Soip over Satellite Testing – TIM Experience

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Abstract. In the present Mobile Telecommunications scenario, the transmission of SS7 signalling on traditional TDM circuits is evolving to a SS7 over IP network (SoIP) solution, due to the continuous efficiency research in optimizing transmission and to the continuous goal of cost reduction. Some operators are using SoIP network in a national environment, while international SoIP networks are going to be deployed in a few years. Since transmissions over satellite may represent a fast way to deploy an international Backbone, TIM performed a trial in cooperation with TILAB, using Cisco Signalling Gateways and EUTELSAT satellite network. This paper describes the most significant results obtained by this experience, with respect to two critical aspects of satellite connection: the Transmission Delay and the Bandwidth Availability. Satellite delay put in evidence some practical limitations for the current Cisco release (called MB9), if compared with the traditional terrestrial Backbone; a special upgraded release (MB9-SAT) resolved them, but dynamic allocation of bandwidth asked for a detailed investigation on configuration criteria, in order to avoid system congestion. Both releases have been tested also with a delay-line simulator, to examine their performances on traffic management with delay varying between 0 and 700 ms. These activities drove us to outline an operative reference model, useful to understand network behavior under different conditions and to configure its fundamental parameters.

Glossary

B_{ETH}:	Signalling on Ethernet traffic Band
B_{IN}:	Traffic Band injected into IP Network
$B_{IN, max}$:	Maximum threshold of B_{IN} before congestion
B_S:	Total Satellite Band
B_{SS7}:	Signalling traffic Band
ΔB:	Increase of Signalling traffic band
CWND:	Congestion Window
DAMA:	Dynamic Assignment Multiple Access

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DPC:	Destination Point Code
EUTELSAT:	Satellite Communications company
GTT:	Global Title Translation
IETF:	Internet Engineering Task Force
IP:	Internet Protocol
M2PA:	MTP2 user Peer-to-peer Adaptation layer
MSU :	Message Signalling Unit
MTP2:	Message Transfer Part 2
MTP3:	Message Transfer Part 3
N_A:	SCTP Associations' Number
OSI:	Open System Interconnection
PAMA:	Permanent Assignment Multiple Access
RTT:	Round Trip Time
SIGTRAN :	Signalling Transport
SCCP:	Signlling Connection Control Part
SCTP:	Stream Control Transmission Protocol
SG:	Signaling Gateway
SoIP :	Signalling SS7 over Internet Protocol
SS7:	Signalling System n.7
T_{ACK} / T_{ALL}:	ACKnowledge / ALLocation Time
TCP:	Transport Control Protocol
TDM:	Time Division Multiplexing
TDMA:	Time Division Multiple Access
TILAB:	Telecom Italia LABoratories
TIM:	Telecom Italia Mobile S.p.A.
TT:	Traffic Terminal
VLAN:	Virtual Local Area Network
WAN:	Wide Area Network

1 Introduction

Satellite communication represents the pioneering stage of telecommunication network in those parts of the world not covered by transmissions infrastructures: it allows a fast deployment of a telecommunication network, giving access to those services typically provided by the wire line and wireless terrestrial networks.

The paper presents some results of SoIP over satellite testing, implemented with CISCO Signalling Gateways, at first equipped with release MB9, then with a special release for "SoIP over satellite" called MB9-SAT. Both of them have been tested also with a delay-line simulator, in order to examine their performances under different delay conditions. Results and observations lead to outline an operative reference model, mainly aimed to guide in the configuration of fundamental transport parameters.

2 Soip over Satellite Testing

The acronym SoIP (Signalling SS7 over IP) can be referred to every system dealing with transport of signalling messages over an IP network.

Signalling Gateways (SG) allow SS7 messages to be transported on IP networks, according to the architectural model proposed by SigTran (IETF Working Group). Usually they are composed of several modules, each of them performing the major functionalities, as shown in Figure 1:

- the line interfaces, that set up the signalling circuits front-end, realizing the interworking function of MTP2 layer messages;
- the central processor, that performs MTP3 and SCCP layers, managing the connection;
- the IP Fast Ethernet Interfaces, that perform system connections to IP backbone.

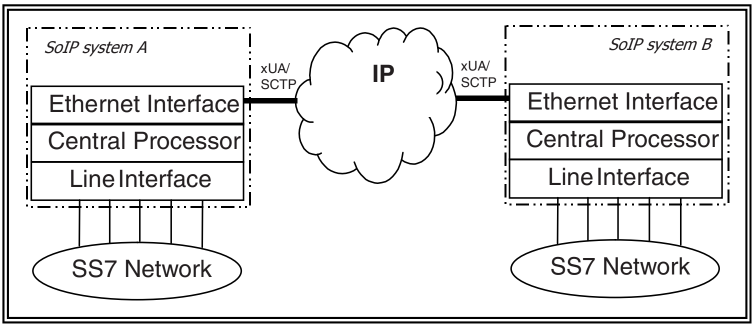

Fig. 1. SoIP System general architecture

Concerning with IP transport, the protocol stack defined by SigTran specifies the replacement of the TCP protocol (layer 4 of OSI reference model) with the new SCTP protocol [1]. The TCP is designed in order to ensure the transfer of long files without the control of the transit time; instead, the SCTP is designed in order to satisfy the timing requirements of the signalling by containing transit delays. Interworking functions between SS7 and IP protocols rely on an adaptation layer, positioned between transport and application layers, which performs adaptation at SS7 layer 2, or 3 and higher, according to manufacturer's strategies [2], [3], [4].

