall VR analogue channels to TMU outputs to record radio conversations. Set the analogue recording channels to VoX recording trigger.

12.2.3. IPR Recording
A DX-Altus system can use a number of IPR-100 or IPR-400 RoIP gateways.

Total Recall VR VoIP recording channels support recording of RTP streams between IPR units. To record such streams configure an RTP Endpoint in Total Recall VR using the IP address and port used by an IPR gateway. In addition, configure the following payload types for the RTP Endpoint:

- Event Payload Type: unset
- Named Payload Type: 97
- Tone Payload Type: 98
13. **Glossary**

Our guides use certain terms and abbreviations.

### 13.1.1. Terms

#### Extensions

Extensions are a Total Recall VR concept that helps identify the source and the destination of recordings. Extensions can be numbers or any free format text. For example, calling and called numbers can be classified as extensions if they match an entry in the Internal Dial Plan.

#### Extension Mapping

Extension mapping is a process used by the Total Recall VR to convert raw identifies of sources and destinations of recordings to user friendly identifiers. For example, when recording VoIP calls the ‘From’ and ‘To’ identifiers may be rather cryptic, say ‘ext122@sip.myenterprise.com’. The extension mapping process can convert this identifier to ‘122’ or ‘Extension 122’.

#### Extension Side Recording

Extension Side Recording is used to specify that a Total Recall VR is used to record calls while connected to the office lines (extension lines) that connect desk phones to the enterprise PBX.

#### Internal Dial Plan

Internal Dial Plan is Total Recall VR configuration which helps it determine which extensions are internal to the enterprise.

#### Recording Channel

Total Recall VR uses recording channels to capture audio on analogue, VoIP or ISDN sources. The number of recording channels can be different to the number source channels. For example, a Total Recall VR can have 20 ISDN channels while connected to an ISDN PRI link which has 30 B channels.

#### Remote Manager

A powerful Java™ based client application for Total Recall VR systems. It installs on Windows™ PCs and can be used to securely configure and manage multiple Total Recall VR systems over a TCP/IP network. In addition, it can be used to monitor recordings in progress in real time as well as search for and then play past recordings.

#### RoD Client

A small Java™ based taskbar application for Total Recall VR systems. It installs on Windows™ PCs and allows users to control in real-time which calls are recorded. In addition, enables users to add notes to recordings of calls while calls are being recorded.

#### Supervisor Client

A small Java™ based client application for Total Recall VR systems. It installs on Windows™ PCs and allows users to manually control (start, stop, …) recording
on analogue channels. In addition, it can be used to monitor recordings in progress in real time as well as add notes to recordings in progress.

**Total Recall VR**

The system that is the subject of this manual.

**Trunk Side Recording**

Trunk Side Recording is used to specify that a Total Recall VR is used to record calls while connected to the trunk lines (exchange lines) that bring telephony services to the enterprise.

### 13.1.2. Abbreviations

![Most definitions courtesy of “Wikipedia, the free encyclopaedia”.

**CLI: Calling Line Identification**

A telephony intelligent network service that transmits the caller's telephone number and in some places the caller's name to the called party's telephone equipment during the ringing signal or when the call is being set up but before the call is answered.

**D/A: Digital to Analogue**

A digital-to-analogue converter (DAC or D-to-A) is a device for converting a digital (usually binary) code to an analogue signal (current, voltage or electric charge).

**DSP: Digital Signal Processor**

A specialized microprocessor designed specifically for digital signal processing, generally in real-time computing.

**DTMF: Dual-Tone Multi-Frequency**

Used for telephone signalling over the line in the voice-frequency band to the call switching centre. The version of DTMF used for telephone tone dialling is known by the trademarked term Touch-Tone, and is standardised by ITU-T Recommendation Q.23. Other multi-frequency systems are used for signalling internal to the telephone network.

**IP: Internet Protocol**

A data-oriented protocol used for communicating data across a packet-switched internetwork.
IP is a network layer protocol in the internet protocol suite and is encapsulated in a data link layer protocol (e.g., Ethernet). As a lower layer protocol, IP provides the service of communicable unique global addressing amongst computers.

**ISDN: Integrated Services Digital Network**

A circuit-switched telephone network system, designed to allow digital transmission of voice and data over ordinary telephone copper wires, resulting in better quality and higher speeds than that available with the PSTN system.

**LAN: Local Area Network**

A computer network covering a small geographic area, like a home, office, or group of buildings.

**MDF: Main Distribution Frame**

A signal distribution frame for connecting equipment (inside plant) to cables and subscriber carrier equipment (outside plant).

**PBX: Private Branch Exchange**

Also called Private Business eXchange, or PABX (Private Automatic Branch eXchange), a PBX is a telephone exchange that serves a particular business or office, as opposed to one a common carrier or telephone company operates for many businesses or for the general public.

**PSTN: Public Switched Telephone Network**

The network of the world's public circuit-switched telephone networks.

**RTP: Real-time Transport Protocol**

The Real-time Transport Protocol (or RTP) defines a standardized packet format for delivering audio and video over the Internet.

**SMDR: Station Message Detail Record**

SMDR is a record containing information about recent system usage, including the identities of sources (points of origin), the identities of destinations (endpoints), and the duration of each call.

**SIP: Session Initiation Protocol**

An application-layer control (signaling) protocol for creating, modifying, and terminating sessions with one or more participants. These sessions include Internet telephone calls, multimedia distribution, and multimedia conferences.

**TCP: Transmission Control Protocol**

One of the core protocols of the Internet protocol suite, often simply referred to as TCP/IP. Using TCP, applications on networked hosts can create connections to one another, over which they can exchange streams of data using Stream Sockets.

**TRVR: Total Recall VR**

A professional voice logging and call recording system.
UDP: User Datagram Protocol

UDP is one of the core protocols of the Internet protocol suite. Using UDP, programs on networked computers can send short messages sometimes known as datagrams (using Datagram Sockets) to one another. UDP is sometimes called the Universal Datagram Protocol.

UPS: Uninterruptable Power Supply

A device which maintains a continuous supply of electric power to connected equipment by supplying power from a separate source when utility power is not available.

VLAN: Virtual LAN

A method of creating independent logical networks within a physical network.

VoIP: Voice over Internet Protocol

Also called IP Telephony, Internet telephony, Broadband telephony, Broadband Phone and Voice over Broadband, VoIP is the routing of voice conversations over the Internet or through any other IP-based network.

VOX: Voice Operated Switch

A switch that operates when sound over a certain threshold is detected.

[End of Document]