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Future of Air Traffic Management Networks Using Fiber and Vsat Technologies

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Abstract: *As air traffic increases, routes get more diverse and light and ultra-light aircraft are becoming most popular. The main issues regarding classic radio communications are delay , availability and reliability of network infrastructure. Thispaper addresses the questions that why a new ATC network generation based on higher speed VoIP (Voice over Internet Protocol) technology has some essential comparative advantages over VSAT link used for Applications.The main benefit of this network is toenhance availability and solving the problems of delay, packet loss and bad quality of voice and data.*

I. Introduction

Communication is the backbone of any air traffic control activity,The Civil Aviation Authorities (CAAs) are responsible for providing reliable communication services to airlines for supporting their mission critical applications.The ideal solution for networks used in air traffic control requires multiplexing of legacy voice and data systems as well as routing of IP traffic over popular WAN infrastructures or VSAT.The Multi-service Integrated Access Devices integrat traffic over a variety of enterprise network infrastructures. It can be used over Switched/Lease Lines, Frame Relay and ATM backbones, satellite networks as well as IP backbone. Line costs are reduced by bundling various boundaries of traffic onto a single network infrastructure.

1.1 Problems definition

The existing Air Traffic Control Networks suffer from many problems such as:

- Higher operation cost
- Higher delay in most sensitive applications (ex.: VHF radio, Hotlines, telephones and radars data).
- Higher latency.
- Higher outage and instability.

Not all types of legacy traffic can be routed.
Lower Network availability and most of them doesn't have backup.
Existing network especially in Africa are still using the copper as a media.

1.2 Objectives

The objective of this research is to **implement** and evaluate a network Models solution for packetizing the different interfaces of the ATC applications into variable bit rate data streams to fulfill the Air Traffic Applications Requirements and:

- To reduce Network operatingcosts.
- To minimize latency.
- To increase Bandwidth utilization.
- To provide high Network stability and reliability.
- To provide flexible network connections.
- To reduce transmission delays and preserve the quality of delay-sensitive traffic (voice/fax).
- To speed up the flow of critical data to destination.
- To reduce outage.

II. Methodology

The methodology relies onWireShark tooland new multiplexer technology to Study and evaluate Fiberlinks and VSAT links used for ATC Application.

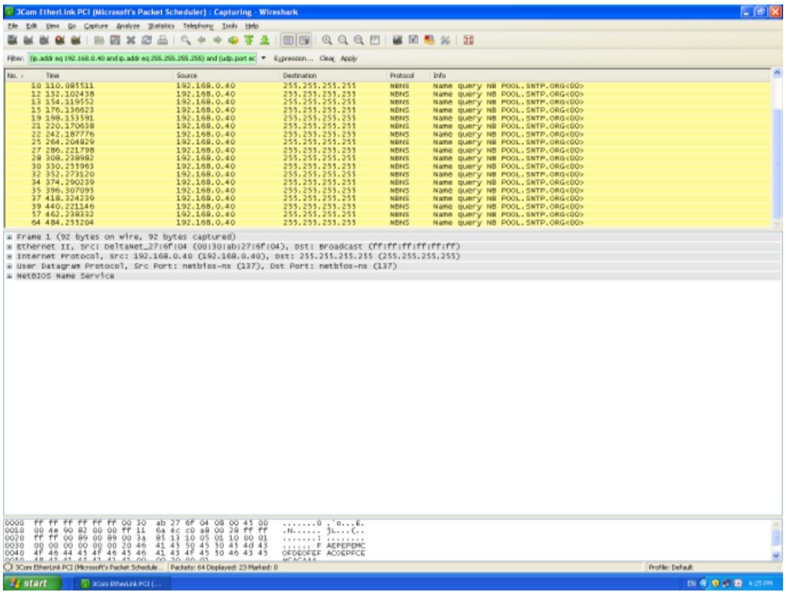
The Multiplexer is composed of high-performance Access Devices that can be used over any type of WAN networks to optimize, compress and covervarious types of traffic in a broad range of applications:

- Digital Circuit Multiplication Equipment networks.
- Switched Voice
- Converged Voice/Data IP networks

