

QUINTRON

WHITE PAPER



***The Convergence of VoIP
For
Mission Critical
Command & Control
Communication Systems***

Introduction

Today's battle commander or disaster control director must have instant availability to a variety of communication capabilities for command and control (C²) mission critical decisions. Complicating this need is today's increasing number of communication capabilities such as landlines, radios, cellular service, satellite interfaces, telephones and Voice-over-IP (VoIP) connectivity.

All of these communication services must interface together in a seamlessly interoperable manner with multiple options for instant and reliable service to support the C² mission in both fixed and mobile command center environments—where failure is not an option.

The continuing and overwhelming evidence indicates there are still compelling needs for improved capabilities in the areas of interoperability and reliability of these systems.

A solution to this situation is the net-centric VoIP technology that is now available which satisfies the required broad range of communication system features and interoperable interfaces to the C² system user.

Technology Overview

The historical development of C² communication systems goes back to the first battlefield techniques of runners, then flags and similar visual displays. Additional technological solutions appeared with field telephones and radios, with increasing sophistication being implemented for encryption and other secure connections. However, all of these systems were individual designs with no, or very limited, ability to interoperate with other similar systems.

Starting in the 1970's, the digital revolution began to offer expanded capabilities in many areas, including integration of disparate communication streams through TDM technology and edge interface devices. Much of this was driven by commercial telephony developments, but increasingly, more specific and focused solutions also became available. This initial ability to integrate, or converge, disparate communication channels increased availability and interest throughout the C² community.

As the internet came into wide-spread use during the mid-1990's, it became obvious that distribution of all forms of data (voice, video, telemetry, situational awareness information) could be most effectively done via IP-based networks. Conversion to IP allowed all data to be transported and managed in common data streams, regardless of the original format.

This conversion was, again, led by commercial concerns of cost effectiveness and commonality. However, it became obvious to industry and Government leaders that developing a single, world-wide network for all data types was the most desirable and best solution for the future. This has created numerous initiatives on a universal basis. Within this universal environment, a net-centric system solution for C² operations was unavailable; however, a new type of IP-based system now offers a viable and effective solution.

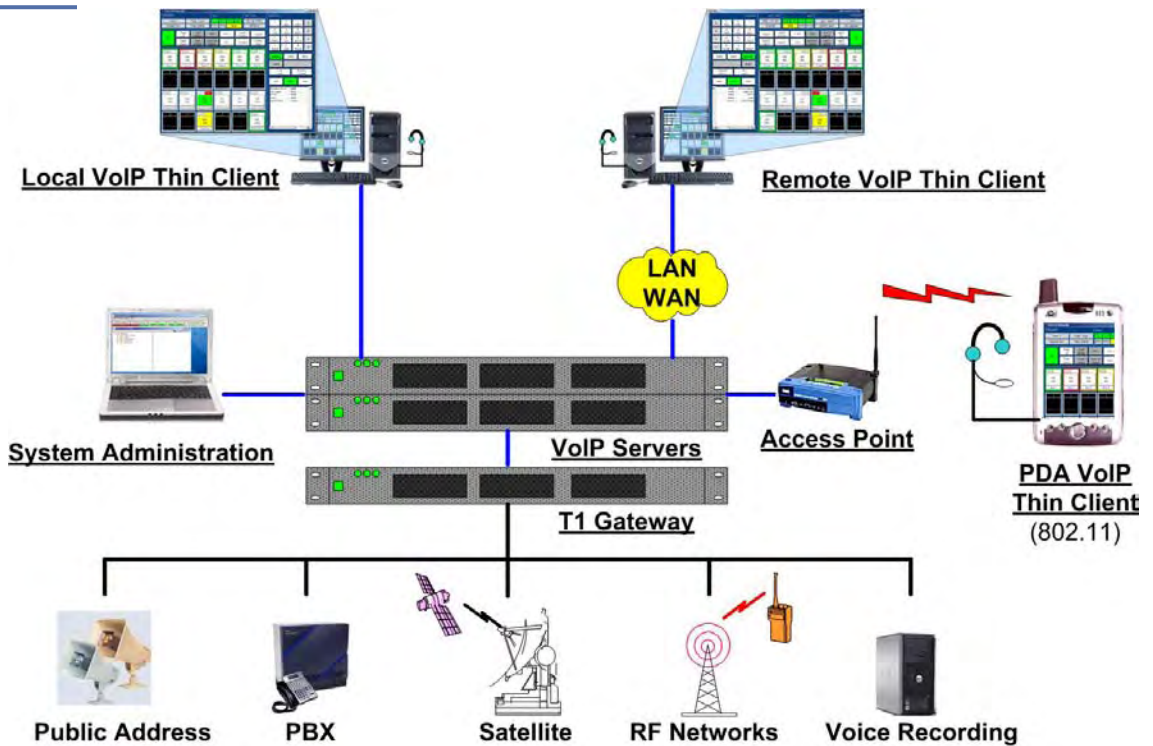
The critical concerns for C² communications remains the same with how to communicate between all involved entities and quickly adapt to changing conditions.

