
Portland, Oregon 18-22 January 1999

Question: 4/15

SOURCE¹: Matsushita

TITLE: G.hs: Enabling G.shdsl and Half Duplex negotiation in G.hs

ABSTRACT

This contribution is presented for information only. A method for initiating half duplex modulation style G.hs is proposed that simply requires minimal clarification to the G.994.1 (TD46/Plen) signal definitions. The TD46 procedures can remain unmodified and the half duplex method can be added at a later date. Criteria for selecting tones for 4k family is also discussed.

1. Introduction:

From the analysis in PO-046, we present a method for initiating half duplex modulation style G.hs that simply requires minimal modification to the G.994.1 (TD46/Plen) signal definitions. The TD46 procedures can remain unmodified and the half duplex method can be added at a later date. Criteria for selecting tones for 4k family is also discussed.

2. Half duplex handshake procedure

A half duplex procedure that requires minimal modification to the current duplex procedures in G.994.1 is described.

This procedure assumes that upstream and downstream negotiation frequencies are frequency separated in such a manner so as to require negligible filtering requirements. This half duplex procedure is independent of what frequencies (carriers) are used to transmit the signals. It could just as well be applied to 4.3kHz carriers.

The basic principles of the procedure are:

- A Half Duplex xTU-R sends flags (R-Flag-HD) instead of tone (R-Tone1). (future definition)
- A Half Duplex xTU-C stops transmitting C-Tones if receive R-Tone1 or R-Flag-HD. (future definition)
- A Full Duplex xTU-R sends R-Tone1 (same as TD46/Plen)
- A Full Duplex xTU-C continues to transmit C-Tones if it does not receive R-Tone1, but it may be receiving flags (R-Flags-HD) or other energy. [stated another way: If an xTU-C detects energy (but not R-Tone1) while transmitting C-Tones, it shall not stop transmitting C-Tones for at least 500 ms.]

¹ Contact: Stephen Palm
Matsushita Graphic Communication Systems

Table 1 provides a road map for the following detailed descriptions (sections 2.1 through 2.8) on the four cases of full duplex (FD) and half duplex (HD) capabilities in the xTU-R or xTU-C. The procedures are identical whether the xTU-R or xTU-C initiates. The Full duplex (FD) cases are identical to TD46/Plen and presented here for easy reference. Although these descriptions are presented separately, it is assumed they could be described in common text and simple modification to the state diagrams.

TABLE 1. HALF AND FULL DUPLEX PROCEDURE SUMMARY

Initiator	xTU-R capability	xTU-C capability	Section	Summary
xTU-R	Full	Full	2.1	Same as TD46/Plen
	Half	Half	2.2	xTU-R send R-Flag-HD xTU-C turns off C-Tones if sees R-Flag-HD (or R-Tone1)
	Half	Full	2.3	xTU-R send R-Flag-HD xTU-C keeps sending C-Tones if does not receive R-Tone1
	Full	Half	2.4	xTU-R send R-Tones1 xTU-C turns off C-Tones if sees R-Tone1 (or R-Flag-HD)
xTU-C	Full	Full	2.5	Same as TD46/Plen
	Half	Half	2.6	xTU-R send R-Flag-HD xTU-C turns off C-Tones if sees R-Flag-HD (or R-Tone1)
	Half	Full	2.7	xTU-R send R-Flag-HD xTU-C keeps sending C-Tones if does not receive R-Tone1
	Full	Half	2.8	xTU-R send R-Tones1 xTU-C turns off C-Tones if sees R-Tone1 (or R-Flag-HD)

An xTU-x with both FD and HD shall give precedence to FD. Use of FD is preferred because it is faster. The signaling method allows a dual mode (FD and HD) xTU-R to detect if the xTU-C was HD only (from the xTU-C's signaling), terminate that session, and restart a G.hs session with HD procedures.

2.1 xTU-R initiated startup (both have FD)

Figure 1 displays the timing for xTU-R initiated startup. Here, the xTU-R starts by transmitting signals from one or both of its signal families (R-Tones-Req), with phase reversals every 16 ms. When detected by the xTU-C, the xTU-C responds by transmitting signals from one or both of its signal families (C-Tones). When this has been detected by the xTU-R, the xTU-R transmits silence for 50 to 500 ms and then transmits signals from only one signal family (R-Tone1). When the xTU-C has detected R-Tone1, it responds by transmitting C-GALF1 (hex character 81) on modulated carriers. When the xTU-R has received GALF characters, it responds by transmitting R-Flag1 (hex character 7E) on modulated carriers. When the xTU-C has received Flags, it responds by transmitting C-Flag1. When the xTU-R has received Flags, it can begin the first transaction.