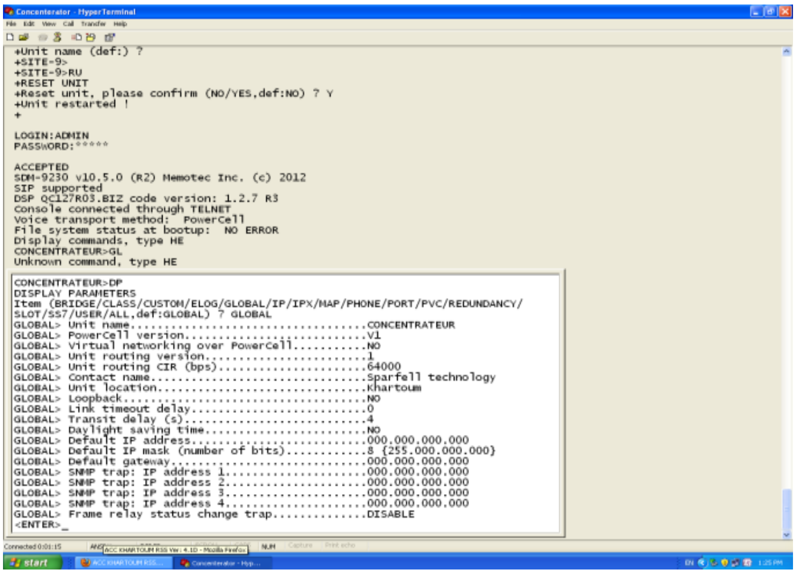
The Multiplexer can concentrate Frame Relay traffic originating from multiple devices, local or remote, onto a single Frame Relay connection. The Multiplexer also supports Frame Relay over IP. This permits using the Multiplexer PVCR protocol to integrate voice and data over the Internet. With FRoIP, the Multiplexer routes a PVC connection over IP instead of Frame RelayA Frame Relay network uses virtual circuits, which are logical paths established between two network access points.

The Multiplexer supports the Frame Relay interface using multiple PVCs. These PVCs are linked to different locations, bundled and attached to the same physical connection to the Frame Relay network.

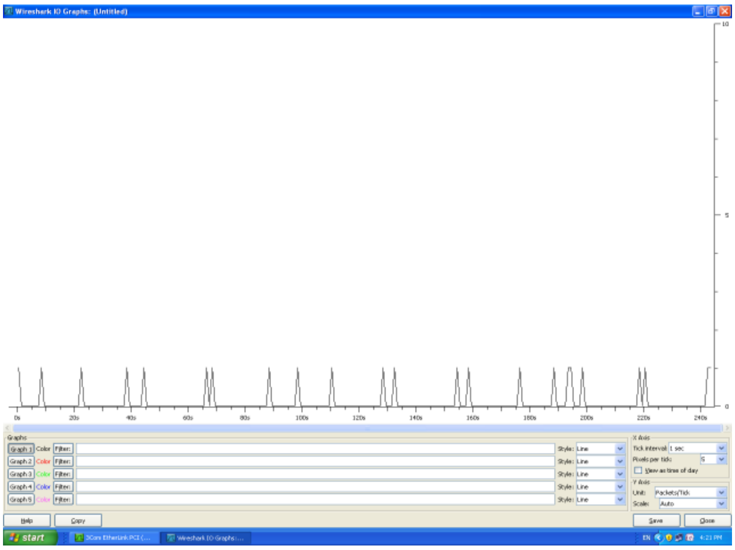
No error correction is done by the network. The responsibility to retransmit is left to the user equipment. Multiplexer is a fast-packet access device, and as such, its basic datagram's are data cells of 96 bytes maximum obtained as a result of the multiplexer incoming frame fragmentation process. The Multiplexer can process cells that measured in Cells per Second (CPS). Which measures how fast the Multiplexer can build and hand-off or receive and rebuild cells and frames, regardless of prioritization schemes.



