



# Application Notes & Test Requirements for T.38 Fax Interoperability

*A White Paper*

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Issue 1.1

**Abstract:**

This document is designed to aid in the basic knowledge of facsimile protocols, functions and phases so that Fax over Internet Protocol (FoIP) can be understood for interoperability testing and troubleshooting.

This document is not a substitute for the ITU-T specifications of T.30 (Analog fax) or T.38 (FoIP). It is meant to enable one to have 90% of the information needed for interoperability testing of fax machines and media gateways between vendors.

This document will be updated on a regular basis as we discover more information about our partner vendor products and new fax equipment that enters the marketplace.

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<b>1</b>	<b>Reference Documentation</b>	

The following ITU-T Recommendations and other references provide a complete background on the aspects of communication network setup and transmission of facsimile information.

- **ITU-T Recommendation H.323** (2003), Packet-based Multimedia Communications Systems.
- **ITU-T Recommendation T.4** (2003), Standardization of Group 3 Facsimile Terminals for Document Transmission.
- **ITU-T Recommendation T.30** (2005), Procedures for Document Facsimile Transmission in the General Switched Telephone Network

- **ITU-T Recommendation T.38** (2010), Procedures for Real-Time Group 3 Facsimile Communication over IP Network.
- **ITU-T Recommendation V.8** (2000), Procedures for Starting Sessions of Data Transmission over the Public Switched Telephone Network.
- **ITU-T Recommendation V.17** (1991), A 2-wire Modem for Facsimile Applications with Rates up to 14 400 bit/s.
- **ITU-T Recommendation V.21** (1988), 300 bits per Second Duplex Modem Standardized for Use in the General Switched Telephone Network
- **ITU-T Recommendation V.25** (Automatic Answering Equipment and/or Parallel Automatic Calling Equipment on the General Switched Telephone Network Including Procedures for Disabling of Echo Control Devices for both Manually and Automatically Established Calls.
- **ITU-T Recommendation V.32** (1993), A Family of 2-wire, Duplex Modems Operating at Data Signalling Rates of up to 9600 bit/s for Use on the General Switched Telephone Network and on Leased Telephone-Type Circuits.
- **ITU-T Recommendation V.32bis** (1991), A Duplex Modem Operating at Data Signalling Rates of up to 14 400 bit/s for Use on the General Switched Telephone Network and on Leased Point-to-Point 2-Wire Telephone-Type Circuits.
- **ITU-T Recommendation V.34** (1998), A Modem Operating at Data Signalling Rates of up to 33 600 bit/s for Use on the General Switched Telephone Network and on Leased Point-to-Point 2-Wire Telephone-Type Circuits.
- **IETF RFC 2327** (1998,) SDP: Session Description Protocol.
- **IETF RFC 2543** (1999), SIP: Session Initiation Protocol
- **IETF RFC 2733** (2000), An RTP Payload Format for Generic Forward Error Correction.
- **IETF RFC 2833** (2000), RTP Payload for DTMF Digits, Telephony Tones, and Telephony.

## 2 Document Change History

EVENT	DOCUMENT DATE	CHANGE DESCRIPTION
Draft 0.1 issued for 1 <sup>st</sup> review by the SIL team	4 Mar 2009	
Draft 0.2	9 Mar 2009	<p>Added sections for Reference, Change-History, Glossary.</p> <p>Reformatted a Test Requirements section.</p> <p>Provided appendixes A thru D to show specific product administrative settings.</p> <p>Provided Appendix Z to show a multipage reference test file.</p>
Draft 1.0	17 April 2009	<p>Updated Appendix D to provide administrative settings for the AudioCodes Mediant trunk gateway family of products.</p> <p>Update recommended firmware vintage for MultiTech adaptors.</p> <p>Provided Appendix E and F to show how some leading fax-server vendor products are administered.</p>
Draft 1.1	13 May 2013	Added section 5.1 to describe 'T.38 Error

		Correction Mode (ECM)'.  Added section 5.2 to describe 'T.38 with Fallback to G.711 Pass-Thru' for interoperation with the Verizon network.
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**Table 1: Document Change History**

### 3 Terminology and Acronyms

TERM	MEANING
ANS	ANS Tone. This is a 2100 Hz signal. The electrical characteristics of this signal are defined by ITU Recommendation V.25.
ANSam	Amplitude-modulated ANSWer tone. This tone consists of a sine wave signal at 2100 Hz with phase reversals at an interface of 450 +/- 25 ms, amplitude-modulated by a sine wave at 15 Hz. When network echo canceller disabling is not required, the phase reversals shall not be imparted to the ANSam signal. The electrical characteristics of this signal are defined by ITU Recommendation V.8.
CED	This is the answer response indicated by the presence of the ANS tone.
CFR	Confirmation to Receive
CNG	Calling Tone
CSI	Called Subscriber Identification. This optional signal may be used to provide the specific identity of the called subscriber by its international telephone number.
CTC	Continue to Correct. This command indicates that the transmitting station shall continue to correct the previous message.
CTR	Response for Continue to Correct. This signal is the digital response to the CTC signal, so that the receiving terminal can accept the contents included in the CTC signal.
DCS	Digital Command Signal. The digital set-up command responding to the standard capabilities identified by the DIS signal which the receiver has sent.
DIS	Digital Identification Signal. Characterizes the standard ITU capabilities of the called apparatus.
EOL	End-of-line. This code word follows each line of data. It is a unique code word that can never be bound within a valid line of data. The end of a document transmission is indicated by sending six consecutive EOLs.
EOM	End of Message
EOP	End of Page
FCF	Facsimile Control Field. This is the first 8 or 16 bits of the HDLC

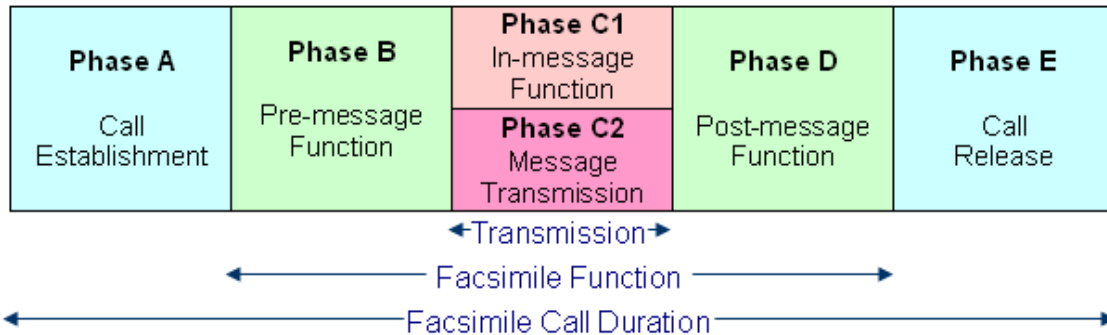
TERM	MEANING
	information field.
G3FE	G3 Facsimile Equipment
MCF	Message Confirmation. Used to indicate that a complete message has been satisfactorily received and that additional messages may follow. (This is a positive response to MPS, EOM, EOP, RR, and PPS).
PPR	Partial Page Request. This signal indicates that the previous message has not been satisfactorily received and that the frames specified in the associated facsimile information field are require to be retransmitted.
PPS	Partial Page Signal. This command indicates the end of a partial page of facsimile information and also indicates to return to the beginning of Phase B or Phase C upon receipt of the MCF signal.
TCF	Training Check Field. This command is sent through the T.4 modulation system to verify training and to give a first indication of the acceptability of the channel for this data rate.
TSI	Transmitter Subscriber Identification
RTC	Return to Control
UDPTL	Facsimile UDP Transport Layer (protocol)