Figure 1 shows the timing requirements between events.

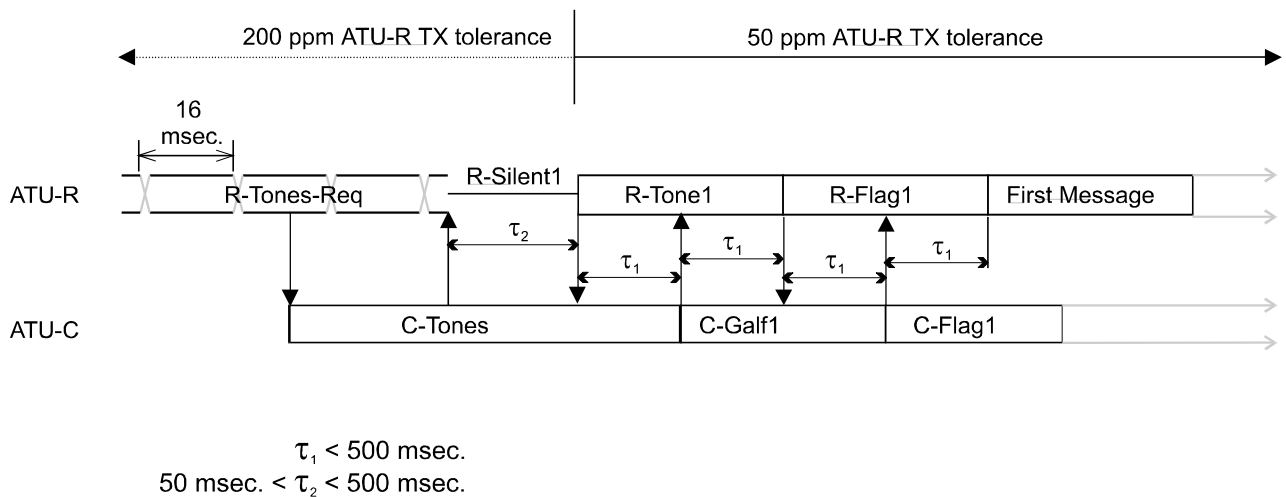


FIGURE 1. xTU-R INITIATED PROCEDURE (BOTH HAVE FD)

2.2 xTU-R initiated startup (both have HD)

The xTU-R starts by transmitting signals from one or both of its signal families (R-Tones-Req), with phase reversals every 16 ms. When detected by the xTU-C, the xTU-C responds by transmitting signals from one or both of its signal families (C-Tones). When this has been detected by the xTU-R, the xTU-R transmits silence for 50 to 500 ms and then transmits signals from one signal family (R-Flag-HD) for at least 100ms until the xTU-C turns off C-Tones. After the last flag has been transmitted, the xTU-R continues with sending the message followed by at least two flags (R-Flag-HD2). When the xTU-C has detected R-Flag-HD2, it can begin transmitting 100ms of flags (C-Flag-HD). After the last flag has been transmitted, the xTU-C continues with sending the message followed by at least two flags (C-Flag-HD2). If the xTU-C message was an ACK, the xTU-R can begin the selected mode initialization sequence. If not, the xTU-R returns to transmitting R-Flag-HD (above) and continues as described above. Likewise the xTU-C prepares to receive R-Flag-HD and continue as above.

Future Required Behavior: If the HD xTU-C is receiving Flags (R-Flags-HD) after beginning to send C-Tones, it shall cease transmission of C-Tones.

2.3 xTU-R initiated startup (xTU-R has HD only, xTU-C has FD only)

The xTU-R starts by transmitting signals from one or both of its signal families (R-Tones-Req), with phase reversals every 16 ms. When detected by the xTU-C, the xTU-C responds by transmitting signals from one or both of its signal families (C-Tones). When this has been detected by the xTU-R, the xTU-R transmits silence for 50 to 500 ms and then transmits signals from a signal family (R-Flag-HD) for at least 100ms. Since the xTU-C only has FD, it does not transmit C-GALF nor turn off C-Tones, it continues to send C-Tones. Since the xTU-R does not see the end of C-Tones, it knows the xTU-C cannot support HD, so it transmits at least 2 octets of R-GALF and then stops transmitting. Since the xTU-C sees R-GALF, it can stop transmitting C-Tones. Session is over.