Wire Shark analysis



MultiplexerConfigration



Fiber Optic flow traffic

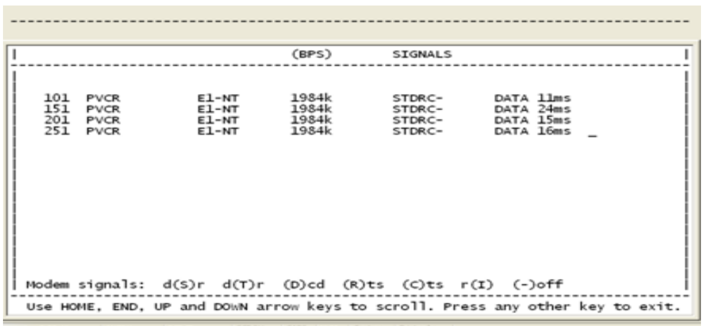
III. Result and discussion

ITU-T standard for speech coding operating at 16 Kbps is LDCD Low Delay Codec G.728. It is officially described as Coding of speech at 16 Kbps using low-delay code excited linear prediction. Delay of the codec is 10 samples (0.625 ms). Therefore,, because of its low delay sampling as well as a greater wide band support than G.729, G.728 passes low bit rate modem signals up to 2400 bit/s. Also, network signalling goes through that codec (ex.: FSK tones in VHF voice). Estimated Quality: 3.85 MOS (Mean Opinion Score)Around 40% when the silence suppression feature is activated. The following table figure(2) comparing between vsat and optical fiber.

voice protocol	VoFR Fiber Obtic	VoIP Vsat	FRAME TIME/ Payload in bytes	Cell Per Seconds (CPS)
LDCD16Kx 1	28	40	5ms/12	400cps
LDCD16Kx 2	22	28	10ms/22	200cps
LDCD16Kx 3	20	28	15ms/32	134cps
LDCD16Kx4	19	24	20ms/42	100cps

Figure (2) Voice Bandwidth and CPSUtilization (1)

Figure 1CPS consumption was calculated by dividing one second by the voice protocol frame time multiplied by two (because of the full duplex nature of the voice conversation). Note that a fax transmission is half-duplex though. Note that comfort noise reduces overall CPS utilization by around 40% when silence suppression is activated. Using PVCR over IP with cell packetization enabled. The following figure (2) summarize Cell per Seconds (CPS) and bandwidth requirements for each voice codec when transported over leased lines or IP networks

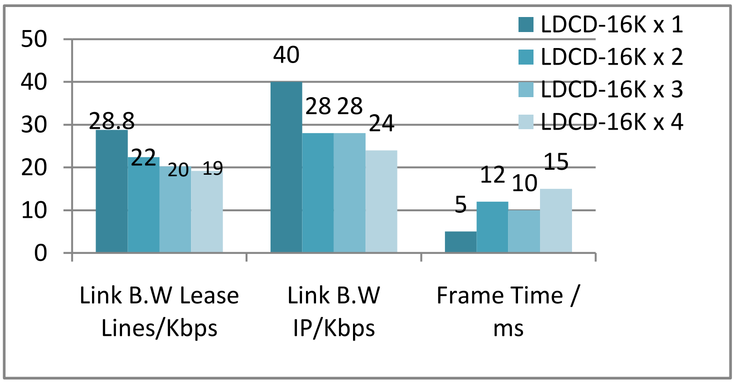


Fiber opticdelay

	SIGNALS (BPS)		NAME	DELAY(MS)
1 PVCR	USER -A--- 2048 k	PVCoIP 102	PS02M10A	DATA 350ms
2 PVCR	USER -A--- 2048 k	PVCoIP 103	PS03M10A	DATA 350ms
3 PVCR	USER -A--- 2048 k	PVCoIP 104	PS04M10A	DATA 350ms
4 PVCR	USER -A--- 2048 k	PVCoIP 105	PS05M10A	DATA 350ms
5 PVCR	USER -A--- 2048 k	PVCoIP 106	PS06M10A	DATA 350ms
6 PVCR	USER -A--- 2048 k	PVCoIP 107	PS07M10A	DATA 350ms
7 PVCR	USER -A--- 2048 k	PVCoIP 108	PS08M10A	DATA 350ms

Vsat delay

The results of study and associated evaluation show thatFiber Link is better than VSAT link when using the voice codec's protocols. This fact is summered as :-



1- Higher bandwidth available in fiber optic.
2- Lower delay in fiber opticranging between 11ms to 24ms compare with vsat 350ms.

IV. Conclusion

Fiber link provides a complete system solution for organizations with wide area internetworking requirements, it solvesdelay's problems, packet loss and bad quality of voice and data.The fiberlink improves the bandwidth, reduces thecost andenhances safety.These networks are intended for a broad range of applications and serve the internetworking needs of central and remote sites.

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