2.1 Testing Architecture

The system under test is composed by the following basic equipments (see Fig. 2):

- SS7 Traffic Simulator, used as load generator, to send and receive the signalling protocols messages. It is able to generate Message Signalling Unit (MSU) of different length (60, 120 and 270 Bytes length are commonly used) and with two types of SS7 routing (via DPC in MTP level or GTT in SCCP level). The Traffic Simulator has a 30 Signalling Links limit capacity, each link able to transport up to 64 Kb/s, so that 30 Erlang bi-directional is the maximum traffic load.
- Signalling Gateways (A and B) are Cisco ITP7500, transporting SS7 layer 3 (MTP3) on SCTP through the adaptation layer M2PA [5], while IP network layer is transferred through a Fast Ethernet.

SG's performances on IP terrestrial backbone have already been estimated in latest trials, where each SG was able to get over 0.98 – 1 Erlang per link on 30 connected Signalling Link, varying MSU's length.

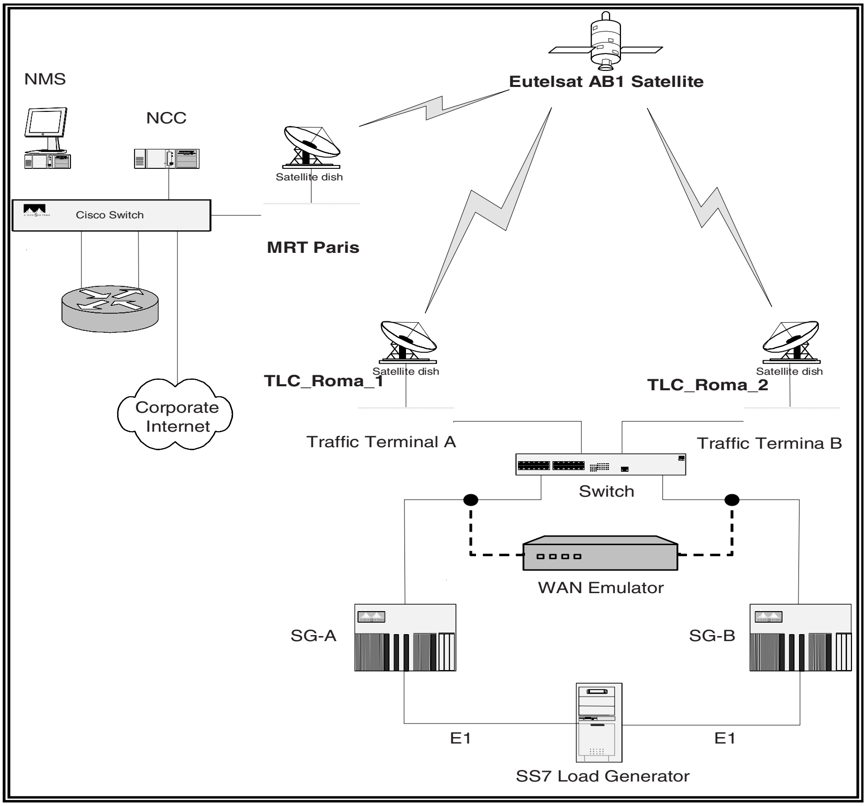

Fig. 2. SoIP over Satellite Testing Architecture

- Traffic Terminal: interface device between Ethernet and Satellite networks, described in paragraph 2.2.
- WAN Emulator: device emulating a Wide Area Network (WAN), whose basic features are fully configurable, such as network bandwidth, packet delay time, packet loss rate, packet's priority, etc. etc. Along the trial it was used only as a delay-line simulator, to allow a detailed performance measurement on delay variation.

2.2 Satellite Connection

EUTELSAT provides the space segment and the satellite connectivity by Linkway Platform from ViaSat Inc., a pay-per-use satellite communication system based on Traffic Terminals: these devices can transport multiple protocols traffic (IP, ATM, Frame Relay, ISDN and Signaling System 7) through a native 10BaseT Ethernet connection to the terrestrial networking equipment, manage the IP routing table and assign dynamical satellite bandwidth as needed.

Remote configuration and control of the entire network are carried out by the Network Control Computer (NCC), connected to the Master Reference Terminal (MRT), installed at EUTELSAT Headquarters in Paris, where the network administrator can configure all the parameters in real time: a complete network becomes a cost-effective solution, thanks to the efficient utilization of space segment resources by TDMA access and their sharing among all terminals by dynamic allocation of bandwidth.

As for the testing network (see Fig. 2), Signalling Gateways SG-A and SG-B communicate with Traffic Terminals TT1 and TT2 through a Layer-2 Switch, where two VLANs separate the traffic between SG-A and TT1 from the traffic between SG-B and TT2: Linkway modems encapsulate the Ethernet traffic into the satellite access protocol and transmit bursts to each other on a Permanent Virtual Circuit, using TDMA access mode.