**Table 2: Terms and Acronyms**

## 4 Traditional (analog) Fax using the T.30 Protocol

The International Telecommunications Union (ITU) standard T.30 defines the phases necessary for document transmission between two fax terminals in the Public Switched Telephone Network (PSTN). There are five phases:

### 4.1 T.30 Phases



**Figure 1: T.30 Operation Phase Diagram**

**Phase A** – A call is established after a connection exists between the sending and receiving terminal and Fax tones can be exchanged. Calls can be setup manually or automatically. In manual operation, a person dials the Fax telephone number and hears the familiar telephone ring called ring-back. After the called endpoint answers, the person hears a Fax tone. The person then switches from their handset to the fax endpoint to continue the transmission. In automatic operation, the Fax endpoint detects dial tone, and dials the desired telephone number. When the called Fax endpoint answers, the calling endpoint immediately transmits a Fax calling tone.

**Phase B** – The pre-message function has both identification and command sections. Identification involves:

- Capabilities of the called endpoint such as bit rate, page length, compression format, etc.
- Reception confirmation sent by the called endpoint.
- Terminal identification such as telephone number and name of organization, etc.
- Non-standard facilities identification such as enhanced security.

Command involves:

- Specifying chosen or negotiated capabilities that were identified.
- Training signal that tests the acceptability of the chosen data rate.
- Synchronization of the two Fax endpoints.

**Phase C1** – The in-message function is the control signals that are sent along with the message. This includes error detection, correction, in-message synchronization and line supervision.

**Phase C2** – The message transmission is the coding scheme of the message itself and is further defined by the ITU-T T.4 standard and is outside the scope of this paper.

**Phase D** – The post-message function includes:

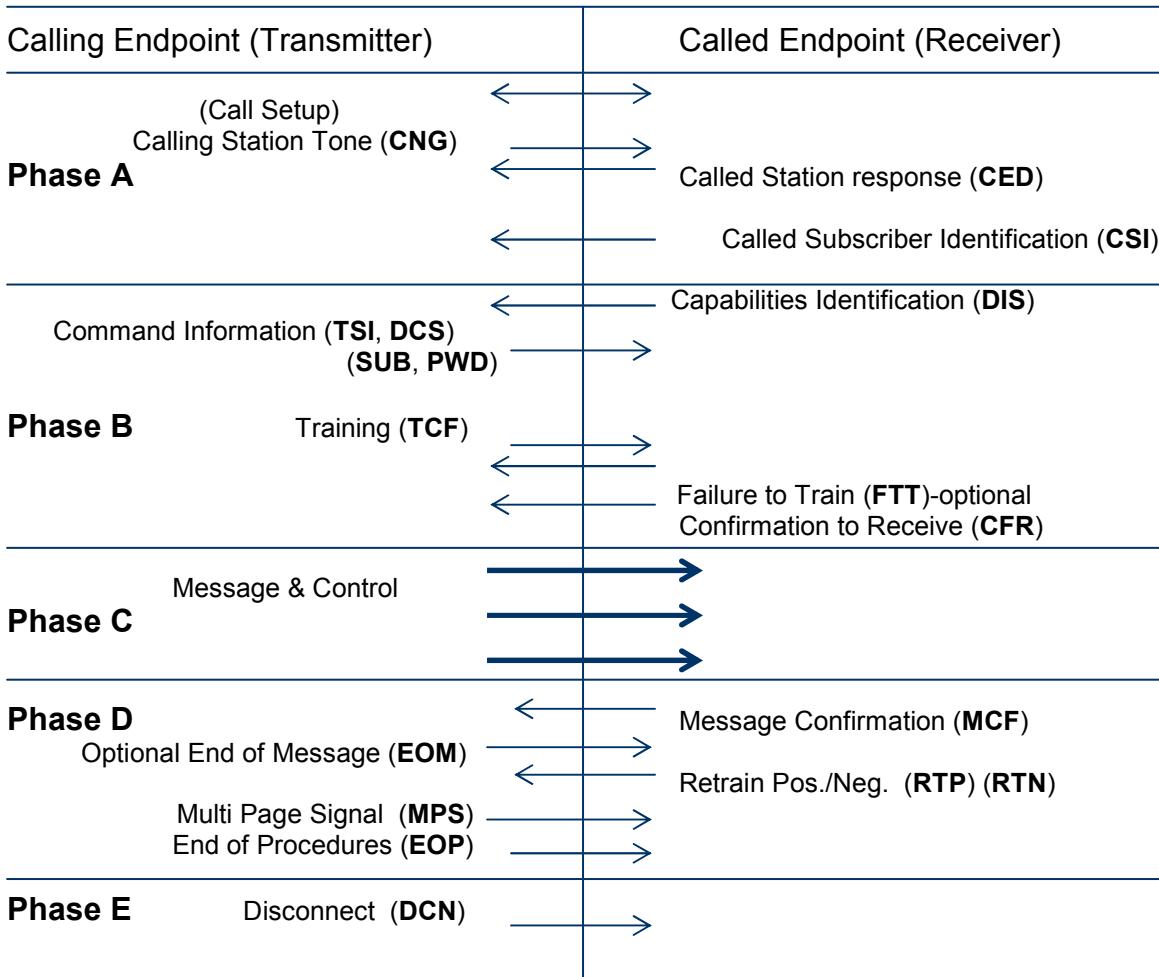
- End of message signaling. All pages have been transmitted and a return to Phase B is possible if needed.
- Multi-page signaling. Sent by the calling endpoint to indicate a page of the document has completely transmitted and returns to Phase C2 to receive the next page of the document.

- End of procedure signaling. Sent by the calling endpoint to indicate that all pages of the document have transmitted and no more are pending. The session can now proceed to Phase E.

Confirmation signaling. Sent by the called endpoint to confirm any of the above messages.

**Phase E** – The calling endpoint terminates the connection by transmitting a special disconnect signal to the called endpoint. No response is needed or expected.