Now required behavior: If the FD xTU-C does not receive R-Tone1 (eg it is receiving Flags (R-Flags-HD) after beginning to send C-Tones, it shall continue transmission of C-Tones for at least 500ms

Now preferred behavior: xTU-R transmit R-GALF when it wants to terminate the session.

Now preferred behavior: FD xTU-C stops sending C-Tones when receives R-Galf

2.4 xTU-R initiated startup (xTU-R has FD only, xTU-C has HD only)

The xTU-R starts by transmitting signals from one or both of its signal families (R-Tones-Req), with phase reversals every 16 ms. When detected by the xTU-C, the xTU-C responds by transmitting signals from one or both of its signal families (C-Tones). When this has been detected by the xTU-R, the xTU-R transmits silence for 50 to 500 ms and then transmits signals from a signal family (R-Tone1) for at least 100ms. Since the xTU-C only has HD, it turns off C-Tones. Since the xTU-R does not see C-GALF (and after a suitable timeout) and can detect the energy drop, it knows that the xTU-C cannot support FD, transmits 2 octets of R-GALF, and then ceases transmission. Session is over.

Future required behavior: If a HD xTU-C received R-Tones1, it shall turn off C-Tones

Now preferred behavior: If a FD xTU-R sees C-Tones go away, it shall timeout (and transmit 2 GALF to terminate). → An xTU-R can transmit GALF to terminate the G.hs session. → An xTU-C receiving GALF knows the session is being terminated. (xTU-R does receive GALF in normal startup)

2.5 xTU-C initiated startup (both have FD)

Figure 2 displays the timing for xTU-C initiated startup. Here, the xTU-C starts by transmitting signals from one or both of its signal families (C-Tones). When detected by the xTU-R, the xTU-R responds by transmitting signals from only one signal family (R-Tone1). When the xTU-C has detected R-Tone1, it responds by transmitting C-GALF1 (hex character 81) on modulated carriers. When the xTU-R has received GALF characters, it responds by transmitting R-Flag1 (hex character 7E) on modulated carriers. When the xTU-C has received Flags, it responds by transmitting C-Flag1. When the xTU-R has received Flags, it can begin the first transaction.

Figure 2 shows the timing requirements between events.

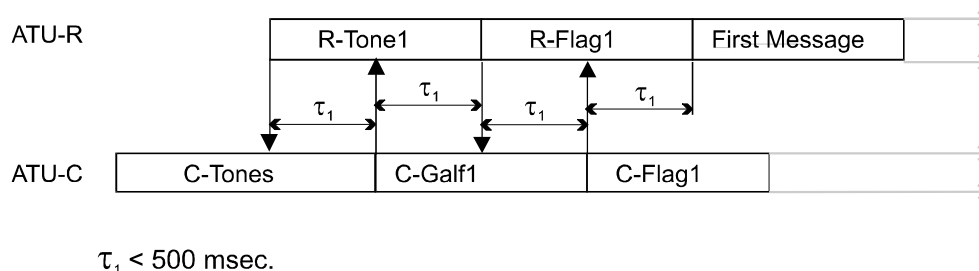


FIGURE 2. xTU-C INITIATING PROCEDURE (BOTH HAVE FD)

2.6 xTU-C initiated startup (both have HD)

The xTU-C transmits signals from one or both of its signal families (C-Tones). When this has been detected by the xTU-R for 50 to 500 ms, then the xTU-R transmits signals from one signal family (R-Flag-HD) for at least 100ms until the xTU-C turns off C-Tones. After the last flag has been transmitted, the xTU-R continues with sending the message followed by at least two flags (R-Flag-HD2). When the xTU-C has detected R-Flag-HD2, it can begin transmitting 100ms of flags (C-Flag-HD). After the last flag has been transmitted, the xTU-C continues with sending the message followed by at least two flags (C-Flag-HD2). If the xTU-C message was an ACK, the xTU-R can begin the selected mode initialization sequence. If not, the xTU-R returns to transmitting R-Flag-HD (above) and continues as described above. Likewise the xTU-C prepares to receive R-Flag-HD and continue as above. If the xTU-R will be terminating the session with an ACK

2.7 xTU-C initiated startup (xTU-R has HD only, xTU-C has FD only)

The xTU-C transmits signals from one or both of its signal families (C-Tones). When this has been detected by the xTU-R for 50 to 500 ms, the xTU-R then transmits signals from a signal family (R-Flag-HD) for at least 100ms. Since the xTU-C only has FD, it does not transmit C-GALF nor turn off C-Tones, it continues to send C-Tones. Since the xTU-R does not see the end of C-Tones, it knows the xTU-C cannot support HD, so it transmits at least 2 octets of R-GALF and then stops transmitting. Since the xTU-C sees R-GALF, it can stop transmitting C-Tones. Session is over.

