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GOOSE MESSAGES BETWEEN SUBSTATIONS USING SDH TRANSPORT

by

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SUMMARY

As part of a Remedial Action Scheme (RAS) projected by UTE, the Uruguay's electric utility, in order to maintain the stability of its transmission grid increasingly complex, it is necessary to implement an industrial network between those transmission stations that are connected through optical fiber. The goal of this industrial network is to deliver synchronism via Precision Time Protocol and GOOSE messages as defined in IEC 61850. These GOOSE messages will be send from two decision centers to designated stations and will cause local tripping to reduce load to the electric system. For the first step of this industrial network that should carry only GOOSE messages, was decided to use SDH NG nodes (Synchronous Digital Hierarchy Next Generation), those capable to achieve in their Ethernet ports stringent availability requirements while maintaining the time of sending messages from the decision centers to the stations defined by the RAS below specified values. With a set of VLAN in a star topology and different values of reserved bandwidth for these communications, were performed the sending and measuring of GOSSE messages. This paper refer to this process, tests and results, which were approved by those responsible for carrying out the RAS project and are close to being implemented

KEYWORDS

SDH NG (Synchronous Digital Hierarchy Next Generation) (RAS (Remedial Action Scheme), IEC 61850, GOOSE messages

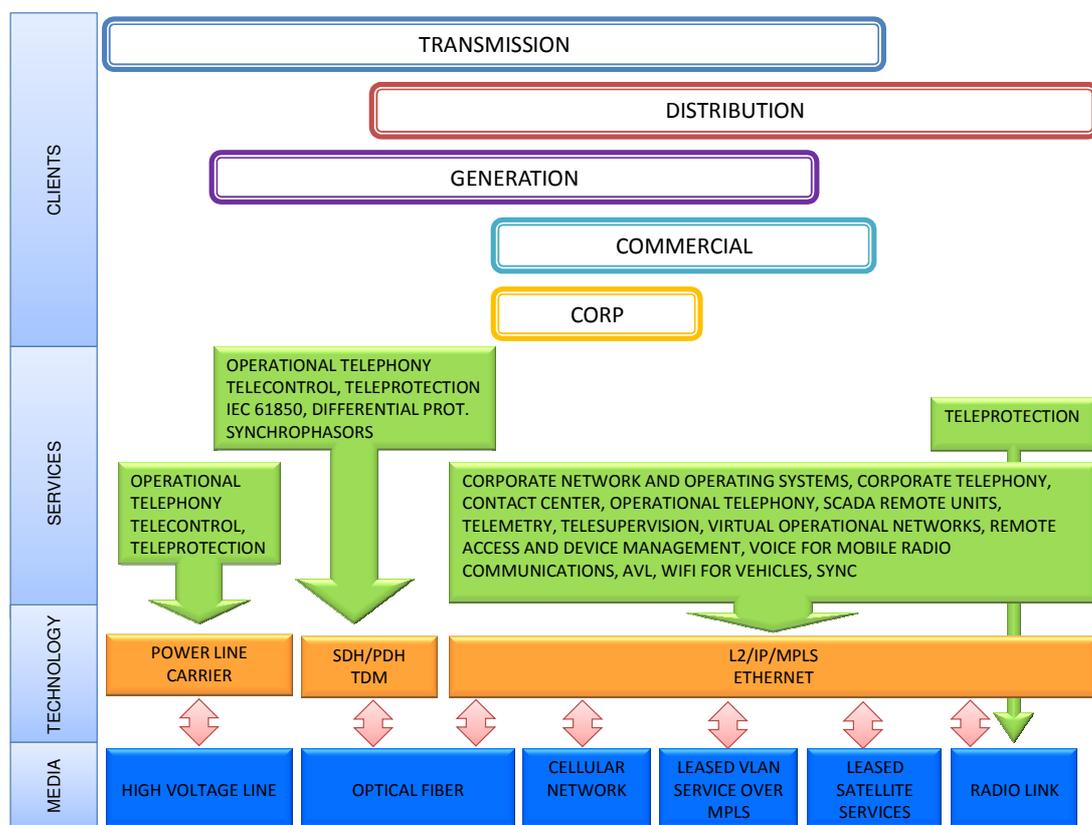
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1. CONTEXT

