

Information Note

Decoding T38 messaging



Decoding T.38 messaging from an Ethereal trace

To look at T.38 messaging, use Ethereal 0.10.12 or greater to capture and decode the VoIP traffic. (This version of Ethereal decodes and presents the T.38 command values on the main screen.)

For SIP, an ethereal filter of 'sip||rtp||t38' will display the key SIP traffic.

For H.323, an ethereal filter of 'h245||h225||rtp||t38' will display the key H.323 traffic.

The resulting Ethereal screen will look something like:

A screenshot of the Ethereal network traffic analysis tool. The window title is "2005-08-15_good - Ethereal". The filter bar shows "sip||rtp||t38". The main pane displays a list of network packets. The selected packet (No. 12287) is expanded to show its details: Frame 12287 (60 bytes on wire, 60 bytes captured), Ethernet II, Internet Protocol, User Datagram Protocol, and ITU-T Recommendation T.38. The packet details pane shows the following hex and ASCII data:

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0000 00 0e 83 62 0e b4 00 50 58 01 06 fe 08 00 45 00  ...b...P X....E.
0010 00 22 7e df 00 00 64 11 07 99 ac 13 01 41 41 f0  ...d. ....AA.
0020 e1 0e 27 1c 48 84 00 0e be de 00 00 01 00 00 00  ...H. ....
0030 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
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If the T.38 packets are not decoded as T.38, clear the filter, select a UDP packet that is a T.38 packet, right click and select 'decode as' and then select T.38

When decoding T.38 packets, check the sequence numbers as packets can be received in the wrong order but will be correctly re-ordered by the Vega T.38 decoder. (It is not a problem if packets are mis-ordered)

Each T.38 (actually T.30) message comprises of a number of v21 hdlc-data packets. Each message starts with two packets FF, C0 or two packets FF, C8. This header is then followed by a command / response identifier and then by any data that relates to that command / response.

The structure of the T.38 (T.30) commands is documented below.

For a standard fax call where the calling party transmits the fax to the called party, the typical sequence of the call is:

- INITIAL IDENTIFICATION commands sent from called to calling party
- COMMANDS TO RECEIVER commands sent calling to called party (transmitter to receiver)
- Fax data sent calling to called - training
- PRE-MESSAGE RESPONSE sent called to calling party
- Fax data sent calling to called – page data
- POST-MESSAGE COMMAND (end of page / end of document) sent calling to called
- POST-MESSAGE RESPONSE sent called to calling
- OTHER LINE CONTROL (disconnect) calling to called

The T.38 protocol is fully defined in the ITU T.30 specification.

Table 1 - T.38 command / responses

Address Field	Control Field	Command / response identifier	DATA
		INITIAL IDENTIFICATION 01, 02, 04 0000 xxxx	
FF	C0 – Non-final frame C8 – Final frame	01 – Digital Identification Signal - Standard ITU capabilities	3 bytes to 10 bytes of data See Table 2 to decode the DIS values
		02 – Called Subscriber Identification (optional)	20 digits (International) telephone number LS digit first padded with space characters See Table 4 to decode the digits; * and # are not allowed
		04 – Non Standard Facilities ... Facilities outside ITU T-series recommendations	
FF	C0 – Non-final frame C8 – Final frame	COMMAND TO SENDER 81, 82, 83, 84, 85 1000 xxxx	
		81 – Digital Transmit Command –Defines capabilities	3 bytes to 10 bytes of data See Table 2 to decode the DTC values
		82 – Calling subscriber Identification	20 digits (International) telephone number LS digit first, padded with space characters See Table 4 to decode the digits; * and # are not allowed
		83 – Password (used for poling mode)	5.3.6.2.8
		84 – Non standard facilities command	
		85 – Selective polling	5.3.6.2.9
FF	C0 – Non-final frame C8 – Final frame	COMMAND TO RECEIVER 41, 42, 43, 44, 45, 48 x100 xxxx C1, C2, C3, C4, C5, C8	
		41 C1 – Digital Command Signal - response to standard capabilities	3 bytes to 10 bytes of data See Table 3 to decode the DCS values
		42 C2 – Transmitting subscriber Identification	20 digits (International) telephone number LS digit first, padded with space characters See Table 4 to decode the digits; * and # are not allowed
		43 C3 – sub address	20 digits (International) telephone number LS digit first, padded with space characters. (Right Justified) See Table 4 to decode the digits; *, # and + are not allowed
		44 C4 – Non standard facilities set-up	
		45 C5 – Password	5.3.6.2.8
		48 C8 – Continue to correct	