## Sequence of Phases and Signaling



**Figure 2: T.30 Sequence of Phases and Signaling Flow**

### 4.2 Summary of T.30 Operations

T.30 is the protocol that governs the control message flow from sending G3 fax equipment to the receiving G3 fax equipment

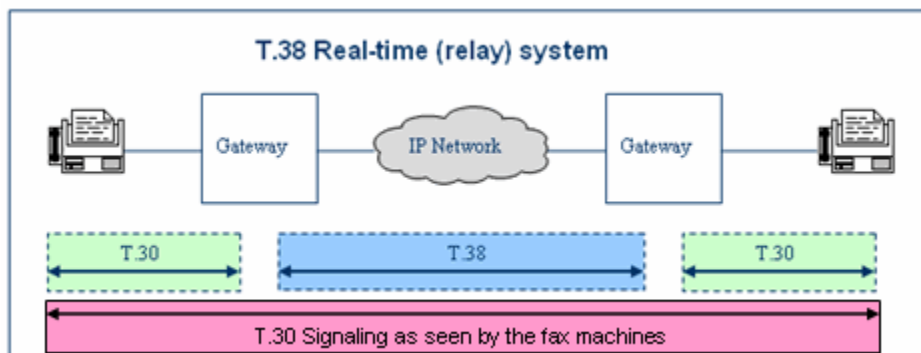
**a) CED tone** At 1.8 to 2.5 seconds after the called station is connected to the telephone line, it sends a continuous 2100 Hz +/- 15 Hz for a duration of not less than 2.6 seconds and not more than 4 seconds.

- b) This is followed by HDLC flag characters for bit stream synchronization and other messages
- c) This is followed by a capabilities exchange between the sender/receiver, which ends with the receiver sending a "confirm to receive" message
- d) Image data (for the page(s) to be faxed) are sent in T.4 formatted messages.
- e) Call is released.

## 5 T.38 Fax Protocol

When IP is part of the path for a T.30 Fax call, media gateways or other conversion devices must transcode (convert) analog signals into IP packets and back again. Additionally, T.30 signaling timing requirements must be satisfied. T.38 is ITU-T protocol that interfaces with T.30 to accomplish the feat of using an IP path between two T.30 machines.

T.38 addresses the demodulation of standard analog Fax transmissions (T.30) from originating machines equipped with modems, transforming the analog stream into an IP data stream. This data stream is then "relayed" from the attached gateway using T.38 to the receiving T.38 gateway. The two gateways often have a data network between them. The receiving gateway converts the digital signal using T.30 standards to "re-modulate" to an analog signal for the destination Fax device. The diagram in Figure 2 is an example of a T.38 system.



**Figure 3: Relationship of T.30 with T.38**

The process of transferring Fax documents by T.38 and IP gateways includes:

- Demodulating incoming T.30 signals from the sending Fax device
- Translating the T.30 fax signals into T.38 Internet Fax Protocol (IFP) packets
- Exchanging IFP packets between sending and receiving T.38 gateways
- Translating T.38 IFP packets back into T.30 signals at the receiving gateway
- Modulating T.30 signals and sending them to the receiving fax machine

Fax relay using T.38 must make the analog Fax machine believe it is talking to another fax machine. It does this by "spoofing" signals.

The following diagrams depict the signaling that takes place between the both fax machines and their local media gateways and are taken from the ITU-T T.38 Specification.



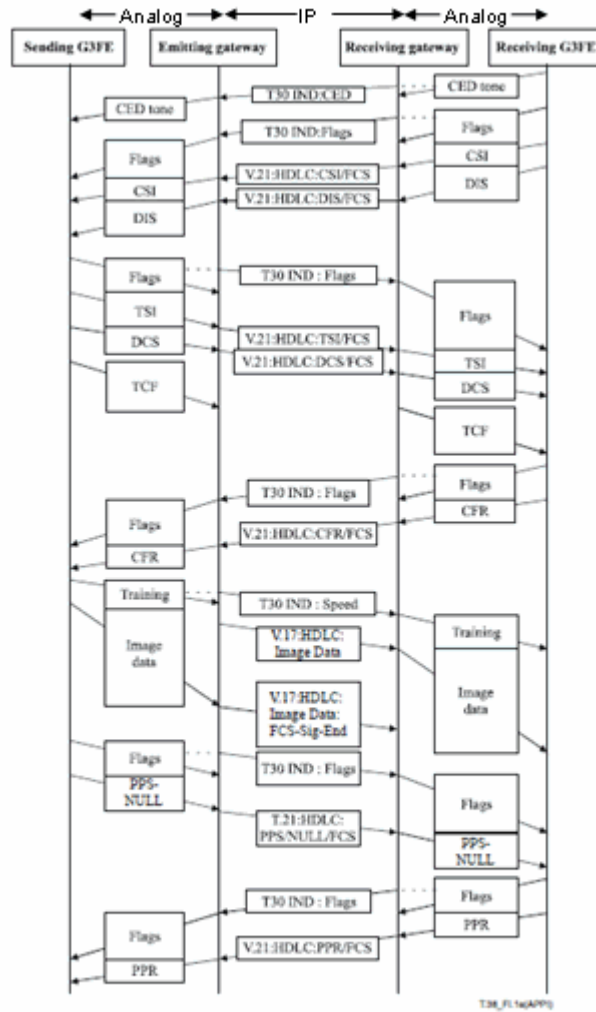


Figure L1 – Two Group 3 facsimile devices communicating through gateways (sheet 1 of 2)

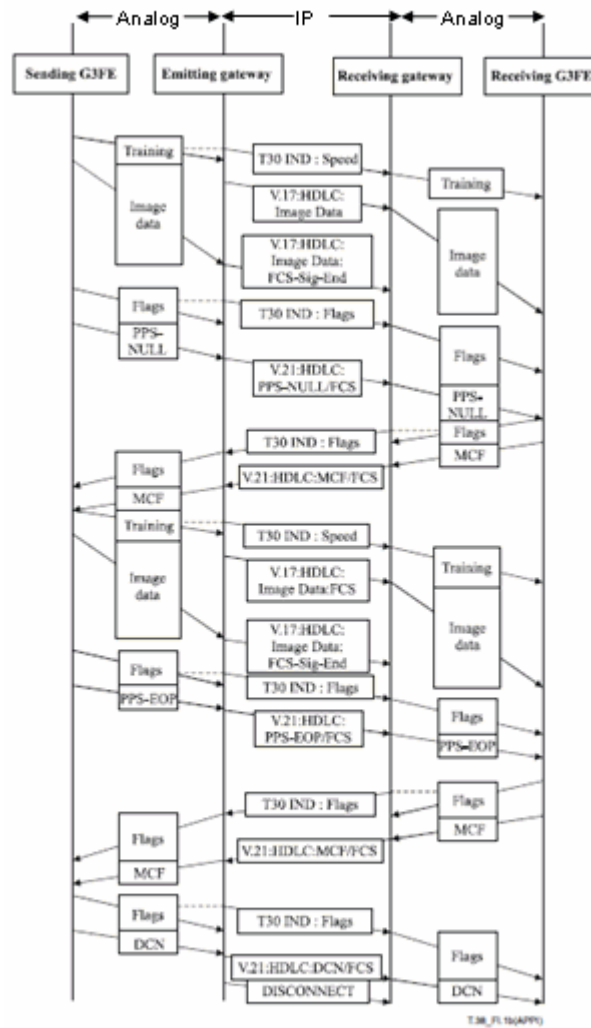


Figure L1 – Two Group 3 facsimile devices communicating through gateways (sheet 2 of 2)

