Knee-Deep in Interoperable Innovation

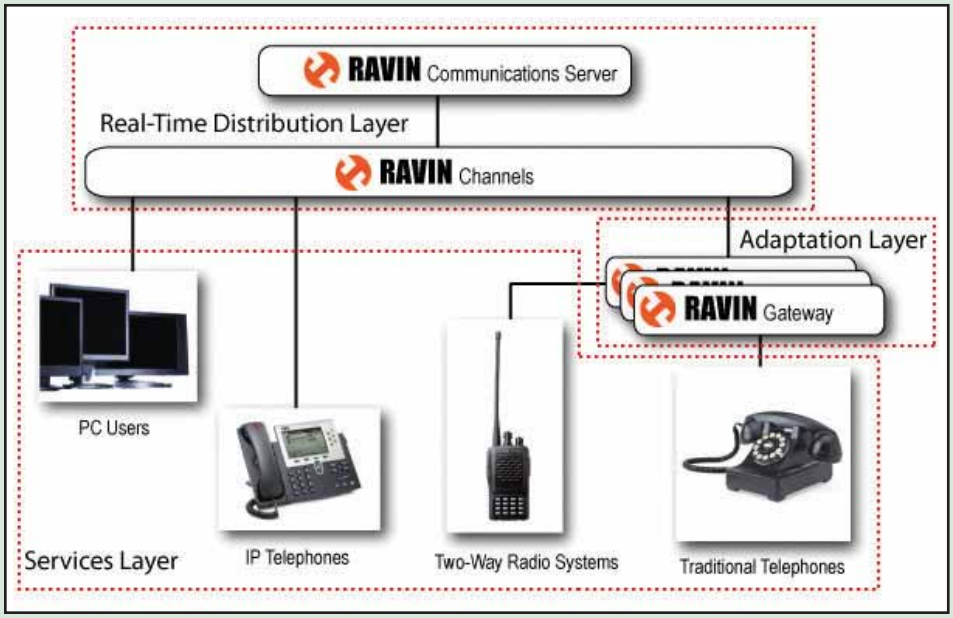
By Lehi Mackissack

Modern telecommunications systems are awash in technological innovation, however what is sometimes lost is that we are simply enabling the exchange of dialog. In an ideal world, one common platform would be the facilitator. Until then, the next best strategy is to create the universal translator that allows organizations to integrate the myriad of available communications devices and make them interoperable. It is my view that IP-based communications is the best solution currently available for accomplishing this.

A telecommunications solution that is built upon bringing disparate communications systems into IP, then creating the ability for them to communicate, is engineered in three layers: the adaptation layer, the real-time distribution layer, and the services layer (Figure 1 below).

Adaptation Layer

The adaptation layer is the critical first step in transforming audio from a wide range of standards-based proprietary communications technologies into standards-based IP traffic.



A Closer Look

This first layer adapts data streams from unique environments by capturing the audio (analog or digital) and compressing it via a variety of industry standard codecs. The associated signalling and empirical data are then built, assigned IP addressing, and packetized ready for distribution into the IP network.

The adaptation layer begins at the physical level, where the specific channel audio and data ports are connected to a standard IP Ethernet Voice Data port on a router or gateway technology.

Each Ethernet Voice Data port supports a single communications channel with gateway technologies designed to accommodate a number of these ports. First the gateway captures the audio data and applies standard codecs, such as G.728, to sample and digitize the audio stream. The digitized audio is packaged into R-UDP packets according to the Real-Time Transport Protocol (RTP) standard, which provides timestamps, sequencing, and QoS markings. The packets are addressed and delivered to unicast or multicast destinations based on the gateway's configuration. With R-UDP, the endpoints in the multicast group do not require confirmation of the data delivery. This reduces the required bandwidth and latency that occurs when an originating device expects a confirmation of data delivery from a recipient.

By translating signals into IP, the adaptation layer delivers interoperability while enabling all participants to continue using their existing communications equipment. At the same time, the channel audio and data streams can be made available to any authorized IP device on the network.