Address Field	Control Field	Command / response identifier	DATA
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FF	C0 – Non-final frame C8 – Final frame	PRE-MESSAGE RESPONSES 21, 22, 23 x010 xxxx A1, A2, A3	
		21 A1 – Confirmation To Receive – Ready to receive	
		22 A2 – Failure to train	
		23 A3 – Response for Continue to correct	

FF	C0 – Non-final frame C8 – Final frame	POST-MESSAGE COMMANDS 71, 72, 73, 74, 76, 79, 7A, 7C, 7D x111 xxxx F1, F2, F3, F4, F6, F9, FA, FC, FD	
		71 F1 – End Of Message (End Of Page)	
		72 F2 – MultiPage signal (End Of Page)	
		73 F3 – End of re-transmission	
		74 F4 – End Of Procedures (End Of Page & End of Document) Clear call	
		76 F6 – Receive Ready	
		79 F9 – Procedure Interrupt - End Of Message, Request Operator Intervention	
		7A FA – Procedure Interrupt - MultiPage Signal, End Of Page, Request Operator Intervention	
		7C FC – Procedure Interrupt – End of Procedure (End of Page & End Of Document)	
		7D FD – Partial Page Signal – (End of Partial Page)	

Address Field	Control Field	Command / response identifier	DATA
FF	C0 – Non-final frame C8 – Final frame	POST-MESSAGE RESPONSES 31, 32, 33, 34, 35, 36, 37, 38, 3D, 3F x011 xxxx B1, B2, B3, B4, B5, B6, B7, B8, BD, BF	
		31 B1 – Message confirmation (more messages may follow)	
		32 B2 – Retrain Negative	
		33 B3 – Retrain Positive	
		34 B4 – Procedure Interrupt Negative (message has not been received properly but can't continue without operator intervention)	
		35 B5 – Procedure Interrupt Positive (message received OK but can't continue without operator intervention)	
		36 B6 – Procedure Interrupt Disconnect	
		37 B7 – Receive not ready	
		38 B8 – Response for end of transmission	
		3D BD – Partial page request	
		3F BF – File Diagnostics Message	
		FF	C0 – Non-final frame C8 – Final frame
58 D8 – Command Repeat request			
5F DF - Disconnect			
FF	C0 – Non-final frame C8 – Final frame	MISC x110 xxxx 60, 61 E0, E1	
		60 E0 – Facsimile coded data	
		61 E1 – Return to control for partial page	

