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IMPLEMENTING UNIFIED COMMUNICATIONS VIA A SINGLE SWAP-C DEVICE

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ABSTRACT

Communications has come a long way from the two dimensional model provided by voice and data. Today complete situational awareness requires bringing a third dimension, video, into the mix. Implementing this unified view into today's military vehicles calls for a unit with a well thought out design that interfaces thoroughly with other equipment and minimizes SWAP-C impact.

This paper addresses the efficient convergence of video with existing voice and data presenting unified communications into a single SWAP-C device.

INTRODUCTION

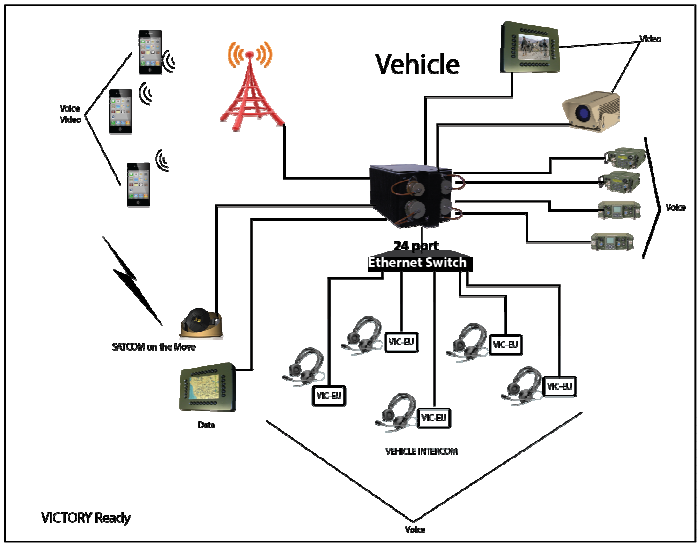
As a whole, military technology and vehicle technology are never quite on the forefront of technology development; even though there are areas of both technologies that lead the developing world and its technology sectors. This paper focusses on full scale big army deployment of vehicle-born technology and the development of multi-purpose SWAP-C technology.

There is a reason that the technology deployed to big army is not the latest. To be deployed, technology must be tried and true. It must overcome all adversarial situations and continue to function. This is the ultimate "takes a licking, and keeps on ticking" forefront.

Yet the latest field-proven and tested commercial-off-the-shelf technology incorporated into proven rugged-packaging ***is*** coming to big army. This new technology from Cornet Technology, Inc. will allow the military to hone and leverage current technology to save space, weight, and power thus reducing cost specifically in vehicles.

MULTI-PURPOSE SWAP-C TECHNOLOGY

The Cornet Technology, Inc. (CTI) standards-based Gigabit Ethernet backbone uses differential



routing and state-of-the-art processors (ARM and Intel) to accept a host of standards-based (PCIe, TDM, and GigE) application boards. Using a standards-based backplane allows CTI to combine multiple application boards into a single chassis for vehicle (ruggedized) based applications.

The application boards presented in this Unified Communications platform include:

- Video streaming and Multi-Channel Video Encoder (HD and SD)
- Vehicle Intercom/Conferencing
- Radio Gateway – that provides interoperability among diverse radios (SRW, WW, HF, UHF, VHF, etc.)
- Tactical Cellular/2G/4G/LTE networking
- Powerful Server
- Multimedia Storage

Each of these cards replaces an existing specialized system and its infrastructure within a vehicle; thus reducing equipment space, power consumption, cabling, training, and operations. Since the backplane that houses or integrates these system cards is a standard Gigabit Ethernet configuration. it provides a smooth transition from today's hodgepodge environment to the VICTORY-based future.

Backplane

CTI's backplane configuration provides a solid base for the CTI VICTORY-capable system configuration. Employing an Ethernet controller as a focus position controller, CTI provides a backbone with which each application card can efficiently communicate. Utilizing differential routing within the backplane reduces stray capacitance and ensures that EMI requirements are effectively managed.

The backplane bus meets each application in any location enabling application cards to be located in any position within the chassis. This promotes a plug and play atmosphere while encouraging system configuration flexibility in all vehicle layouts.

Video

The recent big technology push for deploying forces is video sharing and processing. Until Ethernet was adopted, the equipment required to handle video processing and sharing was large and power hungry. Newer encoding formats allow near real time video applications to be deployed throughout the fighting forces so they can operate on a Common Operating Picture (COP).

Current In-Vehicle Networks (IVN) consists of rear facing cameras and an RWS (Remote Weapons System). The video from these systems is fed into a stand-alone encoder and the video stays within the IVN. Adding an application card for video encoding and decoding into a converged technology unit eliminates an additional piece of hardware and power connection. Taking technology another step forward, the CTI video application card contains a video streaming processor that allows video shared through low data rate and low throughput networks for improved situational awareness.

CTI's video products leverage the latest in DSP technology which provides the ability to upgrade the encoding algorithm and software or firmware for future enhancements. This is important to ensure that the product can be updated as standards evolve thus extending its usable lifespan.

Transmitting compressed video over a radio network is challenging due to the bit error rate and varying over-the-air throughput. Additionally, the substantial size of an I-frame (Intra frame) consumes large chunks of the available bandwidth resulting in total communication failure. To solve the large I-frame problem, CTI encoders are capable of using gradual decoder refresh (GDR)

by which the intra frame refresh is spread over multiple frames.