The use of IP networks offers significant improvements in overall performance and response due to their inherent high-speed and wide transport capability. Integration of legacy telephone and radio connectivity, regardless of manufacture and protocol type, is also easily accomplished. In addition, the capability to quickly create teleconferences in a variety of combinations of different types of communication services which are available in the system is essential.

VoIP C² System Architecture

The architecture of a VoIP C² System will typically provide various options for end user access (control and audio content) along with some central distribution equipment. In addition, an interface device is required to integrate the other types of communication systems that will be utilized in a C² environment. Connections to both local and remote users should be provided via IP network, with encryption and compression options to suit the situation. Some form of overall system administration for pre-programmed configurations will also be normal features. Figure 1 below illustrates this sort of overall system diagram.

**Figure 1:
VoIP C²
System
Architecture**



**Central
Equipment**

IP Central Equipment Unit (IPCEU)

The IPCEU provides central connectivity and distribution for all end users and external interfaces as indicated in Figure 1. The IPCEU may be provisioned in two basic types, non-redundant (single server) or fault-tolerant (two servers with automatic switchover to the secondary server with no system performance impact).

The VoIP C² system architecture provides a dynamically allocable bandwidth (DAB) feature to minimize transmission usage while maintaining preferred end user performance. In addition, different compression algorithms and encryption may be

selected, either at end user log-in or through pre-programmed system configurations. Available circuit pools of internal audio paths are provided, up to a maximum of 1900. If required, a circuit may be accessed by any number of end users simultaneously. Controls at the IPCEU allow selection of incremental active circuit quantities to provide maximum server utilization.

A System Administration Terminal (SAT) is provided in Java for platform independence. The SAT provides a wide array of administration windows for control of the various system assets. Real-time changes can be made instantaneously with appropriate user alerts where interaction with on-going operations might occur.

T1 Gateway

The T1 Gateway of the VoIP C² system provides interface and connectivity to legacy audio devices of all types. A T1 digital port is used because it is still the most widely used standard throughout the communications industry. Analog interfaces to telephones and radios are provided via industry-standard T1 channel banks.

The T1 Gateway is a commercial server, equipped with internal T1 module(s) conforming to industry-standard T1 operations, signaling and controls. The T1 Gateway software converts all incoming audio into VoIP streams for incorporation into the overall C² system by the IPCEU. As another option for smaller installations, the T1 Gateway function can be integrated into the IPCEU servers.

Software Client

End User Software Client

The VoIP C² system utilizes a software client for end user access. This is written in Java to support usage on virtually any computer platform type. The Client is a very small footprint application which utilizes the computer sound card and central operating system for actual audio processing and distribution. The Client GUI provides access controls for circuit selection and activity display. Audio input/output options include standard PC headsets, PC speakers with separate microphone, or full USB headset with integrated push-to-talk (PTT) for keying radios.

Software Client Download

The Software Client is designed for easy dissemination through various download methods. Suitable installation and start-up guidance is provided to assist the end user and minimize the need for central assistance. Operational performance of the VoIP C² Clients is available on many types of computer platforms including, Windows 95 through XP and Vista, Apple/Macintosh and Linux versions.

The VoIP C² system hosts a web server application to allow the initial download of the Soft Client applications. For the initial download, the user opens a browser and enters the URL for the VoIP C² system Soft Client application. A page is presented for the user to “point and click” for the download. The download is currently less than 3 MB and is completed in just a few seconds in a typical premium IP connection.

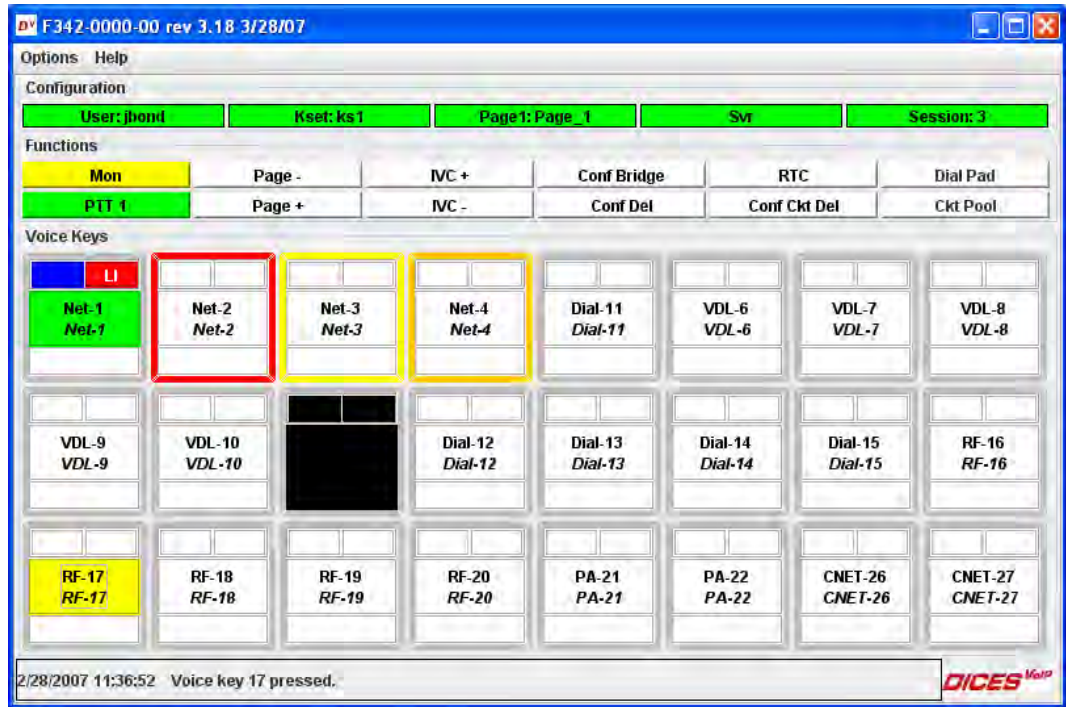
Subsequent software updates may be configured for automatic or prompted updates. When the user starts the application, the application will negotiate with the server for the latest version information and if a later version is available on the server the new version will either be automatically downloaded or the user will be prompted for the

