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Question: 11/16

**Source**<sup>1</sup>: INMARSAT, COMSAT

**Title:** H.324 considerations for geostationary satellite channels

**Purpose:** Proposal

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## Abstract

ITU-T Recommendation H.324 describes a terminal for low bitrate multimedia communication using V.34 modems operating over the GSTN. Because the GSTN is a complex network composed of a great variety of underlying physical supports, provisions should be made to ensure that H.324 operates correctly in all these media. In this paper we introduce the particular aspects of geostationary mobile satellite communications and recommend a suitable approach to handle the value for the acknowledgement timer T401.

## 1. Mobile geostationary satellite channel

A typical single mobile geostationary satellite channel carrying data (multimedia or other) operates at **28.8 kbit/s**. The main characteristics which are of concern in transmission of multimedia information are the bit error rate and the transmission delay. Raw bit error rate can be as high as  $10^{-2}$ , or even worse in fading conditions. However, channel encoding is used to give a typical channel BER of  $10^{-5}$  or better. One-way transmission delay depends heavily on the connection used:

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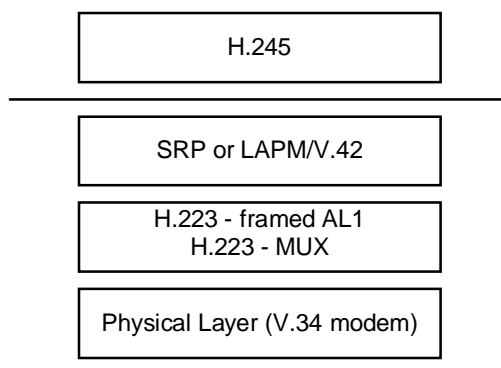
	Double-hop Worst case (ms)	Single-hop Typical case (ms)
<b>Mobile geostationary satellite channel</b>		
Free space transmission delay	260 <sup>(1)</sup>	260
Coding/processing delay	170	170
<b>GSTN</b>		
second GSTN satellite hop	260	-
rest of GSTN	100	100
<b>Total</b>	<b>790</b>	<b>530</b>

Note: (1) As per Table A.1/G.114

These values are much larger than for typical cable GSTN lines (examples are given in Table A.1/G.114).

## 2. Timers in H.324

A number of timers are used in the H.324 control channel (protocol H.245) to acknowledge correct receipt of control information. Recommendation H.324 requires that all H.245 timers shall have periods ( $T_{\max \text{ delay}}$ ) of at least the maximum data delivery time allowed by the layer transporting H.245. The following picture, from H.324 Annex A, shows the protocol stack:



**Protocol stack for H.324 control channel**

SRP or LAPM/V.42 may be used to provide a reliable transport layer for H.245. They use an acknowledge timer T401 and a retransmission counter N400. The value of the timer T401 is a local matter (with the possibility of different periods of T401 for each terminal) but as pointed out in V.42 Appendix IV, it should take in account the following factors:

- the propagation delay involved in transmitting the frame requiring acknowledgment – ( $T_a$ );
- the time needed for the remote DCE to process the received frame and formulate the acknowledgment – ( $T_b$ );

- c) the maximum time allowed to complete transmission of those frames in the remote DCE's "transmit queue" (e.g. a frame already in progress of being transmitted or a frame that can not be displaced) – ( $T_c$ );
- d) the time needed to transmit the acknowledging frame – ( $T_d$ );
- e) the propagation delay involved in transmitting the acknowledging frame – ( $T_e$ );
- f) the processing time needed by the error control function to recognize the acknowledging frame – ( $T_f$ ).

$$(1) \quad T_{401} \geq T_a + T_b + T_c + T_d + T_e + T_f$$

The number of retransmissions (N400) is a local matter as well. The two terminals may operate at different maximum values of N400. No default value is given but it should be at least 6 (H.324 Annex A).

In the case where V.42 is used, two other parameters are of interest: **N401**, the maximum number of octets in an information field; and **k**, the window size. The maximum information buffering allowed by the V.42 entity is  $N401 \times k$ .