### 5.1 T.38 ASN.1 Version Numbers

ASN.1 VERSION	VERSION DEPENDENT CONTENT SUMMARY	ORIGINAL DOCUMENTATION
0	1998 ASN.1 syntax	Initial publication (1998), Amendment 1 (1999), Amendment 2 (02/00).
1	1998 ASN.1 syntax, TPKT, IAF support, supports TCP	Amendment 3 (11/00) Note: Some early implementations supporting TPKT indicate version 0
2	2002 ASN.1 Syntax	Updated Recommendation (2002)
3	V.34, V.33 support, 2002 syntax	Published 2007
4	Defined defaults for negotiated parameters in Annex D	Published 09/2010. Annex D describes SIP/SDP call establishment

Table 3: T.38 ASN.1 Version Numbers

The T.38 version number is a recommended attribute (see table above) that shall be exchanged between the emitting and receiving gateways. An endpoint shall signal the version that it supports in the T38Version attribute in its offer. The recipient of the offer shall accept that version or modify the version attribute to be equal or lower version when transmitting an answer to the initial offer. The recipient of an offer shall not respond with an answer containing a higher version than that which was initially offered.

Early implementations of T.38 equipment may not provide a T.38 version number. In receipt of SDP without the version attribute, the endpoint shall assume that the version is "0". Version "0" devices are recommended to explicitly advertise their version number.

Currently (per R6.3), Communications Manager (and the subtending G430/G450 gateways) supports the versions 0 and 1 for T.38.

## **5.2 T.38 Error Correction Mode (ECM)**

This feature is supported only in the G430/G450 gateways as a media service.

The ECM feature is introduced in CM R6.3. This feature is summarized as follows.

CM will instruct the gateway to use ECM as part of the T.38 Fax Capabilities Exchange if:

- The local media gateway indicates support for this feature via capabilities exchange at registration.
- Ip-codec-set (page 2) has selected 't.38-standard' and 'ecm = yes'

Most modern fax machines with the memory to store page data are able to use Error Correction Mode (ECM) for error-free page transmission. The feature operates in accord with the following steps:

- When ECM is enabled, a fax page is transmitted in a series of blocks that contain frames with packets of data.
- After receiving some line data, a receiving fax machine notifies the transmitting fax machine of any frames with errors.
- The transmitting fax machine then retransmits the specified frames.
- This process is repeated until all frames are received without errors.
- If the receiving fax machine is receiving too many line errors, the fax transmission may fail and one of the fax machines may disconnect.

This feature requires the following components:

- CM R6.3
- G430/G450 R6.3
- Operates on MP20, MP80, and MP160 (G450 only) DSP cards.

This feature is administered on the following form on the CM's SAT interface:

*ip codec-set*

- a) Set the "FAX Mode" to 't38-standard'

## **5.3 Set the new "ECM" field to 'yes'. T.38 with Fallback to G.711 Pass-Thru Operation**

This feature is supported only in the G430/G450 gateways as a media service.

The feature of 'T.38 FAX with Fallback to G.711 Pass-Thru' is introduced in CM R6.3. This feature is summarized as follows.

CM will instruct the gateway to use this feature if:

- The local media gateway indicates support for this feature via capabilities exchange at registration.
- Ip-codec-set (page 2) has selected 't.38-G711 fallback'

This "T.38 Fax with Fallback to G.711 Pass-Through" feature will allow the CM managed enterprise networks to interoperate with Verizon PSTN networks for fax transport. The Verizon service provider migrated to standard T.38 Fax over a long period. As a result the Verizon network employs equipment that supports some proprietary variants of T.38, which are really pass-through techniques. Other service providers, such as AT&T, have moved quickly and deploy a standards-based T.38 Fax solution.

The summary of operation of the 'T.38 Fax with Fallback to G.711 Pass-Thru' is as follows:

- The call connection will be signaled for standard T.38 Fax relay.
- In the event of a failure to successfully negotiate T.38 Fax relay, the Communication Manager will re-INVITE to a G.711 mode of operation.
- By using PCM (G.711) codec sampling, there will be an effort made to simulate a circuit-switched transport.
- The Fax call shall be kept in this G.711 mode until the user disconnects.

This feature requires the following components:

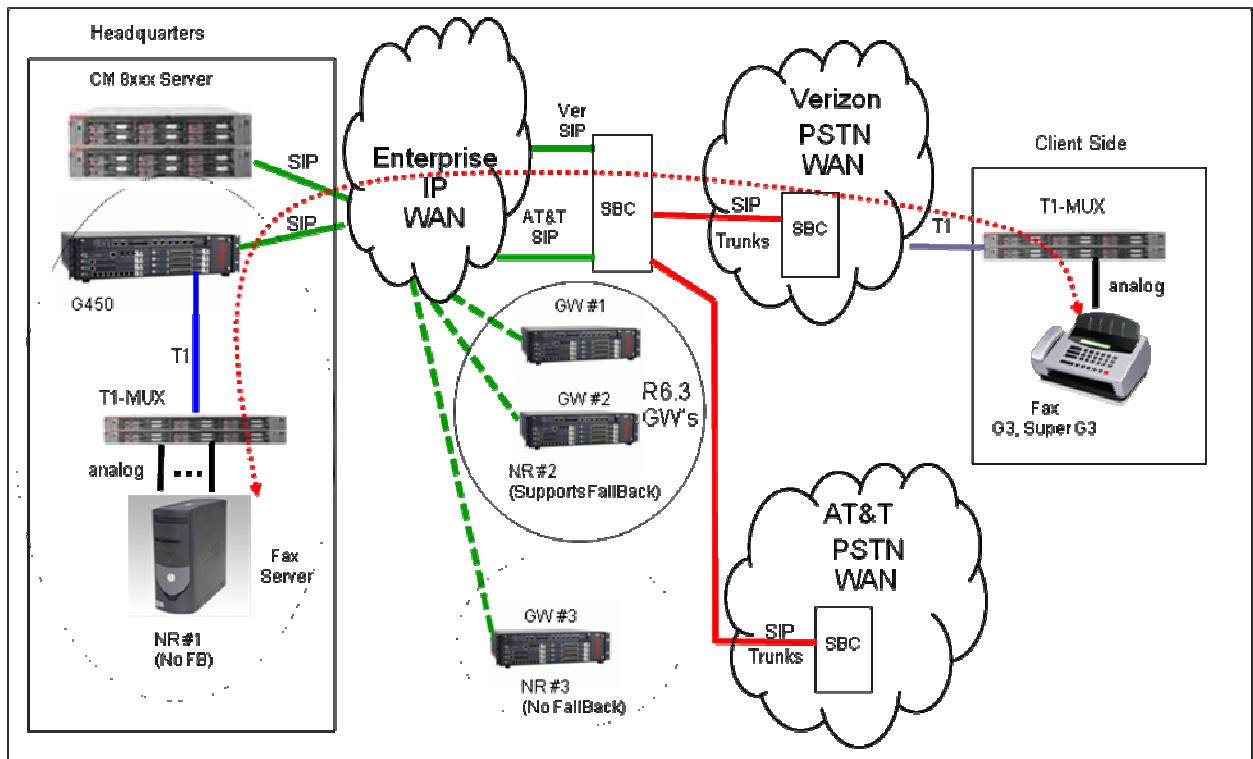
- CM R6.3
- G430/G450 R6.3
- Operates on MP20, MP80, and MP160 (G450 only) DSP cards.

