Cisco Network Emergency Response Vehicle: Enabling IP-Based Incident Management

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EXECUTIVE SUMMARY

Large-scale crises can rapidly overwhelm the communications infrastructure of emergency responders. Whether the event is a natural disaster, a human-caused incident, or a "planned disaster" such as a large sporting event, there is a critical need to make sure that the right people have the right information at the right time. The need for command and control is further complicated by the amount and disparate nature of the information that must be processed. Emergency communication is no longer the sole domain of radio; today's incident managers must be able to process additional voice, video, and data feeds from Geographic Information Systems (GIS) maps such as Google Earth, streaming video, telephony , electronic mail, instant messaging, and even Web 2.0-based real-time content such as Twitter feeds and other "crowd-sourced" incident information.

Based on lessons learned from recent large-scale emergencies such as the 2004 Indian Ocean tsunami and Hurricane Katrina, Cisco has developed the Network Emergency Response Vehicle (NERV) platform to provide a mobile solution that can provide communications support across a variety of different media to incident commanders. These self-deployable vehicles are capable of providing hastily formed networks (HFNs) or incident area networks in minimal time, while assuring security and interoperability between agencies arriving on scene to provide mutual aid.

The NERV enables a unique level of customer support to Cisco customers in the midst of crisis and is an example of the network-based communications transformation now under way in public safety. Through numerous deployments since their introduction in 2007, the Cisco® NERV fleet has demonstrated its value in real-world incidents to emergency responders and the communities that they serve.

RAPIDLY DEPLOYABLE AND RESILIENT

In any crisis situation, it is imperative that any field communications solution is highly mobile and rapidly deployable. The Cisco NERV (Figure 1) fulfills these requirements by being a self-contained vehicle in which all technology travels together as a preconfigured package. Once the vehicle arrives on scene at an incident, it takes a crew of two no more than 15 minutes from the moment the wheels stop to when an incident commander can place a phone call or send email.

Figure 1. Cisco Network Emergency Response Vehicle (NERV)

If the situation requires the NERV to push further into the disaster zone to support additional units, the NERV can be shut down and ready to roll in another 15 minutes. This can greatly simplify planning for the incident command staff, which has the ability to deploy and redeploy the NERV as needed to support the needs of a dynamic incident.

Power is supplied to the onboard systems either through the vehicle's own generator or through a shore power connection to an external power source. Multiple uninterruptible power supply (UPS) systems make sure that any power disruption to the vehicle does not disrupt critical communications.

VEHICLE DESIGN

The Cisco NERV is a NIMS type II Mobile Communication Center[1] designed to be a self-deployable command and communications resource for first responders, critical infrastructure, and other Cisco customers who may have been affected by a catastrophic event and require mission-critical networking in order to recover normal operations in the midst of an acute emergency situation.

When the vehicle deploys for disaster response missions, it arrives ready for up to 72 hours of continuous operations. This enables the NERV crew to immediately start operations once on scene without negatively affecting what is in all likelihood an already logistically challenged situation.

The Cisco NERV crew themselves are part of the program. In addition to their technical skills, all members of the Cisco NERV team are certified in the Incident Command System/National Incident Management System (ICS/NIMS) administered by the U.S. Federal Emergency Management Agency (FEMA). This allows the Cisco NERV to operate as one team with police, fire, EMS, National Guard, and other responders within an ICS incident command or unified command framework transparently.

The team and vehicles are supported by the Cisco Tactical Operations Center in Raleigh, NC, which provides proactive intelligence and logistical support 24 hours a day, 7 days a week to the deployed units and the customers with whom they are engaged.

TECHNOLOGY SUITE

Unlike many contemporary communications and command vehicles, the NERV is built around an IP-based network foundation. This reflects the fact that in recent large-scale disasters, responders took advantage of a breadth of interoperable communications beyond that provided by traditional push-to-talk (PTT) radio. The role for these "hastily formed networks"[2] in and around the incident will continue to grow as more applications are

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[1] The National Incident Management System (NIMS) is the incident management methodology used in the United States and has established standards for mutual aid resources. The NERV actually exceeds the NIMS type II MCC requirements in many areas. The current resource typing definitions are available at www.fema.gov/pdf/emergency/nims/incident_mgmt.pdf.