new download. Again, the Soft Client download takes just a few seconds.

Basic Client Features and Displays

The VoIP C² system VoIP Client provides a virtual panel with a GUI that can be configured numerous ways. A typical virtual panel, as shown in Figure 2 below, provides 24 voice keys for ready access through simple mouse-click activation. In addition, function buttons provide access to other useful features, such as a Circuit Pool for local user circuit selection to the active GUI, a Rolodex for quick phone dialing from a pre-programmed list, a DTMF pad for standard phone access, volume controls for overall client and individual circuit keys and numerous other user functions with ready access through the user GUI screens.

Figure 2
Client
Display



The Client GUI can also be reduced in size, where needed, to facilitate access to other user computer displays. This can be in the form of a smaller horizontal or vertical format that retains visual display of all keys and states, or fully minimized to the computer tool bar with one-click reactivation to full display mode.

The basic C² system design can also be adapted for fully dedicated operation stations as well where the user computer is already fully loaded with other applications, or where having a dedicated station simply fits the needs of the environment better. In these cases, several options may be provided, as illustrated in Figure 3. The wall mount box design is fully weatherproof for exterior applications, and can be fully certified for operation in hazardous areas. The desktop and rack mount designs for suited for office and control room applications. Each of the hardware devices provide the same features and user controls as described for the software Client above.

**Figure 3
Hardware
Options**



Customer Applications **VoIP System Applications**

- Military
- First Responders
- Construction
- Oil and Gas

**The Evolution of
The C²
System
Design**

Quintron Systems has developed and supplied C² solutions of all technology types since incorporation in 1970. The initial systems were analog technology and supported space and missile launches and launch related activity. In 1980, the first digital TDM C² systems and products were developed and deployed in support of larger space and missile programs, including the Space Shuttle program. Continuing through the 2002 second and third generations of these C² systems and products were developed and installed at numerous command center locations around the world

A fourth generation system TDM system was developed and deployed during the early 2000's that incorporated the first fully-distributed software operating system application for a C² communication system. This system design provides a Central Equipment Unit server function for overall system control, with distributed local processor modules through out the system. This unique design facilitates the highest possible response, with control initiated at the lowest equipment level, with reduced interaction at the central control server.

The common control distribution of C² system utilizes Fast Ethernet as the central backbone, incorporating redundant networks for increased system reliability. All processors used open-source operating system software for maximum cost efficiency

and proven reliability.

The fourth generation system architecture has provided the central design for convergence into a fully IP-based C² system solution. As the system architecture in Figure 1 illustrates, this simple yet powerful new C² system solution utilizing only three major components: the IP Central Equipment Unit (IPCEU), the T1 Gateway and the End User Client software.

Operability

The operability of the C² communication system provides central control of critical field operations to maintain complete control of the operation. This includes overall coordination and control of voice, video and data requirements.

It is widely acknowledged that voice communications is most critical as the communication element of command and control provides the broadest real-time intelligent information content.

There are effective solutions for smaller-scale C² communication requirements. Until now, expanded system solution options that provide smaller size system and mobile applications with enhanced capabilities and interoperability were not available.

The wide range of system configuration features outlined in this White Paper system provides the battle commander and the disaster control director with comprehensive operational response scenarios, including:

- Conferences,
- Point-to-point, point-to-group and group-to-group direct line communications,
- Multi-channel radio circuit access with legacy systems
- Access to satellite channels
- Access to digital or analog telephone circuits
- Public address system access
- Digital voice recording

The net centric design of the C² system embodies real-time response further and facilitates rapid deployment in response to changing conditions for the battle commander and emergency actions for the disaster control director. This allows Incident Managers to quickly evaluate scene operations and effectively allocate resources. Moreover, the C² system provides a stable interoperable platform which ensures the tactical team(s) complete interoperability and integration of mission critical communications—where failure is not an option.