In UTE, the telecommunications network through optical fiber is conformed mainly with two separate systems:

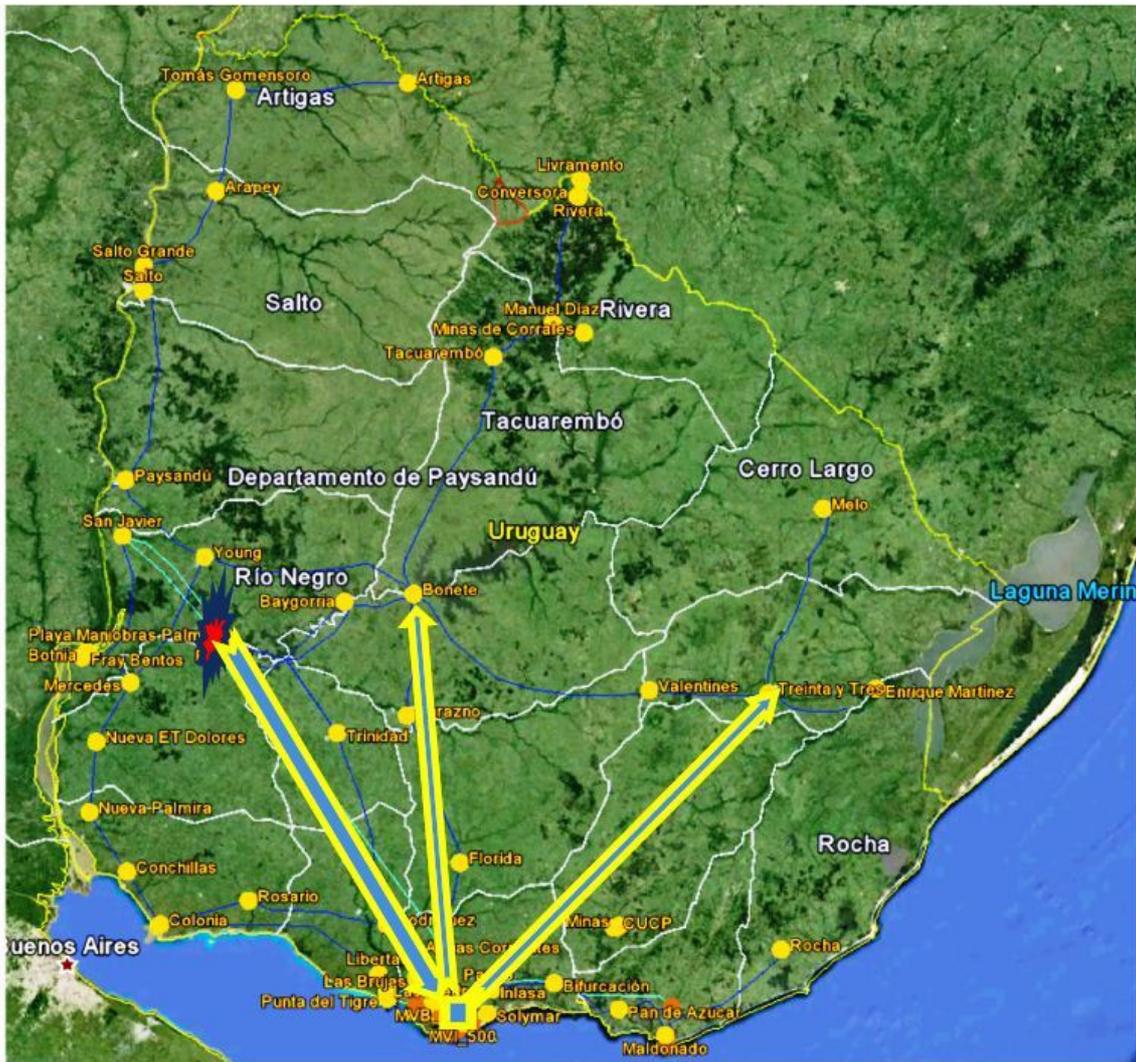
- A TDM network with SDH technology which transports services such as telephony operation (PAX), IEC 870-5-101 telecontrol, teleprotection over G.703 channels, 64kbps or 2Mbps, differential protection using IEEE C37.94 interfaces over 64kbps channel G 703
- An operational network that carries IP services such as telephony, voice over IP, remote IEC 870-5-101 / 104, remote device management, SNMP alarm monitoring, etc.,