2.8 xTU-C initiated startup (xTU-R has FD only, xTU-C has HD only)

The xTU-C transmits signals from one or both of its signal families (C-Tones). When this has been detected by the xTU-R for 50 to 500 ms, the xTU-R then transmits signals from a signal family (R-Tone1) for at least 100ms. Since the xTU-C only has HD, it turns off C-Tones. Since the xTU-R does not see C-GALF (and after a suitable timeout) and can detect the energy drop, it knows that the xTU-C cannot support FD, transmits 2 octets of R-GALF, and then ceases transmission. Session is over.

3. Carrier Selection criteria and proposal

In the selection of G.hs carriers, the following criteria shall be met:

1. Considers all of the services/families known today (Annex A, Annex B, Annex C, HDSL2, VDSL, etc)
2. Upstream and downstream will not use the same frequencies (i.e., G.hs does not use echo canceling)
3. FDM filter implementations (with a few nonessential additions) - i.e., avoid upstream/downstream interleaving
4. Avoid existing T1.413 activation tones (8, 44, 48, 52, 60) (as per G.hs agreement 2.12)
5. G.dmt Annex A and G.lite Annex A use same carriers. G.dmt Annex C and G.lite Annex C use same carriers. (For both upstream and downstream)
6. At least one carrier of G.dmt Annex A is same as that of G.dmt Annex C. At least one carrier of G.lite Annex A is same as that of G.lite Annex C. (for both upstream and downstream)
7. The ADSL Annex A Downstream band is reduced to tone 37 through 68 based on the G.lite agreement 27.19
8. Reasonably robust against Intermodulation products
9. A grid for decimation (mainly applicable for Annex A and Annex B)
10. Higher frequency tones should be spaced farther apart to reduce leakage in filters
11. In general, 3 tones per Annex
12. Tones between 14 and 64 should not be transmitted into a TCM-ISDN environment.
13. For the convenience of spectrum planning, 4kHz family tones can be approximated by nearby 4.3kHz family tones.
14. HDSL2 "preferred" upstream 10k (3)- 255kHz (59)
15. HDSL2 "preferred" downstream 280k (65)-375k (87) (plus below 280kHz is available though)
16. Avoid (if possible) RADSL activation frequencies. Upstream 68kHz (~#16) and 85kHz (~#20). Downstream 282kHz (~#65) and 306kHz (~#71).

TABLE 2 CARRIER SETS FOR THE 4.3125 kHz AND 4kHz SIGNALLING FAMILIES.

Signal Designation	Upstream Frequency Indices (N)			Downstream Frequency Indices (N)		
A43	9	17	25	40	56	64
B43	37	45	53	72	88	96
C43	7	9		12	14	64
A4	(4)	(28)	(34)	(66)	(67)	(76)
	kHz			kHz		
	16.0	120.0	148.0	284.0	288.0	328.0

HDSL2 "preferred" upstream 10k (3)- 255kHz (59) 4, 28, 34
 HDSL2 "preferred" downstream 280k (65)-375k (87) (plus below 280) 66, 67, 76

TABLE 3. G.HS CARRIER PROPOSAL

		4	7	8	9	12	14	17	25	28	31	34	37	40	44	45	48	52	53	56	60	63	64	66	67	68	72	76	88	96	255	
UP	Avoids	8																														
	shdsl	4																														
	Anx. A		9								17	25																				
	Anx. B																															
	Anx. C		7	9																												
DN	Avoids																44	48	52											60		
	shdsl																															
	Anx. A														40															66	67	76
	Anx. B																															
	Anx. C																															
IN																																
UP	shdsl	4																														
	Anx. A		7								31																					
	Anx. B																															
	Anx. C		7		13																											
DN	shdsl																															
	Anx. A																															
	Anx. B																															
	Anx. C																															

4. Summary:

1. This paper should be presented under the G.hs text correction section.
2. Expectations: Presented for information only.