The requested satellite bandwidth is obtained by two carriers, both of them dynamically accessible from terminals, according to the Multi Frequency TDMA protocol (only one terminal transmitting on a carrier at the same time under control of the MRT); taking into account the protocol headers and the guard time between the TDMA bursts, the maximum available bandwidth per carrier is 2320 Kbps.

This value represents the maximum full duplex Ethernet throughput on satellite, available both as full Permanent Assignment Multiple Access (PAMA, i.e. 2048 Kb/s) Band and as mixed combination of Permanently Assignment (i.e. 1024 Kb/s) and Dynamic Assignment Multiple Access (DAMA, exceeding) Band.

2.3 Test Typologies

It's in common experience that IP transport is prone to delays, which can be emphasized by interworking functions between the different protocols in use and, in this case, by the satellite connection: that's why more attention is asked to parameters such as packet delay, loss rate [6] and satellite bandwidth availability in testing innovative signalling transport systems.

In fact, performance testing has the purpose to evaluate the traffic level (in terms of Loss Rate and Transit Delay) that can be handled respecting SS7 standard specifications, while varying MSU length, SS7 routing (via DPC in MTP level or GTT in SCCP level) and the bandwidth allocation on the satellite network.

The trial's main target was to evaluate critical impacts of the satellite connection usage on the whole system, as introduced in the following paragraph.

2.4 Critical Aspects

The satellite connection introduces two critical aspects on the system: the Transmission Delay and the Bandwidth Availability.

A traditional SoIP system introduces a 20-40 ms delay due to processing on single SGs, which complies with acknowledges timers of SS7 messages. Now, satellite connection introduces 640-680 ms Round Trip Time (RTT), that means the entire system's RTT will be about 700 ms: it's necessary to evaluate the impact of Transmission Delay on the SS7 messages time-outs and on the SCTP retransmission timers [7], [8], [9].

Satellite bandwidth can be assigned in two different ways: PAMA Band is permanently assigned on satellite, whereas DAMA Band is assigned on demand and if available, according to a specific negotiating algorithm, with configurable allocation/de-allocation speeds. When using PAMA Band, the satellite connection affects entire system only by introducing its nominal delay; when using DAMA Band it's necessary to estimate the negotiating algorithm incidence on entire system delay and on possible SG congestions.

3 Main Results

3.1 Transmit Delay Effects

In order to investigate the transmit delay effects on satellite link (about 700 ms RTT), system equipments have been configured as follows:

- Satellite band: PAMA Band at 2048 Kb/s with about 150 Kb/s DAMA Band, so that there is no bottleneck on this side;
- Signalling Gateway: IOS in Release MB9 and one SCTP association, with Congestion Window (CWND) growing from initial value to 64000 Bytes (maximum value), as configured by manufacturer.
  CWND is one of the SCTP variables regulating the transmission rate, as focused later on.

Two are the anomalous consequences we observe:

1) when generated traffic stays between 400 and 850 Kb/s in Ethernet Band, there is a transient congestion up to 70 s (loss rate 40-70%);
2) when traffic exceeds 850 Kb/s, congestion lasts for more than 240 s.

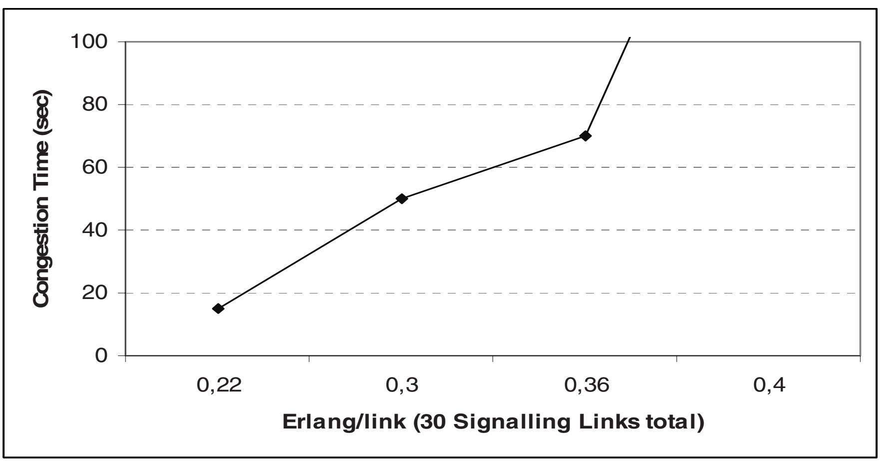

Fig. 3. Congestion Time vs. Erlang/link (Rel. MB9)

Figure 3 shows how congestion duration increase with generated SS7 traffic: when load generator works at 0.36 Erlang/link, there is a transient congestion of about 70 s that limits Transmitted Band to 300 Kb/s, even if generated band is about 1020 Kb/s. This is connected with CWND rising from initial value to the needed level.