Table 2 DIS / DTC values

<p>First byte ... 0000 0--- ← Reserved ---- -x-- ← V.8 capabilities ---- -x- ← Octets ---- ---0 ← Reserved</p> <p>Octets: 0 = 256 octets preferred 1 = 64 octets preferred</p>	<p>Second byte ... x--- ---- ← Ready to transmit (polling) -x- ---- ← Receiver fax operation --xx xx-- ← Data Sig Rate ---- -x- ← lines per mm ---- ---x ← 2-d coding capability</p> <p>Data Sig Rate values 0000 Rec v.27 ter fall-back mode 0001 - 0010 - 0011 - 0100 Rec V.27 ter 0101 Reserved 0110 - 0111 Reserved 1000 Rec V.29 1001 - 1010 - 1011 - 1100 Recs V.27 ter & V.29 1101 Recs V.27 ter, V.29 & V.17 1110 Invalid 1111 Reserved</p> <p>lines per mm 0 = R8 X 7.7 lines/mm 1 = 200 X 200 pels/25.4mm</p>	<p>Third byte ... xx-- ---- ← Recording width --xx ---- ← Max rec length ---- xxx- ← Min scan line time ---- ---x ← Byte 4 follows</p> <p>Recording width 00 = 215 mm 01 = 215, 255 & 303 mm 10 = 215 & 255 mm 11 = Invalid</p> <p>Max Recording length 00 = A4 01 = unlimited 10 = A4 (297 mm) & B4 (364 mm) 11 = Invalid</p> <p>Min scan line time 000 = 20 ms 001 = 40 ms 010 = 10 ms 011 = 5 ms 100 = 10 ms half pitch 101 = 20 ms half pitch 110 = 40 ms half pitch 111 = 0 ms</p>	<p>Extension byte (byte 4) ... 0--- ---- ← Reserved -x- ---- ← Uncompressed mode --x- ---- ← Error correction mode ---0 ---- ← Reserved ---- 0--- ← Reserved ---- -0-- ← Reserved ---- --x- ← T.6 coding ---- ---x ← Byte 5 follows</p>
<p>Extension byte (byte 5) ... 0000 000- ← Reserved ---- ---x ← Byte 6 follows</p>	<p>Extension byte (byte 6) ... x--- ---- ← R8 x 15.4 lines/mm -x- ---- ← 300 x 300 pels/25.4mm --x- ---- ← R16 x 15.4 lines/mm &/or 400 x 400 pels/25.4mm ---x ---- ← Inch based res pref ---- x--- ← Metric based res pref ---- -x-- ← Min scan line time ---- --x- ← Selective polling ---- ---x ← Byte 7 follows</p> <p>Min scan line time 0 = single pith 1 = half pitch</p>	<p>Extension byte (byte 7) ... x--- ---- ← Sub addressing capability -x- ---- ← Password --x- ---- ← Ready to transmit(polling) ---0 ---- ← Reserved ---- x--- ← Binary file transfer ---- -x-- ← Document transfer mode ---- --x- ← Electronic Data Interchange ---- ---x ← Byte 8 follows</p>	<p>Extension byte (byte 8) ... 0--- ---- ← Basic Transfer Mode -0-- ---- ← Reserved --x- ---- ← Ready to transmit (polling) ---x ---- ← Character mode ---- 0--- ← Reserved ---- -x-- ← Mixed mode ---- --0- ← Reserved ---- ---x ← Byte 9 follows</p>
<p>Extension byte (byte 9) ... x--- ---- ← Processable mode 26 -x- ---- ← Dig Network Capability --x- ---- ← Duplex capability ---x ---- ← JPEG coding ---- x--- ← Full colour mode ---- -0-- ← Reserved ---- -x- ← 12 bits/pel component ---- ---x ← Byte 10 follows</p> <p>Duplex capability 0 = Half duplex only 1 = Duplex or half duplex</p>	<p>Extension byte (byte 10) ... x--- ---- ← No subsampling -x- ---- ← Custom illuminant --x- ---- ← Custom gamut range ---x ---- ← Letter size capability ---- x--- ← Legal size capability ---- -x-- ← Rec T.85 basic capability ---- --x- ← Rec T.85 L0 capability ---- ---0 ← Extend field</p>		