This feature is administered on the following form on the CM's SAT interface:

*ip codec-set*

- Set the "FAX Mode" to 't38-G711 fallback'

A topology illustration is shown in Figure 4. This topology shows an Avaya customer who has contracted for network services from Verizon and AT&T. By carefully selecting the type of fax codec in IP network regions, we may use 'T38-standard' to serve the trunks which carry traffic to the AT&T network; and use 'T38-g711 fallback' to serve the trunks which carry traffic to the Verizon network.



**Figure 4: T.38 Fax with Failover to G.711 PT (Mixed Service Providers)**

## 6 Types of Fax Equipment

There are seven internationally recognized specifications for Fax equipment (see Table 1). Of these, Group 3 Fax equipment (known as G3fe) was popular initially. A G3 Fax machine transmits at 9.6 Kbps. An enhanced version of G3 (EG3 or Enhanced G3) transmits at 14.4Kbps and has improved error correction.

The newest specification for analog Fax is called Super G3 (SG3) and has the capability of 33.6 Kbps transmission, V.8 handshaking, and T.85 image compression. This new standard results in speed improvement up to 6 times that of G3. Super G3 will negotiate down to standard G3 speeds and capabilities when connected to a G3 machine at the other end. SG3 is the most commonly implemented type in existence today.

Type	Year	Speed	Technology
G1 – Group 1	1968	~6 minutes per page	Analog
G2 – Group 2	1976	~3 minutes per page	Analog
G3 – Group 3	1980	9.600 Kbps	Analog
EG3 – Enhanced G3	~1986	14.4 Kbps	Analog
SG3 – Super G3	1988	33.6 Kbps	Analog
G4	1988	64 Kbps	Digital (ISDN)
IAF – Internet Aware Fax	1998	As fast as modem permits	Digital (IP)

**Table 4: Types of Fax Equipment**

### 6.1 Summary of G3 Fax Machine Operation

#### G3 Fax Machine Operation

- Bandwidth rates: Operates commonly with V.29, V.27 and V.17 at 9600-bps maximum. Operates with V.17 at 14400-bps max for EG3 machines.
- Operation: The receiving fax machine provides a standard CED signal when called and connects to the line.
- Interoperability: The protocol steps are to:
- a) Detect calling tone
  - b) Generate the T30 IND-CED followed by T30 IND-Flags to initiate the capabilities exchange
  - c) Rate adapt to 14000 (EG3), 9600 or possibly slower speeds.

#### SG3 Fax Machine Operation

- Bandwidth rates: Operates commonly with V.34 (provides transmission at rates up to 33600-bps. These machines have the ability to negotiate to a lower rate for compatibility with the peer fax machine.

- Operation: The receiving fax machine provides an ANSam signal when it is called and connects to the line.

Interoperability with SG3 machines

:

For interoperability between G3 and Super-G3 fax machines, the V.34 fax machines are forced to use their backward compatibility with the T.30 mode. This requires a reduction in transmission speed to 14,400 baud (EG3). Quite often the rate is actually 9600 baud (G3).

The protocol steps are to:

a) Detect ANSam tone

Note: For the TDM portion of the network, the answer tone is important so that

- 1) the transmitter may disable ingress echo cancellation; and
- 2) the receiver may disable egress echo suppression

b) Convert to generating the T30 IND-CED followed by T30 IND-Flags to initiate the capabilities exchange

c) Rate adapt to either 14000, 9600 or possibly slower speeds.

Note: Communication Manager does not support V.34.

- CM supports ECM operation with the introduction of R6.3 (and G430/G450 gateway release 33.13).

## 7 Requirements for Testing

### 7.1 Requirement <140344-1> G3 Fax Test Devices

G3 fax devices constitute the smaller set of legacy analog fax machines. These devices support V.27, V.29 (9600 bps max) or V.17 (14400 bps max). There is no “best set of fax machines” to use for testing. In order to test many types of fax models, it really is imperative that the FaxLab emulation testing device be used. This requires two probe kits for best flexibility of testing different modes at each end of the network.

G3 fax machines have not been in manufacture for about 20-years. Apart from using FaxLab or owning a G3 fax machine, the only way to test G3 functionality is to manually set a SG3 machine to 9600 and ECM to off. The following models of fax machines have been commonly deployed with our customer base: Note that these devices are characterized as being “low cost”. Any models from these vendors would provide a good test if set to G3 standards. Some models that were encountered in testing with other vendors and interfacing with customers are listed:

1. Physical Fax devices:
  - a. Brother ( models 2920)
  - b. Canon (models GP160 )
  - c. HP ( models 3015, J5780)
  - d. Panasonic (models )
  - e. Ricoh (models 1130L)
  - f. Samsung (models SF565P )

The transmitting fax machine should be set to operate SG3 levels. The receiving fax machine is manually set to 9600-bps and ECM to off. The SG3 machine should rate adapt to 9600 and disable ECM as part of the capabilities exchange phase. If this does not happen, the test (transmitting) fax machine should not be approved because it does not interoperate as the T.30 spec demands.

### 7.2 Requirement <140344-2> SuperG3 Fax Test Devices

SuperG3 (SG3) fax devices are analog machines that support V.34 (33.6K). SG3 comprises the lion’s share of today’s market.

There are is “best set of fax machines” to use for testing. In order to test many types of fax models, it really is imperative that the FaxLab emulation testing device be used. This requires two probe kits for best flexibility of testing different modes at each end of the network.