Real-Time Distribution Layer

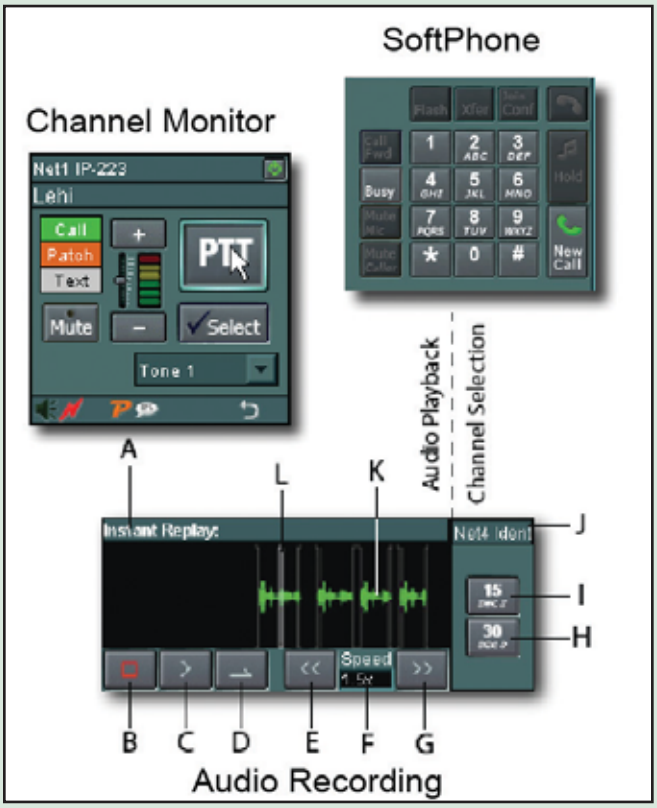
The goal of this layer is to distribute the IP channel audio and data streams to the right endpoints in a highly scalable manner with a high degree of reliability.

Elements of this layer are implemented both in the gateway and in the network that connects them. Some of the most widely implemented standards and architectures in IP networking are used in this layer, including IP Multicast support and QoS.

Unicast distribution is often used for dial-in access to communication channels or to provide a more centralized approach to management.

Multicast distribution makes the channels available to multiple hosts and management applications simultaneously and allows very dynamic connectivity through well-known non-proprietary Internet Group Management Protocols.

QoS (quality of service) ensures priority for IP-channel audio traffic delivering deterministic performance even in the most congested situations. QoS can be simplified on larger capacity transport facilities that are privately provisioned and can also be quite granular in matrix, giving differing priorities to the same types of traffic supporting distinctly different application priorities.



Services Layer

The services layer adds critical management, security, and client-integration services. The client GUI (graphical user interface) manages and secures the solution and delivers innovative tools for linking connected communications systems. Communications resource engines manage distributing IP channel audio and data information, enhancing command and control console functions to the various endpoints (Figure 2 below).

A Mesh of Communications

Together, these three layers offer more than communications flexibility and interoperability; they offer broad-based information sharing. The IP-centric approach provides the only foundation that will scale to accommodate an unlimited number of operators sharing common communications resources.

Next-Generation Telecommunications Control Systems: Applied

Pacific Gas and Electric (PG&E) is one of the largest combination natural gas and electric utilities in the United States. PG&E provides energy service to approximately 8 million customers throughout a 70,000-square-mile service area in northern and central California.

There are more than 200 radio stations covering the company's service area, as well as hundreds of links to the Public Switched Telephone Network, PG&E's Private Switched Telephone Networks, and VoIP Telephone Networks. Furthermore, there is growing use of commercial cellular "push to talk" services by PG&E's operations, maintenance, and construction personnel.

These communications systems must be efficient and dependable, allowing for agility as the company's long-term vision is met.

One of the objectives is to improve the reliability of the communications architecture. This is achieved by migrating away from a TDM architecture to one that is IP-based, affording them the ability to take advantage of the resilient redundant self-healing characteristics that IP networks provide. Furthermore, the IP architecture must enable all operators to have access to all communications resources.

As declining technologies are replaced, PG&E

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understood the need to focus on the emerging technology of communications over IP, knowing that this technology will continue to evolve with many enhanced characteristics on the horizon.

PG&E's strategic vision is to consolidate the number of transmission and distribution electric control centers. To simultaneously deliver to the larger control centers access to all of the communications resources in the company is no easy task, and therefore the technology required four basic IP-interoperable principles: reliability, redundancy, complete communications accessibility, and mobility.

Reliability

The planned consolidation of electric control centers increases the importance of reliability; in essence fewer control centers are controlling larger geographic areas.

The electric control center's communications reliability was of utmost importance to PG&E. As PG&E migrates to IP telephony applications, it is optimizing its telephone systems by increasing the use of reliable VoIP telephony as well as maintaining linkages to its traditional telephone systems. This enables PG&E to have minimal points-of-failure, therefore enabling quicker response in the case of an emergency. Maintaining the highest levels of reliability, with complete backup capabilities in the event of catastrophic failure of any one of these control centers, is an essential requirement for PG&E.

Redundancy

The increased importance of reliability requires the electric control centers to be redundant, allowing multiple electric control centers and their operators access to all radio and telephone resources in an organized manageable format. The redundant characteristics of the enterprise network and fully redundant accessibility of all communications resources are also essential ingredients.