The following Diagram MTSC (Media, Technology, Service, Clients) shows the whole picture:



2. THE REQUEST

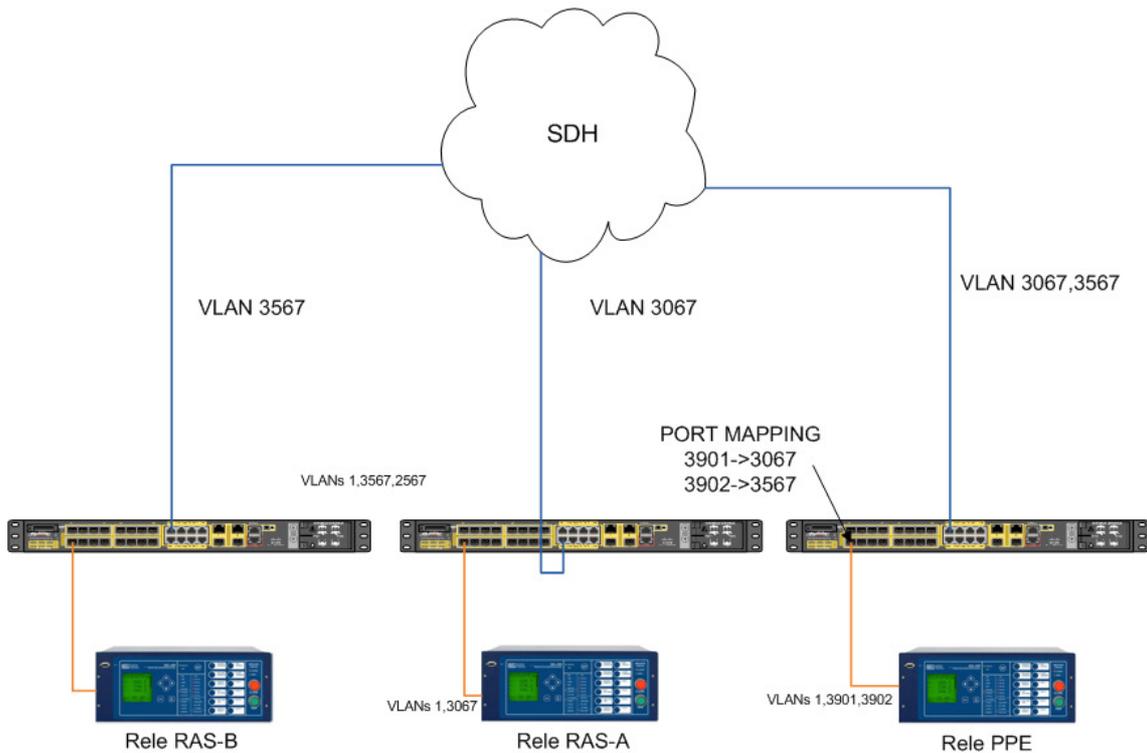
The Transmission team is carrying out a draft of Remedial Action Scheme, where a decision-making center that knows the state of the high voltage network, receive the information about important events that can compromise its stability, and based on predetermined algorithms sends GOOSE messages to relays in remote stations for discharging and keep the grid stability.



We received the request to transport those GOOSE messages between network stations. The IP network is migrating to MPLS but this process is still in the beginning, so this network is not yet considered suitable for this requirement. Instead, SDH network is mature and formed by New Generation nodes, including a switch capable of transporting Ethernet over SDH. The premise was to configure a VLAN to each destination point and dedicate it to the GOOSE messages. The challenge was that these messages must arrive in less than 20 ms and get his behavior well characterized to avoid unexpected results. Assign a VLAN dedicated to each point involved a bandwidth reservation, avoiding competition for media access but constraining the bandwidth available for the complete solution.