The following models of fax machines have been commonly deployed with our customer base:

2. Physical Fax devices:
  - a. Brother MFC 4500ML
  - b. Canon H12250
  - c. HP 1200xi
  - d. Panasonic KXFP101
  - e. Panasonic UF-495
  - f. Sharp FO-4400
  - g. MultiTech MultiModem ZPX V.92 (Internal modem)
3. FaxLab 5.1 SuperG3 Emulations
  - a. Brother MVC 3320CN (color InkJet MFP)
  - b. Brother MVC 8820d (monochrome laser MFP)
  - c. Canon MultiPASS F80 (color InkJet MFP)
  - d. HP OfficeJet 7110 (color InkJet MFP)
  - e. KyoceraMita KM-F1050 (monochrome laser MFP)
  - f. Lexmark X215 (monochrome laser MFP)
  - g. Minolta MF2800 (monochrome laser MFP)

- h. Muratec F-320 (monochrome laser MFP)
- i. Okidata OKIFAX 4580 (monochrome LED MFP)
- j. Panasonic UF-9000 (network laser MFP)
- k. Sharp FO-4400 (monochrome laser MFP)
- l. Sharp FO-DC600 (monochrome laser MFP)
- m. Toshiba DP120F (network laser MFP)
- n. Xerox WC Pro575 (monochrome laser MFP)

### **7.3 Requirement <140344-3> Topologies for Intervening IP Network**

The call path must include at least two IP-connected PNs (G650s) or one PN with an IP link to an H.248 gateway. This tests shuffling and represents real-world implementations.

It is recommended that the following two topologies be tested:

1. Connect a fax machine to the analog port of the gateway (under test). Using an IP link, connect to a second H.248 gateway (choices are (G450, G430, G700, G350 or G250). A second fax machine that is connected to the analog Media Module port of the second H.248 gateway
2. Connect a fax machine to the analog port of the gateway (under test), then use an IP link to connect to a G650. The second fax machine is connected by an analog TN port board that resides within that G650.

Note: the reason for this is to test the conversion of analog signals to IP and back again for T.38 interoperability.

### **7.4 Requirement <140344-4> DSP Modules to Test With**

It is recommended that the test involve:

1. A G650 with a TN2302AP (Cruiser) module or H.248 gateway (G700, G350, G250) as the transcoding media converter.
2. A G650 with a TN2602AP (Crossfire) module or H.248 gateway (G450, G430) as the transcoding media converter.

Note: the reason for this is that the DSP algorithms have been developed on two separate platforms.

### **7.5 Requirement <140344-5> Interop Testing with H.323 Fax Adaptors**

It is recommended that some testing be conducted between the gateway “under test” with a well-known product. The most common H.323 gateway that has been deployed in Avaya customer topologies has been the MultiTech MVP130-AV-FXS. This is a single analog port that may be provisioned for either voice or fax. Appendix C contains a simple description of some of the key administrative settings for this device.

### **7.6 Requirement <140344-6> Fax page lengths and types**

It is recommended that a test should be conducted with the transmission of a single and multi-page fax. Single page faxes exercise the call setup, transmission and tear down of a connection between two fax devices. Secondly, this test should be repeated by sending a 10 page fax. A 10-page or longer fax tests memory, synchronization and fine errors when both text and graphics are used. Appendix Z provides a ten page file that is a very good exercise in the determination of whether there are any problems with multi-page synchronization.



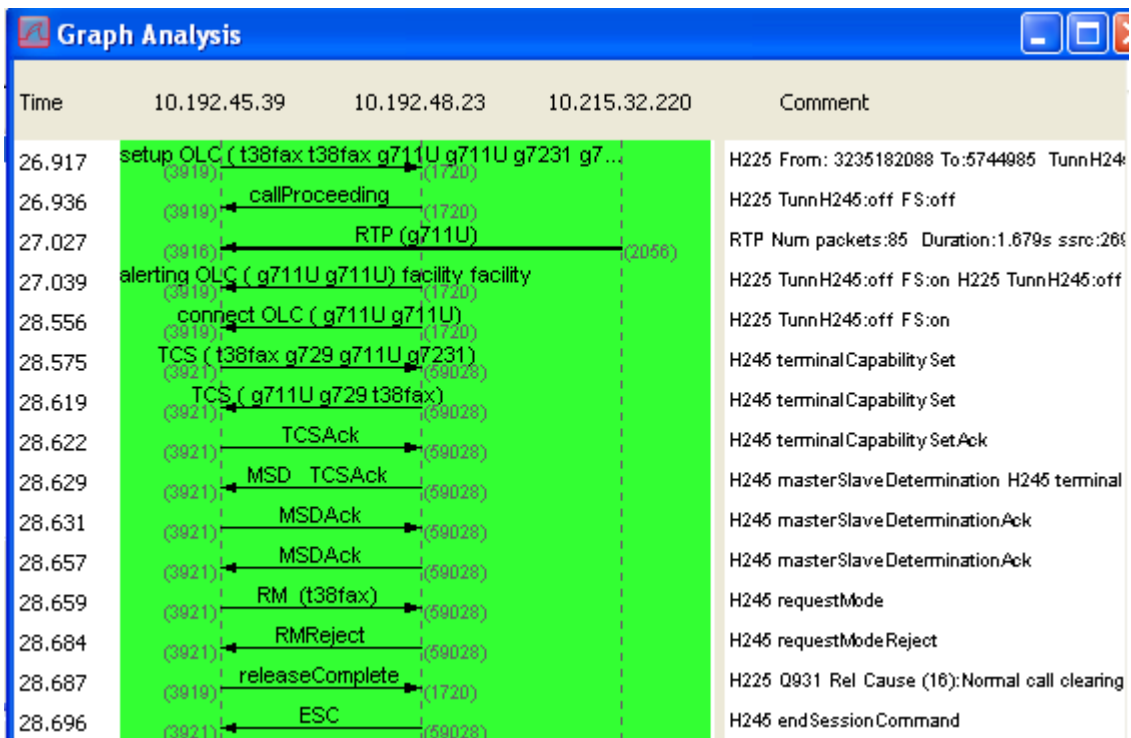
### 7.7 Requirement <140344-7> Use of CM's List-Trace-Station

It is recommended that a list-Trace-Station (or List-Trace-TAC) be running on the calling station before the test fax call is made. The results will verify that:

- the transition from the voice codec to the T.38 state
- the network regions involved in the call
- the ip-codec-set options for both voice and fax
- the jitter and packet loss counters during the fax call

### 7.8 Requirement <140344-8> Use of a sniffer capture

It is recommended that a sniffer capture is running before the first fax call. The sniffer should be connected to a mirrored port on the Ethernet switch closest to the first IP conversion point to the fax machine or gateway under test. Programs such as Wireshark can display the T.30 signaling in the T.38 portion of the sniffer capture. This can aid in troubleshooting an interoperability issue. An example of the output is shown below:



Additionally, an analog wave can be recreated for spectral analysis from the sniffer capture by development if needed.