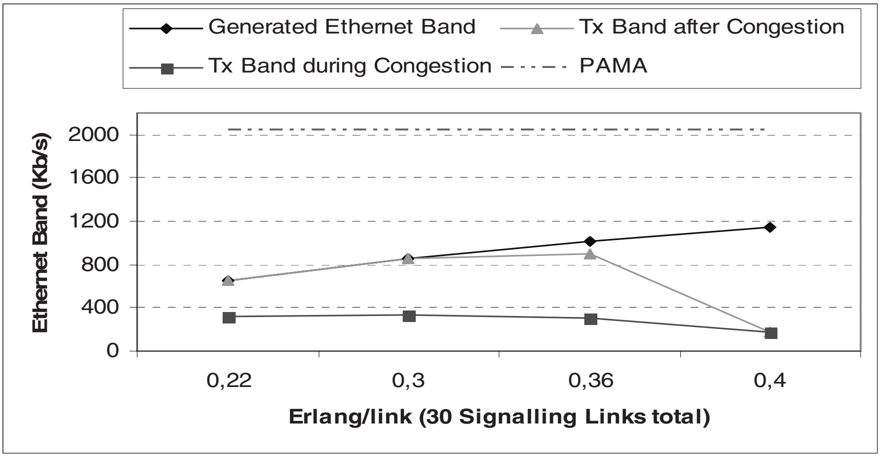

Fig. 4. Generated and Transmitted Ethernet Band vs. Erlang/link (Rel. MB9)

In Figure 4 there's an example of how Transmitted Band vary with generated SS7 traffic (both during and after congestion): when traffic is 0.36 Erlang/link, Transmitted Band is 300 Kb/s during 70 s of transient congestion and rises to 900 Kb/s after it, even if generated band is about 1020 Kb/s.

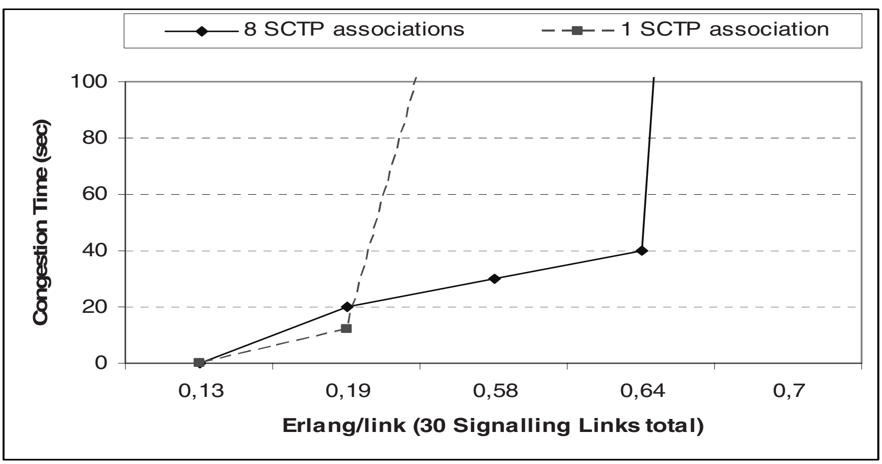

Fig. 5. Congestion Time vs. Erlang/link (8 associations, Rel. MB9)

To improve such a limited performance, the simplest step is activating more than one SCTP associations, even if it implies that occupied Ethernet band increases, SS7 traffic being equal, according to number of activated and then used associations.

Moreover uniform distribution of SS7 traffic among all SCTP associations is not granted, because SG strictly divides messages according to their Signalling Link Code, when in-sequence delivery is required: thus, the SS7 interface configuration (link-sets amount and dimension) could influence packet distribution and congestion conditions as well.

Setting Association number N_A=8 (maximum link-sets dimension) obtains a little improvement on critical behaviour, without totally solving it (see Figures 5 and 6): the initial congestion is shorter in time and lower in percentage (duration 20-40 s, loss rate 5-20 %), and it becomes a continuous state after a higher threshold (while generated traffic doesn't exceed 1900 Kb/s, equal to 0.64 Kb/s in this case), but it is still unacceptable, bringing forward that N_A is not decisive.

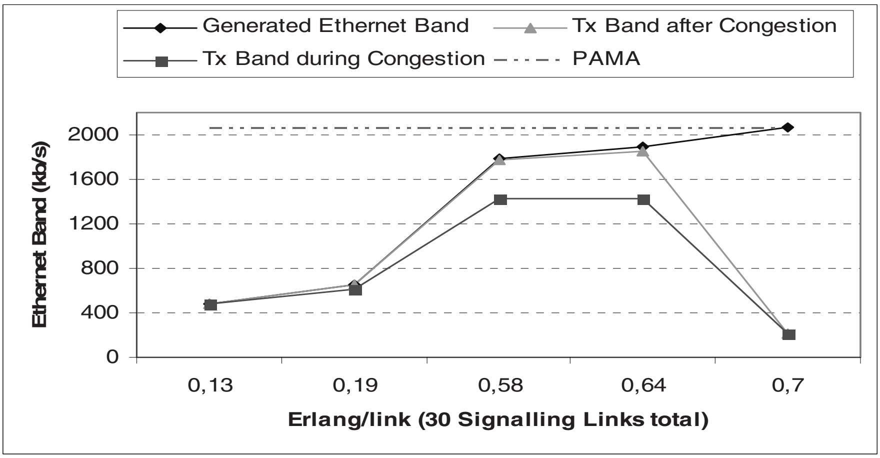

Fig. 6. Generated and Transmitted Ethernet Band vs. Erlang/link (8 associations, Rel. MB9)

For a further examination of the single SCTP association behavior varying RTT, we replace the satellite connection with a WAN Emulator and increase RTT value on this instrument: congestion happens when RTT exceeds 600 ms, with loss rate growing with RTT itself, independently from MSU length (60 or 270 Bytes) and SS7 routing (DPC or GTT), as shown in Figure 7.