### 3. Recommendations regarding T401

For the case of a typical geostationary satellite link we have:

$T_a = 530 \text{ ms}$  (typical case) /  $790 \text{ ms}$  (worst case)

$T_b = 300 \text{ ms}$  (typical case)

$T_c =$  considered to be small in multimedia applications

$T_d = 24 \text{ bits}$  (3 octets) /  $2400 \text{ bits/s}$  (worst case) =  $10 \text{ ms}$

$T_e = 530 \text{ ms}$  (typical case) /  $790 \text{ ms}$  (worst case)

$T_f =$  considered to be small in multimedia applications

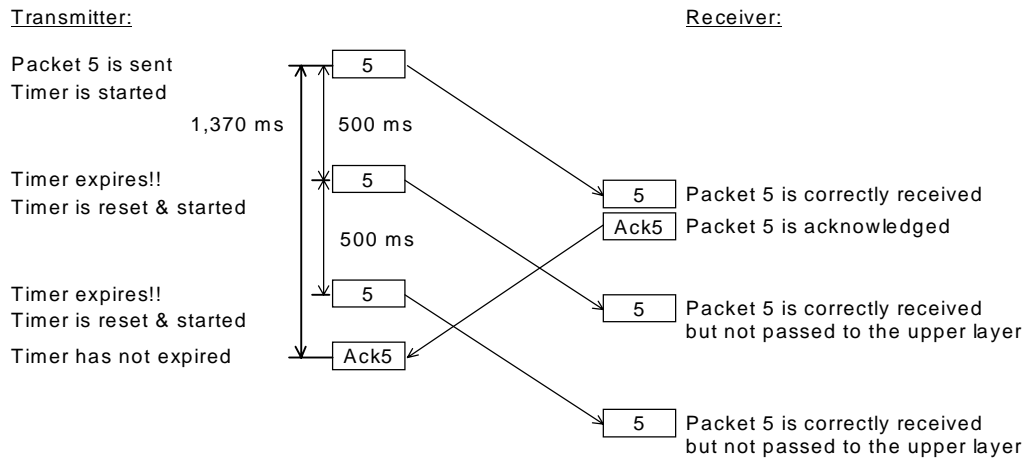
Which yields a minimum value for  $T_{401}$  and  $T_{\max \text{ delay}}$  of:

	<b>T401</b>	$T_{\max \text{ delay}}$
<b>Typical case</b>	<b>1,370 ms</b>	<b>8,220 ms</b>
<b>Worst case</b>	<b>1,890 ms</b>	<b>11,340 ms</b>

Holding this inequality:

$$(2) \quad \frac{N401 \cdot k}{DataBitRate} \geq T_{401} \geq RoundTripDelay$$

**At present**, most developers are using a period for T401 (500 ms) which is below the typical satellite round trip delay (1,370 ms). Therefore retransmissions would occur in the satellite channel even in error free conditions:



### Error free case with T401 period of 500 ms and round-trip delay of 1,370 ms

This will reduce the available bandwidth and the overall performance will decrease. In particular, for the given figures, two retransmissions will be necessary for any single transmitted data packet. This means that only one packet out of three will not be discarded at the far end. Therefore, if the default T401 value is used, the throughput for an average-delay connection through a geostationary satellite will **drop to a third** of the throughput obtained for a terrestrial connection (all other factors remaining constant).

To overcome this problem two possible approaches can be followed:

#### 1) Adjust the value of T401 at communications start-up

Communication is started with a value arbitrarily set (typically a low value for T401 would be used to speed up connection establishment) but if it is lower than the one suggested in this paper, an H.245 round-trip delay procedure would be used at the very beginning of the communication to tune T401 appropriately.

#### 2) Set a large default minimum period for T401

If the value of 1.37s (or greater) is adopted as minimum starting value of T401 there will be no throughput degradation. In the case of communications not over geostationary satellites, an H.245 round-trip delay procedure can be used during communication to finely tune T401.

**It is our recommendation that Approach 2) above be adopted, which concurs with a recent amendment approved to the draft text of H.Multilink. Additionally, for V.42, the values of N401 and k should be set according to inequality (2).**