## 8 Appendix A: Administration of Communication Manager

### 8.1 Communication Manager Administration Settings

1. *IP Codec Set*
  - a. Set for T.38 mode
  - b. Set for the desired redundancy mode (it would be simpler to start off with redundancy set to "0" at first)
  - c. Set the ECM field to 'yes'
2. *IP Trunk* (Optionally as needed)
  - a. Configure a trunk group using "h323" or "sip" as the type
  - b. Configure a signaling group
  - c. Don't assume shuffling is supported if the trunk terminates to another vendors device
3. *PN synchronization*
  - a. G650 Port Networks should always have a synchronization source applied to maintain low clock drift. Preferably, the synch source should come from a Telco provider (via a DS-1 trunk interface) or an ISP Provider (via an IP clock synchronization method). Multi-page faxes may fail without a good synch source.

### 8.2 Clear Channel Operation

Operating in a clear channel mode (such as G.711 voice codec) is not recommended for general application usage. The success of this mode requires a data network that has very minimal delay. Also, clear channel mode may employ a dynamic jitter buffer or allow VAD (Voice Activity Detection) which de-optimizes fax transmissions. The topology should not have very many transit points upon which transcoding takes place. Our experience has shown that it is difficult to enjoy success with multi-page fax transmission.

There are many different interpretations of how "clear channel" operates in different gateway devices. Some of these modes are proprietary and may not operate at all!

## 9 Appendix B: Administration of AudioCodes MP1xx Gateways

### 9.1 AudioCodes MPxxx Administration Settings

This product is a SIP-based multi-port gateway. It may be used as a protocol adaptor to “IP connect” analog ports and present to Communications Manager as a SIP type of phone. For the purpose of this application note, it may also be used as a protocol adaptor to convert an analog fax machine into a SIP fax data appliance.

The MP114 has two ports that may be used for analog station-side appliances.

The MP118 has four ports that may be used for analog station-side appliances.

1. Set the “fax modem mode” to “Switching to T.38 Mode using SIP Re-Invite”
  - a. Set “IsFaxUsed” to “1”
  - b. Set “FaxRelayMaxRate” to “9600” or “14400”.
    - i. We recommend testing at 9600 baud for Crossfire (TN2602AP) and G450, G430.
    - ii. The Cruiser (TN2302AP and other H.248 Media Gateways (G700, G350, G250) support a maximum data rate of 14400 baud.
  - c. Set “FaxRelayRedundancyDepth” to agree with CM’s IP Codec Set form.
  - d. Set “FaxRelayECMEnable” to agree with CM’s IP Codec Set form.
2. Set the “Fax relay transport mode settings” as follows:
  - a. Set “FaxTransportMode” to “1”
  - b. Set “V34ModemTransportType” to “0”
  - c. Set “V32ModemTransportType” to “0”
  - d. Set “V23ModemTransportType” to “0”
  - e. Set “V22ModemTransportType” to “0”

## 10 Appendix C: Administration of MultiTech MVP130-AV-FXS Adaptors

### 10.1 MultiTech MVP130-AV-FXS Administration Settings

This product is an H.323-based single port Terminal Adaptor. It may be used as a protocol adaptor to “IP connect” a single analog phone in a conference room or lobby and present to Communications Manager as an H.323 type of phone. For the purpose of this application note, it may also be used as a protocol adaptor to convert an analog fax machine into an H.323 fax data appliance.

Make sure that the firmware load on this product is at 2.06.FQ (or newer).

The key administrative needs are accessed via the windows-based management routine located on the craftsperson’s PC:

1. *Interface Parameters* page:
  - a. Set “Interface Type” to “FXS”
2. *Voice/Fax Parameters* page in the Fax parameters box:
  - a. Set “Fax Enable” to “y”
  - b. Set “Max Baud Rate” to “9600”
  - c. Set “Mode” to “T.38”
3. *Communication Manager Parameters* page:
  - a. Set “Register to Communication Manager” to “checked”
  - b. Set “Primary Gatekeeper Address” to “IP address of CLAN or PE”

## **11 Appendix D: Administration of AudioCodes G860 and Mediant Family of Trunk-Side Gateways**

### **11.1 AudioCodes Mediant 1000/3000/5000 Gateway Administration Settings**

The AudioCodes Mediant gateways (models 1000, 3000, and 5000) have the ability to receive PSTN trunks, terminate the protocol and convert to SIP trunks which may be forwarded into CM/SM servers.

The Avaya G860 gateway is based on the Mediant 5000 gateway product and serves as a SIP-based High Density Trunk Gateway. It is typically deployed in a data center/headquarters site to provide cost effective distribution of bundles of PSTN trunks for redirection into a CM/SM managed SIP-based communication network. This G860 gateway receives separate instances of T1 or E1 interfaces via the TP8410 module or larger pipes (DS3, OC3, STM-1 interfaces) directly into the TP6310 module. The larger bandwidth interfaces contain bundles of T1 or E1 trunk circuits. These T1 circuits may support T1-Robbed Bit or ISDN Primary Rate signaling. These E1 circuits may support E1-CAS, E1-R2MFC, or ISDN Primary Rate signaling protocols. The G860 gateways provides the termination of the incoming/outgoing PSTN calls and converts these calls to IP-based calls which support the SIP signaling protocol. The G860 gateway routes these calls via SIP trunk groups over to Communications Manager or Session Manager.

The administration of these AudioCodes Mediant gateway members is completely consistent with the MP1XX gateways (as described in Appendix A):

1. Set the "fax modem mode" to "Switching to T.38 Mode using SIP Re-Invite"
  - a. Set "IsFaxUsed" to "1"
  - b. Set "FaxRelayMaxRate" to "9600" or "14400".
    - i. We recommend testing at 9600 baud for Crossfire (TN2602AP) and G450, G430.
    - ii. The Cruiser (TN2302AP and other H.248 Media Gateways (G700, G350, G250) support a maximum data rate of 14400 baud.
  - c. Set "FaxRelayRedundancyDepth" to agree with CM's IP Codec Set form.
  - d. Set "FaxRelayECMEnable" to agree with CM's IP Codec Set form.
2. Set the "Fax relay transport mode settings" as follows:
  - a. Set "FaxTransportMode" to "1"
  - b. Set "V34ModemTransportType" to "0"
  - c. Set "V32ModemTransportType" to "0"
  - d. Set "V23ModemTransportType" to "0"
  - e. Set "V22ModemTransportType" to "0"