This result confirms RTT on satellite link is so high that the amount of data waiting for acknowledge (called OUTSTAND) reaches CWND Maximum Value too fast, driving the system to a congestion state: that's why the configuration of the single association shall be modified in terms of SCTP parameters.

In order to make them accessible to operator, manufacturer modifies SG Operative System (special Release MB9-SAT), suggesting values in brackets: Initial CWND Size (384000), Retransmit CWND Rate (0, SCTP Fast Restart), Fast CWND Rate (0), Transmission Queue Depth (8000); besides, CWND never grows over its initial value.

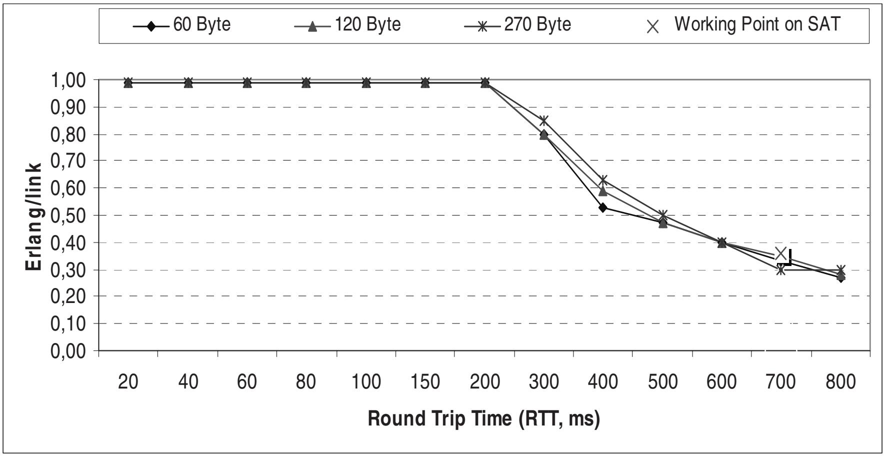

Fig. 7. Traffic Limitation vs. RTT (1 association, Rel. MB9)

Experimental checking with WAN Emulator shows complete absence of congestion through only one SCTP association, even when SS7 traffic rises suddenly to 30 Erlang (see Figure 8).

After this updating, we can proceed to evaluate bandwidth availability effects, coming back to satellite connection.

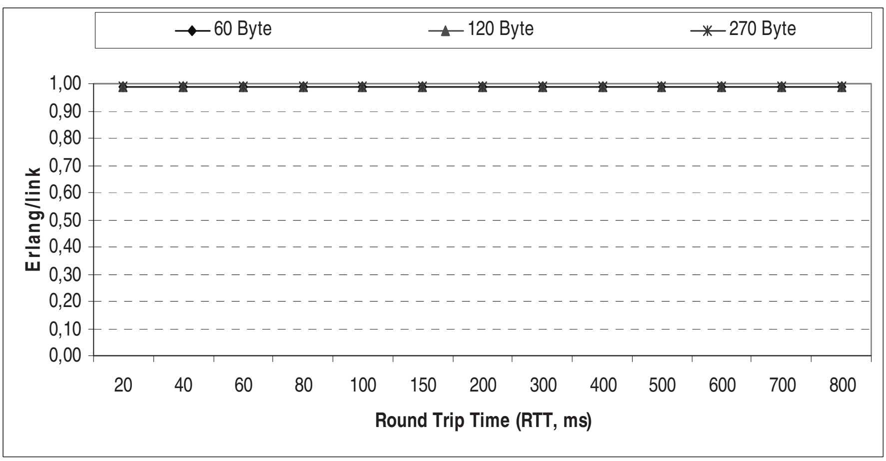

Fig. 8. SS7 Traffic Load vs. RTT (1 association, Rel. MB9-SAT)

3.2 Bandwidth Availability Effects

In order to evaluate satellite bandwidth availability effects, we observe system reactions increasing SS7 traffic, with PAMA Band set first to 2048 Kb/s and then to 1024

Kb/s; thank to Operative System change, there is no initial congestion, but two critical consequences appear (see Figure 9):

1) when Ethernet Band of generated traffic exceeds PAMA Band even only by 5%, about the 50% of messages are lost (Used Band lower than Expected Band);
2) SS7 traffic has to be reduced to 50% of PAMA Band to clear congestion.

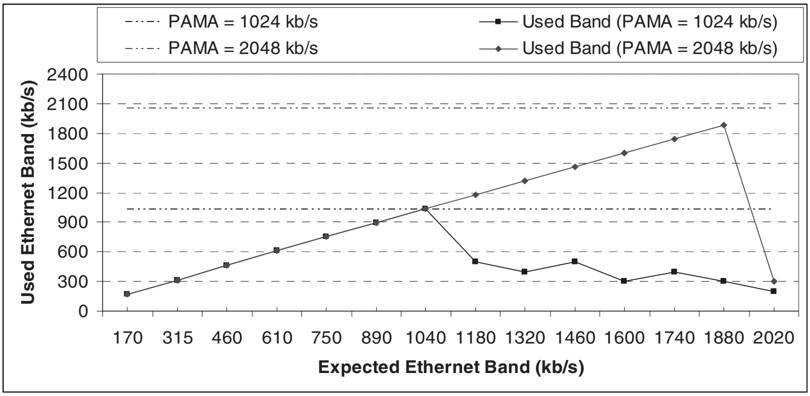

Fig. 9. Examples of Used Ethernet Band vs. Expected Ethernet Band

We can explain this behaviour by the following observations:

- the amount of acknowledge waiting data (so called OUTSTAND) grows with SS7 traffic band (B_{SS7}) and with the Acknowledge Time T_{ACK}, needed by SCTP to receive a transmitting data acknowledge and made up by Round Trip Time, possible DAMA Band Allocation Time (T_{ALL}) and possible Queuing Time on SS7 receiving interface (T_Q), according to:

$$OUTSTAND = B_{SS7} \cdot T_{ACK} \qquad T_{ACK} = RTT + T_{ALL} + T_Q{}^{1} \tag{1}$$

- OUTSTAND and CWND define respectively the traffic band injected in the network (named B_{IN}) and its maximum threshold (named $B_{IN,\,max}$), beyond which Congestion Avoidance (CA) Algorithm takes action, according to:

$$B_{IN} = OUTSTAND\,[Bytes] \cdot 8\,[bit] / T_{ACK} \tag{2}$$

$$B_{IN,\,max} = CWND\,[Bytes] \cdot 8\,[bit] / T_{ACK} \tag{3}$$

When B_{SS7} is constant and lower than PAMA Band, OUTSTAND is constant too, T_{ACK} is just equal to RTT and B_{IN} is equal to B_{SS7}; apparently, this situation leads to set CWND at the highest value, so that Congestion Time T_C, needed by OUTSTAND to reach CWND, is as long as possible (at least longer than T_{ACK}) and the Satellite Band B_S (PAMA+DAMA) can be fully employed, without congestion limit.

[1] T_Q will be omitted from now on, since it can be avoid by generating less than 1 Erlang/link on each of 30 Signalling Links per SG.

But when B_{SS7} grows up of ΔB, exceeding PAMA Band before $B_{IN, max}$, the Satellite Allocation/De-Allocation (SAD) Algorithm causes a T_{ALL} (1÷2 s), which makes T_{ACK} surely longer than T_C: because of this, not only OUTSTAND (and thus B_{IN}) grows faster to CWND ($B_{IN, max}$) causing congestion, but also the higher CWND has been set, the heavier congestion goes, with both CWND and OUTSTAND falling down and oscillating, triggering SAD and CA Algorithms in cycle. The system returns to a stable condition only by traffic reduction to 50% of PAMA Band.

Facing such effects, increasing the SCTP associations' number appears no longer useful, as easy to check by using WAN Emulator first and then going back to satellite connection:

- without band limitation (WAN Emulator), setting Associations' Number N_A=2 makes accepted traffic double, RTT and CWND being equal, because accepted traffic is proportional to N_A and CWND, inversely proportional to RTT;
- with band limitation (satellite connection), available band is however shared between N_A=2 associations, each of them going congested to half the traffic of previous case, since two associations with fixed CWND are equal to single association with doubled CWND, once again underlining its basic importance.

Therefore our final goal is to define the appropriate rules, which allow to correctly set CWND value, so that, when OUTSTAND reaches it, there both values stay still and any other traffic increase is rejected by periodic loss events, without performance collapse and simultaneously without wasting B_S.

3.3 Defining an Operative Reference Model

We can model the transmitting side of the system under test as shown in Figure 10, where the SS7 traffic band (B_{SS7}, generated by 30 Signalling Links, each at 0.xx Erlang rate) feeds OUTSTAND for the time T_{ACK}, being injected in the Fast Ethernet network as $B_{ETH} = (1+\alpha_{OH}) \cdot B_{IN}$ (with α_{OH} to calculate OverHead).

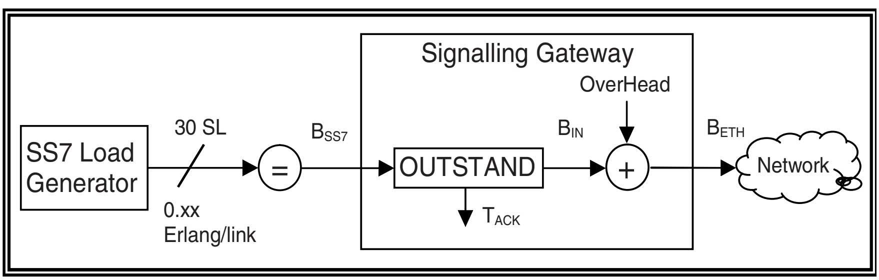

Fig. 10. System under Test transmitting scheme

Together with (1), (2), (3) and according to what expounded above, they let us formalize the following relations:

a) when CWND is such that $(1+\alpha_{OH}) \cdot B_{IN, max}$ is lower than PAMA Band and B_{SS7} increases of ΔB, OUTSTAND grows in function of ΔB as

$$OUTSTAND = B_{SS7} \cdot RTT + \Delta B \cdot RTT \quad (4)$$

and, if CWND is reached, CA Algorithm is able to keep them both to maximum value, rejecting any other traffic increase by periodic loss events, without performance collapse;