The control operators usually work from one electric control center. However if they were needed at another center, the requirement was that they could go to that center, log in to the console communications application with a username and password, and all their communications resources would be there for them. If an emergency were to arise, a range of emergency-response staff would also require access to the same communications resources, radio or telephone, from anywhere on the network or from outside the network through a secure VPN connection.

Complete Communications Accessibility

The system requires that all IP-based console systems access the complete range communications resources.

An operator, maintenance technician, or manager wants to call someone else from his or her console. Within the rich graphical user interface of their console, a call is placed or received from an integrated console application. The console application is comprised of graphical representations of all of the various communications resources: softphone, dispatch console, instant replay audio recorder, SMS text messaging, email client, communications channels, telephone directories, status and presence display of operators in service with console-to-console intercom functions—all made available through on integrated console GUI. (See Figure 2 on page 45.) As calls are actively enabled, they are also being recorded within the application, and required beep tones are inserted as needed, thus notifying the users on both sides of the communication channel that the conversation is being recorded.

Mobility

Mobility takes a tremendous amount of integration in a common platform. Electric control center operators must be able to "easily" switch their ongoing push to talk radio or telephone conversations of their IP-based (hard-wired) system to a (wireless) 802.11 handset while maintaining the same recording beep tone session.

During a conversation using the console telephone, radio, or other communication channel, the operator needs to roam within the control room to adjacent areas where map boards or electronic grid displays are present. A communicator, a wireless IP handset or PDA device, allows the personal mobility required by the operator as he or she relocates to the location of the resource. As this transition from the operator's console device to the mobile communicator occurs, the audio recording within the application's voice logging utility continues without disruption.

A vision of wireless communications comes to life by simply placing a caller on hold within the application and picking up the caller from a mobile wireless 802.11 handset or PDA device. This allows the electric control center operator the flexibility to freely move about the facility as the mobile device associates with a wireless access point.

The pervasive accessibility and characteristics of the technology vision provide ubiquitous access by PG&E supervisors and technicians. Added varia-

tions of strategically designed WiLan and WiMax hotspots in various locations throughout the company's service area help mold a future vision of access by fleet personnel, as well.

IP-Based Interoperability Technical Advantages

- The IP-enabled solution is based on proven, open, standards-based technology and commercial products.
- A multi-layered network defense is implemented through standards-based security.
- The solution adapts to all radio technologies, including legacy systems, preserving existing investments and providing a broader range of vendor flexibility.
- The solution achieves inter- and intra-agency interoperability by distributing certain IP communications channels on LAN and WAN networks while making others available for mutual or inter-agency communications.
- By consolidating onto the Enterprise IP network, ubiquitous communication is possible using IP-enabled devices. QoS capabilities give priority to voice traffic over data traffic during periods of congestion, keeping voice quality clear and connections stable.
- The solution enables multiple communications systems to be joined together on a permanent or ad hoc basis using technologically sound off-the-shelf technologies. The scalable, distributed architecture can support just a few to hundreds or thousands of users over unlimited distances across the enterprise network.
- The converged communications network enables an organization to recoup costs through either reduced facility charges or a reduction in the number of required connections at each site's location. The RAVIN Blade (Figure 3 below) and Peripheral Interface Controller architecture enables the enterprise network control center operators to enjoy reduced noise and heat generated by workstations that continue to manifest in, under, and around each console operator position.
- The solution extends the reach of command and control capabilities anywhere on the enterprise's wired and wireless IP networks by enabling simultaneous remote monitoring and dispatch through IP-enabled devices.
- The solution's architecture offers a rich new set of integrated IP capabilities for secure, policy-based information sharing between the enterprise's facilities, centers, and virtually any IP endpoint on the enterprise network, which can significantly expand and improve response.
- The solution provides E-learning applications that can be used to develop online training programs delivered to employee's desktops as a part of refresher training on new application releases or as a part of human resources' new hire orientation.

The Rubber Meets the Road

From Goals and Visions to Implementation

PG&E project managers quickly discovered that while there was an overabundance of vendors promising nirvana, reality was much more difficult. The monumental challenge was finding a technology solution that could become the launch pad that allowed PG&E to integrate its existing communications technologies in current use with a segue into emerging technologies of tomorrow. The utility giant was in search of a strategic communications technology developer with an enabling technology and a common vision and drive, a partner that could embrace unanticipated challenges that are sure to arise. Having a strategic technology partner who understands both the problems and vision coupled with a solution makes all the difference between success and failure.

PG&E selected Network Integration & Consulting Services (NICS) of Draper, Utah, to deliver on their goals and their vision. RAVIN; NICS Next-Generation Unified interoperable communications technology is the platform upon which PG&E will standardize for console operations, communications optimization, enterprise-wide voice logging, and additional mobile communications and computing functions. RAVIN is the launch pad, and NICS is the visionary partner.

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