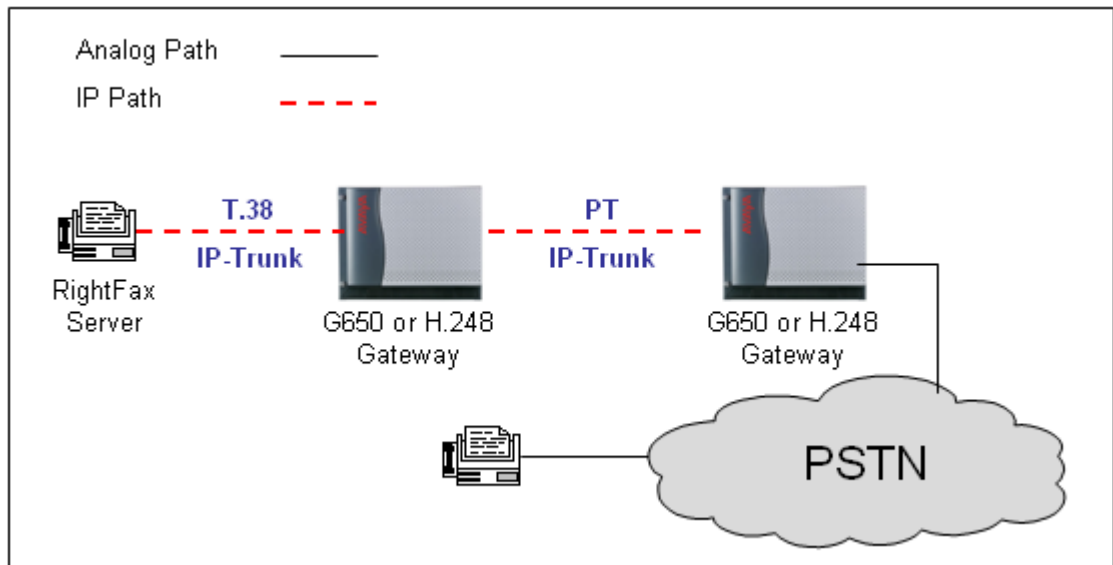
## 12 Appendix E: Interoperability information for the RightFax Server

### 12.1 RightFax version 9.3.3 patch and environment optimization instructions

RightFax is a pc-based application made by Opentext that directly sends/receives (via the Ethernet port) T.38 packets to another T.38 gateway or device.

Some important administrative notes include:

- Be sure the cover page option is set to “off”.
- Shuffling is allowed as long as a TIE trunk is not part of the call path.
- Place the RightFax server in a separate network region. The codec-set should specify T.38 as the fax transport mode. All other PNs in the call path can be set to “Pass-Through” to mitigate delay because T.38 will not shuffle between PNs. See the following diagram:

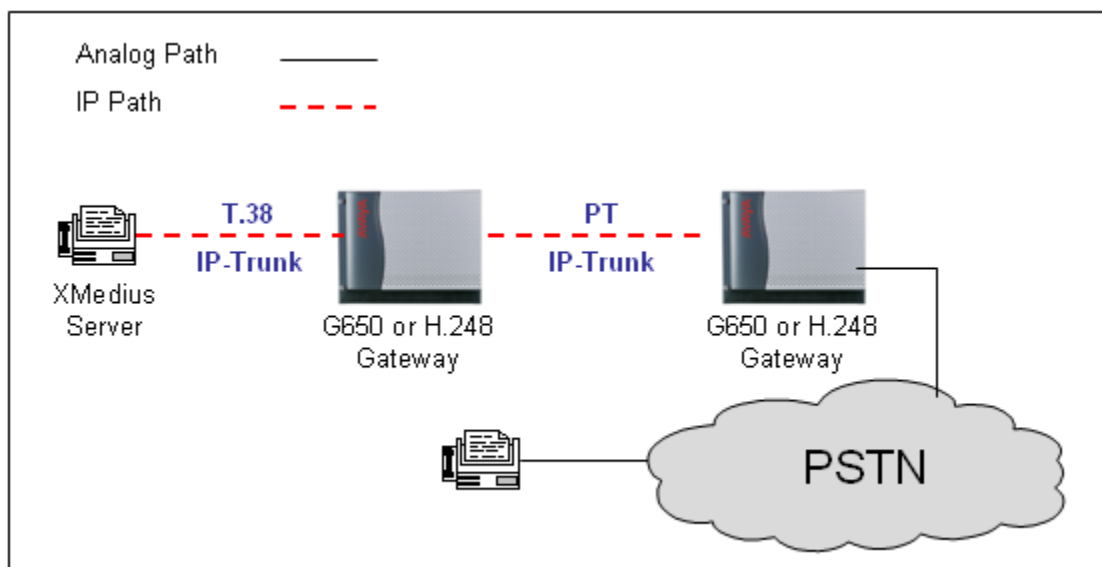


## 13 Appendix F: Interoperability information for the Xmedius Fax Server

### 13.1 Xmedius interoperability instructions

The Xmedius fax server works well for most implementations. Field issues have surfaced the following administrative notes:

- We definitely do not support the "transparent" DataProtocolCapability. From H245: transparent indicates the capability to support a specified data application using transparent data transfer.
- We only support UDP protocol for T38.
- Avaya does not support the "transparent" Data Protocol Capability which uses TCP. Avaya only supports UDP for H.245 signaling.
- **Shuffling to Xmedius is never supported**; therefore the trunk between the Xmedius server and the PN or Gateway should have shuffling disabled on either the sig-group or network-region forms or both.
- When two or more PNs have PRI links to the PSTN, Avaya patch 15891 must be part of the Service Pack. CM-5.0 load 825.4 SP-3 and beyond should include this patch. The symptom is that the PN not directly connected to the Xmedius trunk will stop fax calls from reaching the PSTN.
- Place the Xmedius fax server in a separate network region. The codec-set should specify T.38 as the fax transport mode. All other PNs in the call path can be set to "Pass-Through" to mitigate delay because T.38 will not shuffle between PNs. See the following diagram:



## **14 Appendix Z**

Sample Fax Multi-Page Test File follows this page.



SAMPLE FAX TEST (10 PAGES)

TEST FAX NUMBER

(first number not crossed out, e.g. ~~1~~ ~~2~~ 3 4... means this is No.3)

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20



## Test Pattern 1.0

This here be some text. We want at least one page of text included in this testing because text is usually what people transmit in a fax – like a contract page with a signature. Don't get me wrong, graphics are fine but text gives us that warm and fuzzy feeling that this testing is rooted in simulating real-world scenarios.

Graphics, on the other hand, allow us to see minute transmission flaws that are easily overlooked in a text message. The brain is a wonderful thing, and can cause us to overlook small missing details. Take, for example, the car company called KIA. Have you ever noticed that the "A" is missing the bar? It looks like a "Λ".

There are other examples of how the brain will fill in missing pieces of characters, or even whole words. I won't bore you with more details. The point is that text is not the best transmission to prove a fax system is working correctly.

Because the human brain is adept at recognizing patterns, the following pattern pages will easily allow one to detect even a small fax issue.

# Test Pattern 1.1

# Test Pattern 1.2

# Test Pattern 1.3

# Test Pattern 1.4

## **Test Pattern 2.1**

## **Test Pattern 2.2**



## **Test Pattern 2.3**

# Test Pattern 2.4