b) when CWND is such that $(1+\alpha_{OH}) \cdot B_{IN,\ max}$ is greater than the whole B_S and B_{SS7} increases of ΔB over PAMA Band, OUTSTAND grows in function of ΔB and of T_{ALL} as

$$OUTSTAND = B_{SS7} \cdot RTT + \Delta B \cdot (RTT + T_{ALL}) \quad (5)$$

where the second term implies a transient dynamic rise, making OUTSTAND suddenly exceed CWND, so that CA Algorithm triggers the cycled action of SAD Algorithm, which drives SCTP association to a continuous congestion, cleared only by traffic reduction to 50% of PAMA Band;

c) when CWND is such that $(1+\alpha_{OH}) \cdot B_{IN,\ max}$ is greater than PAMA Band, but lower than B_S, it's possible to overcome PAMA Band and to avoid congestion by keeping ΔB under the opportune threshold.

All these conditions are schematically summed up in the three working cases of (6), whose knowledge allows a right configuration of transport parameters:

(6)

Case A: when CWND is such that $(1+\alpha_{OH}) \cdot B_{IN,\ max} > B_S$

$B_{ETH} < PAMA \Rightarrow B_{IN} = B_{SS7}$, Loss Rate = 0%

$B_{ETH} > PAMA \Rightarrow B_{IN}$ falls down, LR = 50% (congestion)

Case B: when CWND is such that $(1+\alpha_{OH}) \cdot B_{IN,\ max} < PAMA$

$B_{ETH} < B_{IN,\ max} \Rightarrow B_{IN} = B_{SS7}$, LR = 0%

$B_{ETH} > B_{IN,\ max} \Rightarrow B_{IN} = B_{IN,\ max}$, $LR = (B_{SS7} - B_{IN,\ max}) / B_{SS7}$

Case C: when CWND is such that $PAMA < (1+\alpha_{OH}) \cdot B_{IN,\ max} < B_S$

$\Delta B < \Delta B_{max} \Rightarrow$ case b.

$\Delta B > \Delta B_{max} \Rightarrow$ case a.

Finally, the study on N_A number of SCTP associations can be summed up in the following:

$$N_A \cdot CWND \cdot 8 / T_{ACK} = constant = N_A \cdot B_{IN,\ max} = B_{IN,\ MAX} \quad (7)$$

where $B_{IN,\ MAX}$ is the total Maximum Injected Band, to be compared to B_S according to (6), that means $B_{IN,\ max}$ to be compared to B_S / N_A.

From this viewpoint, also statements in paragraph 3.1 about Transmit Delays (N_A = 8) find justification:

- 8 SCTP associations with CWND maximum value 64000 are equivalent to a single association with CWND maximum value 516000, enough to reach PAMA Band and fall in congestion with Loss Rate 50% (case A);
- initial congestion dues to CWND too slow rise from initial value.

Expressions (1), (2), (3), (4) and (5) build up an operative reference model about the system under test.

4 Test Methodology and Experimental Evidences

According to previous achievements, it follows that:

1) system congestion find the trigger event in band availability, when PAMA Band is over and DAMA Band gets allocated in T_{ALL};
2) two SCTP associations with fixed CWND are equivalent to one association with doubled CWND, on the basis of (5);
3) CWND is a significant parameter and shall be fixed on the basis of (6);
4) SS7 generated traffic increase shall take in consideration (6), as well.

To execute meaningful tests, system equipments are configured as follow:

- Satellite band: PAMA Band at both 2048 Kb/s and 1024 Kb/s with DAMA Band on demand till a total band of about 2150 Kb/s, configuration of SAD Algorithm in order to have the quickest allocation and the slowest de-allocation;
- Signalling Gateway: one SCTP association, with different CWND initial value.

From the whole tests we find that there isn't any dependence on SS7 routing (DPC or GTT) and different MSU length means essentially different OverHead fraction α_{OH} (inversely proportional to MSU length), SS7 generated traffic being equal.

4.1 Experimental Evidences

Starting with the suggested value for CWND (384000 Bytes), $B_{IN,\ max}$ is about 4600 Kb/s (considering T_{ACK} = RTT = 650 ms) and, whatever OverHead fraction we use, the system is in *Case A* for both PAMA Band choices. With 270 Bytes long MSUs, α_{OH} is about 0.16 and $\Delta B \approx 120$ Kb/s corresponds to steps of about 140 Kb/s in Ethernet Band. Tests for both PAMA values show that no messages are lost until PAMA Band is quite over; then, Ethernet Band falls down and start to oscillate, the system goes under congestion with Loss Rate of about 50% and turns stable only after B_{IN} is hardly reduced (as yet shown in Figure 9).

Changing CWND value to 154000 Bytes, when using 270 Bytes long MSUs, the system is in *Case B* with PAMA Band set to 2048 Kb/s and a null value for DAMA Band, because RTT rises from 650 ms to 750 ms while approaching PAMA, so that $B_{IN,\ max} \approx 1650$ Kb/s and $(1+ \alpha_{OH}) \cdot B_{IN,\ max} \approx 1910$ Kb/s.

Tests show that B_{IN} rises till $B_{IN,\ max}$ and then any traffic increase is periodically rejected, without compromising system performances (see Figure 11).