To overcome the varying bandwidth challenge, the CTI video card employs automatic Rate control. The video card starts with the configured bit rate and attempts to adapt to network conditions based on packet loss statistics in the RTCP reports from the client, encoding is adapted so that the packet losses are within a threshold. This is achieved by changing the encode bitrate appropriately on the fly. If the packet loss is over the threshold, the bitrate will be reduced and if there are no packet losses, the bitrate will be increased.

The video encoder/decoder card provides the capability for multiple configurations. There is a single HD 1080P/60, or dual 1080P/30, or 4 SD/720P channels. Each configuration utilizes a standardized H.264 format to ensure interoperability with other industry products and most importantly facilitates information sharing with other NATO organizations.

Voice

There are two separate voice application cards for use in the chassis. Voice application card one, is a Radio Gateway Card. Voice application card two is the Conference Card.

The Radio Gateway Card allows up to four radios to be connected and shared across the system. Each radio represents a separate connection and is independent of any other radio connected to the Radio Gateway Card. The card accepts balanced and unbalanced 600 Ohms with input levels between -46 dbm to 12 dbm adjustable 300Hz to 3400Hz. The connection is agnostic to radio type and band. Being agnostic allows intermingling between radio vendors and waveforms. Tying the radios into the Ethernet backplane provides a common access to the users within the network to utilize and partition roles or priorities of radios to users. Each user can hold different roles and responsibilities that can be modified through an administrator function contained in the system management software during set up.

The Voice Conferencing Card allows up to 32 users. A single conference can consists of a maximum of 32 members. The users can be a combination of local users or remote users. Six of the users contained in a conference are restricted to local in-vehicle users (crew positions). They can be segregated to conference among themselves for crew conference only or the conference can be expanded with no geographic restrictions to include additional participants. Only network access is required to extend this feature outside of the vehicle.

The common bond between the Radio Gateway Card and the Voice Conferencing Card is the format for the communications protocol. Both cards present the voice communications into the Ethernet backbone by utilizing Real-Time Protocol (RTP/SRTP). RTP [1] provides the framework for real-time services for audio and video conferencing within packet networks. The use of RTP allows the services to be pushed through the network on top of a User Datagram Packet (UDP). UDP being a connectionless packet allows for flexibility with in the deployed networks and opens the capability for these on-vehicle services to share outside the vehicle regardless of network transport layer. The RTP outlines the connection side for the real time conferencing (Voice and Video) and the information contained within the packet provide the necessary information for the data to be assembled at the destination with little packet loss or any issues of being out of sync. The RTP provides the time stamp and order of each packet to provide a packet map for reassembly.

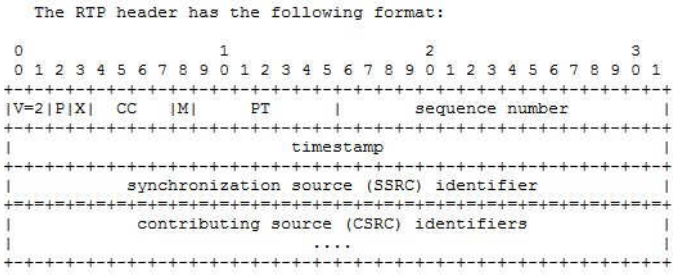


Figure 1[2]

This cuts down on jitter and delay. The timing source can be network timed or timed through external GPS to maintain synchronization. The option of the network clocking for the packets allows for a fall back should one form or the other be rendered inoperable.

Tactical Cellular

A new medium being introduced to the battlefield in recent years is a militarized or private version of commercial based cellular networking. CTIs cell-application card merges legacy battlefield technology with the newly adopted cellular technology.

This card can provide two functions. The first function provides Ethernet access for a mobilized mini-base station. Sharing the backplane of the chassis/network allows users of the system to separate outside of the vehicle and maintain remote operations and connectivity through the cell network. The system employs a generic configuration to tie the cell base station into the configuration. Since this technology is still in its battlefield infancy the application card provides agility to the cell phone backhaul. It can merge or bridge the network/communications to access vehicle mounted resources or even extend its reach through the long haul satellite or radio networks that are also tied into the IVN.

Since mini cellular base station costs can be extremely high if every vehicle is outfitted with one, the second function of the Cellular Card it to act as a cellular user endpoint. This allows vehicle occupants, mounted or dismounted, with the ability to use lighter short-range power-saving devices, such as cell phones, to maintain and coordinate localized communications without having to directly fidget with radios, satellite, or other normal long-haul systems for short haul transmissions and networking.

Summary

By unifying voice, video, and data technology into a single vehicle-sized device, Cornet Technology fulfills the goal of CERDEC to field electronic packages that can deliver a variety of capabilities [3]. Leading our development with standards-based commercial technology allows Cornet Technology's innovative engineering environment to provide flexibility to our solutions and products thus better serving the Warfighter. This flexibility enables us to design products that dismantle stove-piped platforms and maintain capability sets for integration into today's Ethernet based technological Army.

Unified Communications establishes an all-encompassing network platform eliminating rigidity that was developed to support legacy ad-hoc system design. Cornet Technology's expertise not only enhances unified communications and its core purposes, but also puts products through the process of consolidating technology to shrink the packaged process for deployment.

REFERENCES

[1] H. Schulzrinne, Columbia University; S. Casner, Packet Design; R. Fredrick, Blue Coat Systems Inc.; V. Jacobson, Packet Design "RTP: A Transport Protocol for Real-Time Applications", July 2003

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[3] J.R. Wilson, Military & Aerospace Electronics, May 9, 2014 "Consolidated networking military combat vehicles for military combat vehicles."