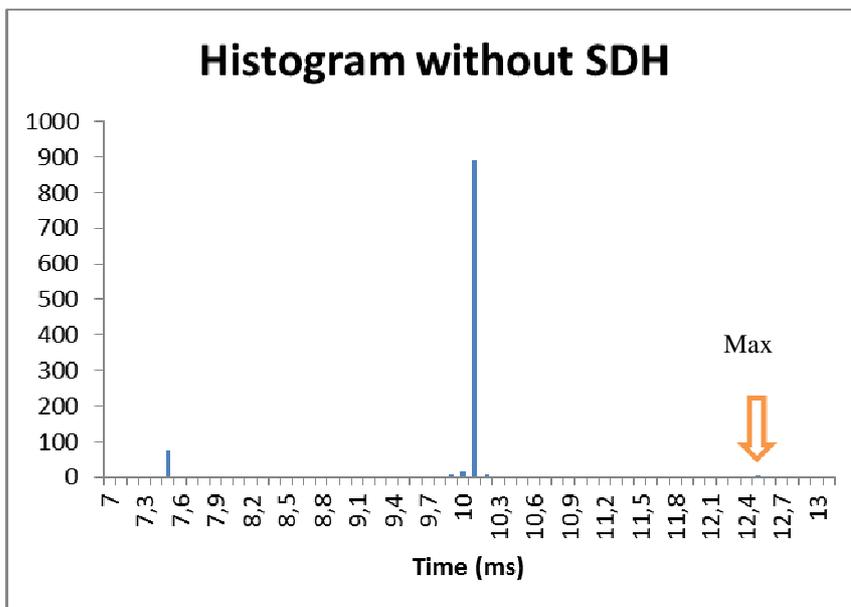
3. LABORATORY TESTS

In this regard, laboratory tests were made to know the times in a scheme that the following figure shows:



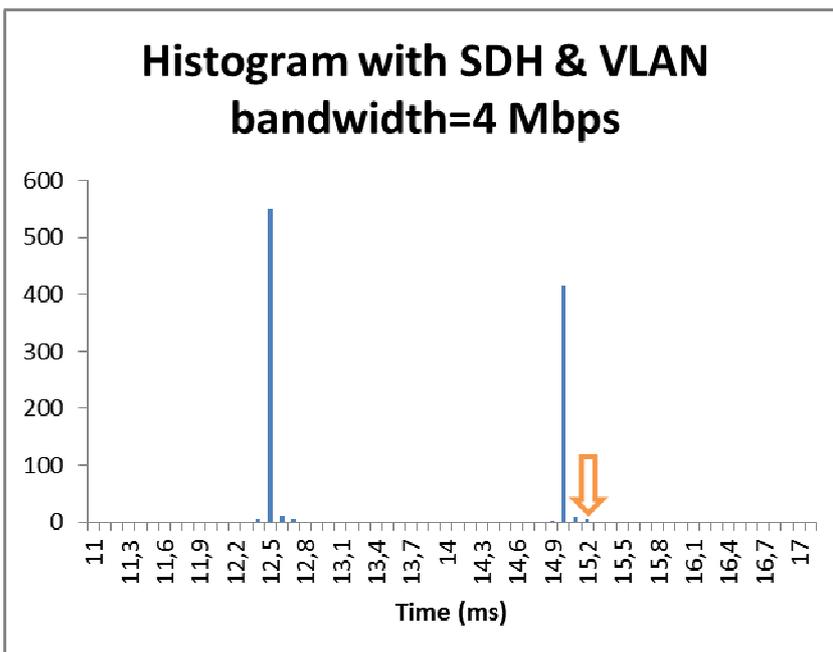
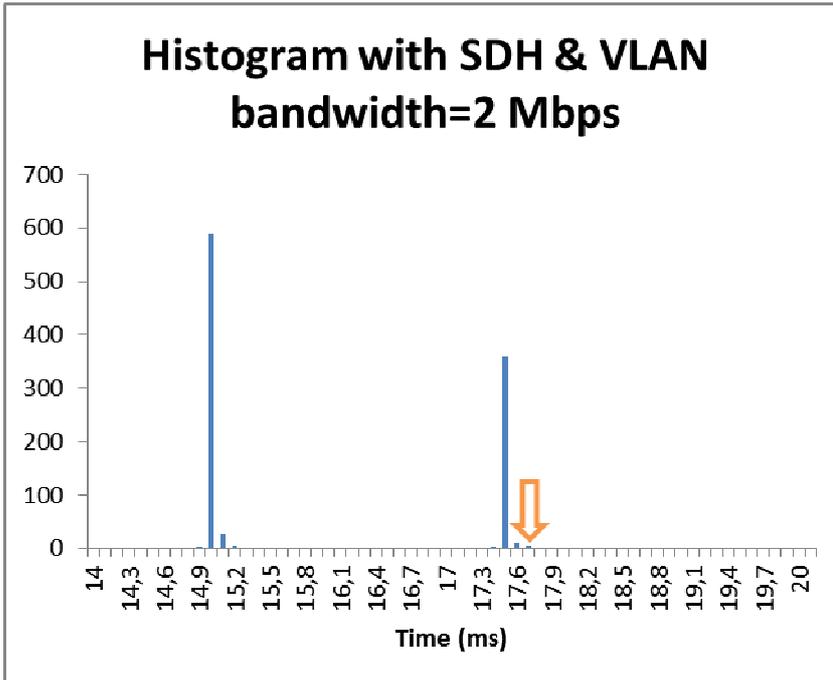
GOOSE messages were sent from the relays at RAS-A and RAS-B to a relay at PPE. After the reception of each message, the relay PPE returned another message as acknowledge to its sender. Each transmitter recorded the emission time and the time of receipt of the message back, so times obtained are twice the required time to sending a GOOSE message and its detecting by the relay.