If DAMA Band is set to 250 Kb/s, RTT is about 650 ms also while approaching PAMA Band, so that $B_{IN, max} \approx 1850$ Kb/s and $(1+ \alpha_{OH}) \cdot B_{IN, max} \approx 2150$ Kb/s: the system is lightly in *Case C*.

A test with 270 Bytes long MSUs shows that, with $\Delta B \approx 130$ Kb/s (it corresponds to steps of about 150 Kb/s in Ethernet Band), congestion comes only when $B_{IN, max}$ exceeds PAMA Band, being kept at about 2100 Kb/s by periodic loss.

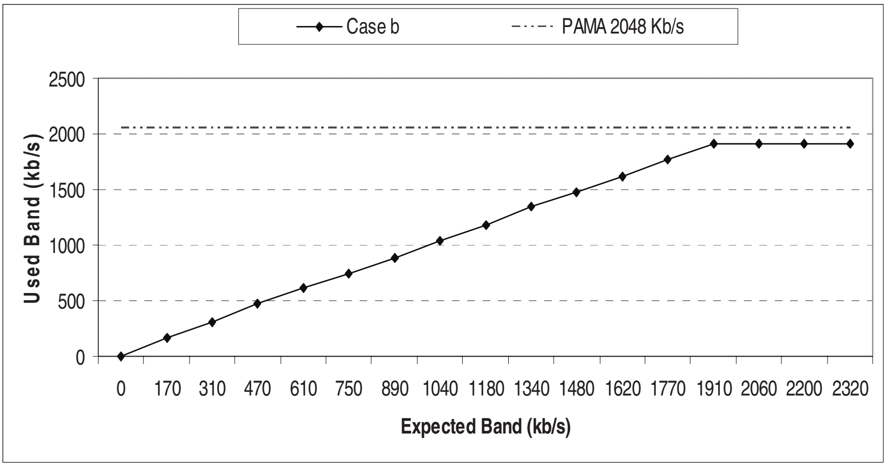

Fig. 11. Examples of tests results in case B

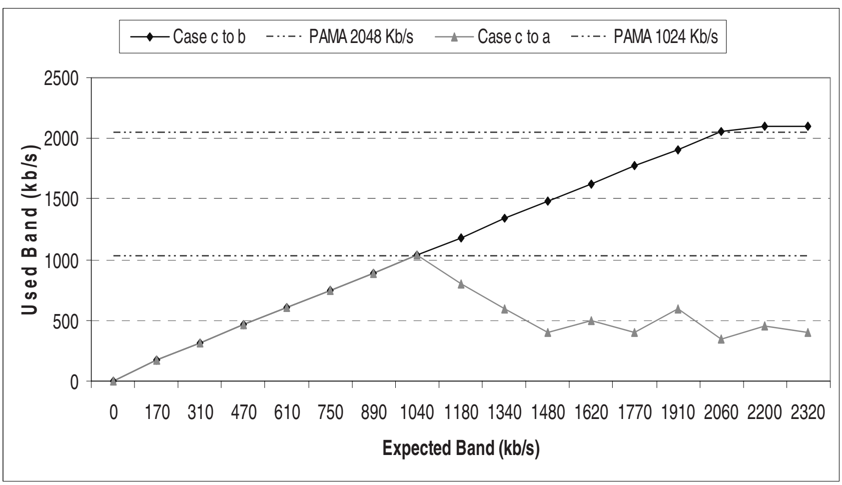

Fig. 12. Examples of tests results in case C

Results with 60 Bytes long MSUs are quite the same: RTT grows to 750 ms and $(1+ \alpha_{OH}) \cdot B_{IN, max} \approx 2300$ Kb/s, the same ΔB is accepted and $B_{IN, max}$ stay around 2100 Kb/s by periodic loss.

The situation is stressed by setting PAMA Band to 1024 Kb/s, where $\Delta B \approx 190$ Kb/s keeps the system in *Case B*, while $\Delta B \approx 250$ Kb/s drives it to *Case A* (see Figure 12).

4.2 Open Issues

Since the system behavior appears quite complicated, there are still some details to be clarified, that our future experimental activity will aim to.

The main aspects to be investigated are:

- T_{ALL} dynamic contribution to OUTSTAND quick growth;
- ΔB_{max} correlation with SCTP parameters, as CWND, and with the system's parameters, as T_{ACK}, T_{ALL}, etc.;
- Transit Delays of SS7 messages during DAMA Band allocation may exceed specifications' time-outs.

5 Conclusion

Our trial activity on SoIP over Satellite connection shows that it can be used in operations choosing in the right way the mentioned parameters. It has been underlined how its critical aspects (Transmit Delay and Bandwidth Availability) can influence the whole system's performances. While delay consequences (RTT 640-680 ms) seems to be overcome by configuring the maximum size of the SCTP Congestion Window at higher value (or equivalently by using more than one SCTP association), the fact that satellite bandwidth can be provided both as permanent (PAMA) and dynamic (DAMA) appears not to be solved at all by these actions, because the Satellite Allocation/De-allocation Algorithm can interact with SCTP Congestion Avoidance Algorithm in a dangerous way for system stability, if parameters aren't configured with special attention.

In order to guide configuration choices we propose an operative reference model, whose usefulness has been confirmed by testing validation, even if still more study is needed to have it completed.

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