Table 3 DCS (response) values

<p>First byte ... 0000 0--- ← Reserved ---- -x-- ← Invalid V.8 cap req ---- --x- ← Invalid Octets req ---- ---0 ← Reserved</p>	<p>Second byte ... 0--- ---- Rerserved (polling) -x-- ---- ← Receiver fax operation ---xx xx-- ← Data Sig Rate ---- --x- ← lines per mm ---- ----x ← 2-d coding capability</p> <p>Data Sig Rate values 0000 2400bps, Rec V.27 ter 0001 14400bps Rec V.17 0010 Invalid 0011 Reserved 0100 4800bps, Rec V.27 ter 0101 12000 bps Rec V.17 0110 Invalid 0111 Reserved 1000 9600bps, Rec V.29 1001 9600bps Rec V.17 1010 Reserved 1011 Reserved 1100 7200bps, Rec V.29 1101 7200bps, Rec V.17 1110 Reserved 1111 Reserved</p> <p>lines per mm 0 = R8 X 7.7 lines/mm 1 = 200 X 200 pels/25.4mm</p>	<p>Third byte ... xx-- ---- ← Recording width --xx ---- ← Max rec length ---- xxx- ← Min scan line time ---- ---x ← Byte 4 follows</p> <p>Recording width 00 = 215 mm 01 = 303 mm 10 = 255 mm 11 = Invalid</p> <p>Max Recording length 00 = A4 01 = unlimited 10 = B4 (364 mm) 11 = Invalid</p> <p>Min scan line time 000 = 20 ms 001 = 40 ms 010 = 10 ms 011 = 5 ms 100 - 101 - 110 - 111 = 0 ms</p>	<p>Extension byte (byte 4) ... 0--- ---- ← Reserved -x-- ---- ← Uncompressed mode --x- ---- ← Error correction mode ---x ---- ← Frame Size ---- 0--- ← Reserved ---- -0-- ← Reserved ---- --x- ← T.6 coding ---- ---x ← Byte 5 follows</p> <p>Frame size 0 = 256 octets 1 = 64 octets</p>
<p>Extension byte (byte 5) ... 0000 000- ← Reserved ---- ---x ← Byte 6 follows</p>	<p>Extension byte (byte 6) ... x--- ---- ← R8 x 15.4 lines/mm -x-- ---- ← 300 x 300 pels/25.4mm --x- ---- ← R16 x 15.4 lines/mm &/or 400 x 400 pels/25.4mm ---x ---- ← Resolution type ---- x--- ← Don't care resolution type ---- -x-- ← Don't care scan line time ---- --0- ← Reserved ---- ---x ← Byte 7 follows</p> <p>Resolution type Min scan line time 0 = metric based 0 = single pith 1 = inch based 1 = half pitch</p>	<p>Extension byte (byte 7) ... x--- ---- ← Sub addressing transmission -x-- ---- ← Password transmission --0- ---- ← Reserved ---0 ---- ← Reserved ---- x--- ← Binary file transfer ---- -x-- ← Document transfer mode ---- --x- ← Electronic Data Interchange ---- ---x ← Byte 8 follows</p>	<p>Extension byte (byte 8) ... 0--- ---- ← Basic Transfer Mode -0-- ---- ← Reserved --0- ---- ← Reserved ---x ---- ← Character mode ---- 0--- ← Reserved ---- -x-- ← Mixed mode ---- --0- ← Reserved ---- ---x ← Byte 9 follows</p>
<p>Extension byte (byte 9) ... x--- ---- ← Processable mode 26 -x-- ---- ← Dig Network Capability --x- ---- ← Duplex capability ---x ---- ← JPEG coding ---- x--- ← Full colour mode ---- -0-- ← Preferred Huffman tables ---- --x- ← 12 bits/pel component ---- ---x ← Byte 10 follows</p> <p>Duplex capability 0 = Half duplex operation 1 = Full Duplex operation</p>	<p>Extension byte (byte 10) ... x--- ---- ← No subsampling -x-- ---- ← Custom illuminant --x- ---- ← Custom gamut range ---x ---- ← Letter size ---- x--- ← Legal size ---- -x-- ← Rec T.85 basic ---- --x- ← Rec T.85 L0 ---- ---0 ← Extend field</p>		

Table 4 - digit coding

In digit order	In coded data order
D4 → +	04 → space
0C → 0	0C → 0
8C → 1	1C → 8
4C → 2	2C → 4
CC → 3	3C → 6
2C → 4	4C → 2
AC → 5	54 → *
3C → 6	8C → 1
EC → 7	9C → 9
1C → 8	AC → 5
9C → 9	C4 → #
04 → space	CC → 3
54 → *	D4 → +
C4 → #	EC → 7

Annex 1 – example call

This is a call where the fax was sent calling to called party, negotiations were attempted at 9600, dropped back to 7200, then succeeded and the fax sent successfully.

Called to calling FF C0 04 <data> – Non Standard Facilities
Called to calling FF C0 02 <data> – Called Party Number
Called to calling FF C8 01 <data> – Standard ITU capabilities, including, e.g. 9600bps, Rec V.29
Calling to called FF C8 C1 <data> – Digital Command Signal, including, e.g. 9600bps, Rec V.29
...
[T.38 training data]
...
Called to calling FF C8 22 – Failure To Train
Calling to called FF C8 C1 <data> – Digital Command Signal, including, e.g. 7200bps, Rec V.29
...
[T.38 training data]
...
Calling to called FF C8 21 – Confirmation ready to receive
...
[T.38 fax page data]
...
Calling to called FF C8 F4 – End of procedure; End of Page, End of document
Called to calling FF C8 31 – Message confirmation (more messages may follow)
Calling to called FF C8 DF – Disconnect

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