Different configurations were tested each one with 1000 tests messages, first without going through the SDH equipment, then passing through these equipment with different bandwidth assigning . The measurements results were:

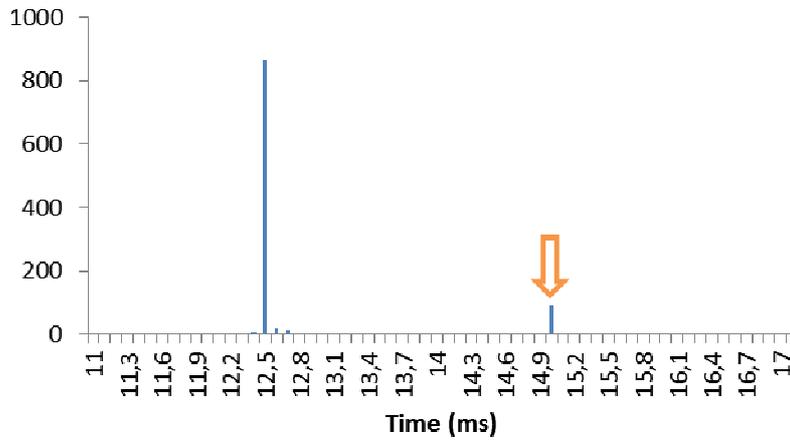


In this case the mode is 10.1 ms, and the maximum is 12.5 ms (2 times in 1000 tries) Similar results were observed from the other transmitter.

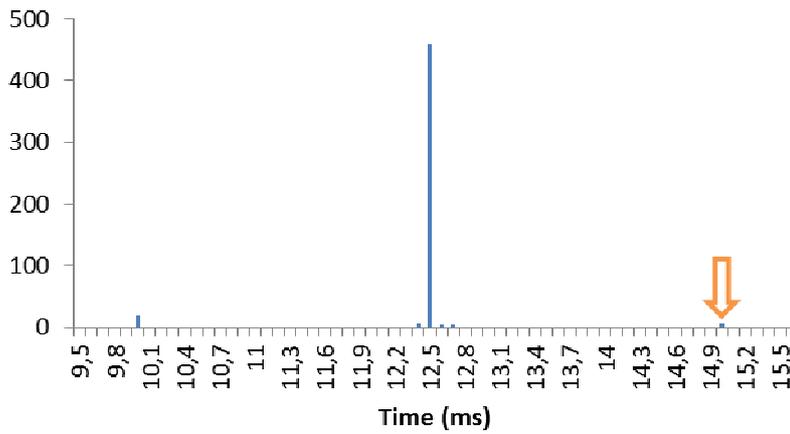
Then the configuration was changed including SDH and different VLAN bandwidth:

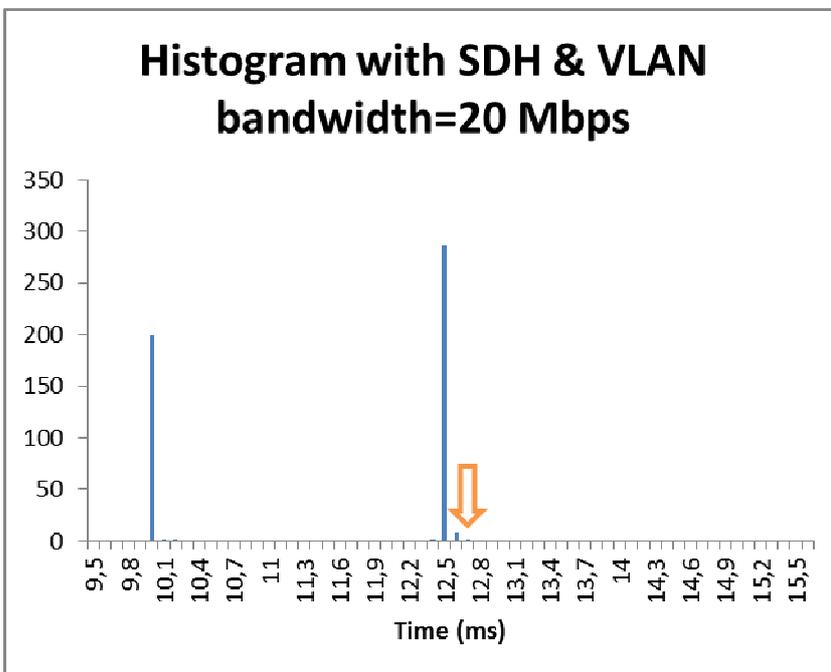
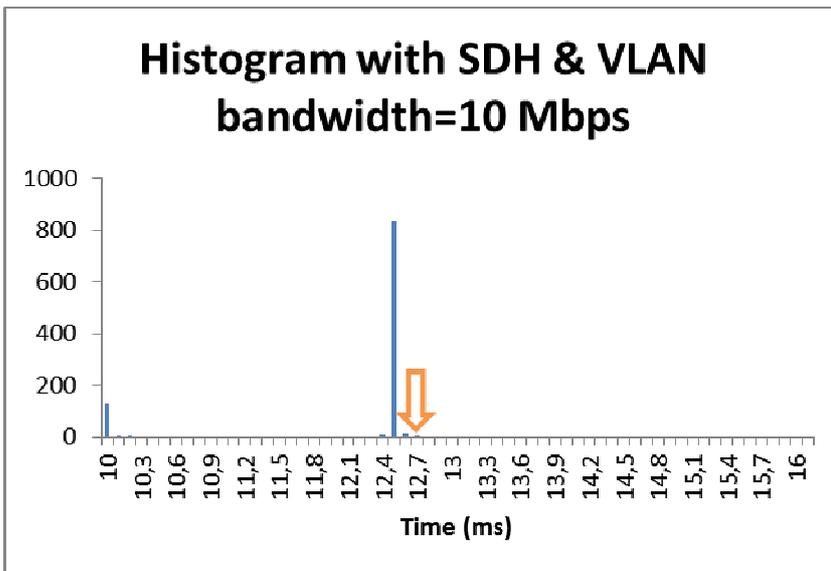


Histogram with SDH & VLAN bandwidth=6 Mbps



Histogram with SDH & VLAN bandwidth=8 Mbps





Maximum delay in ms against bandwidth (one way):