[2] The term "hastily formed network" was coined at the U.S. Naval Postgraduate School after Hurricane Katrina to describe impromptu networks that provide crisis communications. For more information, see www.nps.edu/Academics/Institutes/Cebrowski/Research/HFN.html.

developed for incident managers and as emergency operations learn to adapt to the new technology. IP-based communications make sure that resources are available on scene regardless of where those resources physically reside. If they are reachable on the network, geography does not matter. The engineering section of the Cisco NERV brings together different technologies to provide situational awareness for the command staff (Figure 2).

Figure 2. Engineering Section of Cisco NERV

The NERV is designed to interoperate with the legacy communications systems of today and provides a path to the emerging network-centric communications systems of the future.

Satellite-Based Connectivity

The Cisco NERV uses a 1.8-meter satellite dish to provide up to five megabits of bandwidth for all voice, video, and data applications that need access to the Internet or other remote networks. Unlike older VSAT satellite systems, there is no need for operators to manually point the dish to the correct azimuth and elevation. Instead, the auto-acquire capability of the control unit means that the vehicle crew can continue to operate other systems while the satellite is deployed or stowed. The NERV needs only a clear shot of the southern sky, and the satellite control systems take care of the rest. The use of geosynchronous communications satellites can introduce significant delay in communications, so the NERV uses Cisco Wide Area Application Services (WAAS) technology to maximize network performance across the satellite WAN link.

Wired and Wireless Network Infrastructure

The core network of the Cisco NERV is provided by a number of Cisco Integrated Services Routers (ISRs). These routers are configured to provide a number of different services on the vehicle such as secure virtual private network (VPN) tunneling services to back-end resources, firewall and other security services, telephony services using Cisco Unified CallManager Express, and controllers for the wireless network infrastructure. The networks on the vehicle are segmented by a number of Layer 2 and Layer 3 techniques to make sure of security and quality of service.

Wireless network services are provided by Cisco 1240 Series Wireless Access Points within the interior of the vehicle and by the Cisco 1500 Series Wireless Mesh Access Point on the external mast of the vehicle. The mesh access points allow the NERV to provide a large 802.11-based wireless footprint around the vehicle up to several

hundred feet away. Additionally, the NERV carries six additional mesh access points in storage. With the ability to daisy-chain access points together, the wireless mesh access points are able to provide network access to a large area with hundreds of hosts, such as an extremely large fireground command post or campus environment.

Voice over IP

The Cisco NERV provides a full suite of telephony services through Cisco Unified CallManager Express software, which enables voice communications over wired Cisco 7900 series phones, 9900 series video phones, as well as the onboard cache of Cisco 7925 Wireless IP Phones. The Cisco NERV vehicles use VPNs to reach back to the public switched telephone network (PSTN) gateways located at the NERV support hubs of Raleigh, North Carolina and San Jose, California. Intelligent gatekeeper software makes sure that if reachability to one hub is interrupted, telephony services will switch automatically to the other.

The flexible, satellite-based telephony capability makes sure that the NERV is able to provide telephone services to first responders and other served agencies even if the local PSTN or mobile phone network is unavailable or otherwise destroyed by the emergency or its aftermath. The Cisco Unified CallManager Express implementation onboard the NERV supports up to 240 phones, which allows incident managers the flexibility to set up large phone banks, with the number of simultaneous calls dependent upon available satellite bandwidth.

Cisco Video Conferencing

The conference room onboard the NERV is equipped with a Cisco TelePresence™ 1000 high-definition video conferencing solution. Cisco TelePresence allows incident commanders and other on-scene leadership to have secure high-definition, high-quality video conferencing and collaboration with remote personnel quickly and easily. The Cisco NERV fleet participates in the Cisco TelePresence Exchange network, which enables thousands of Cisco TelePresence units around the world to communicate using regional MPLS-based points of presence. This means that remote staff can participate in a meeting with a NERV either through their own Exchange-based Cisco TelePresence systems or at any number of convenient "public" Cisco TelePresence rooms around the world to collaborate with on-scene staff.

The NERV also leverages Tandberg video conferencing systems. The Tandberg 770 MXP provides video conferencing in the NERV conferencing area. The Tandberg Tactical MXP provides portable video communications in a compact heavy-duty watertight case for use in extreme conditions. It is fully integrated and wireless system is ideal for field operations. The Tandberg FieldView Rugged Camera is a handheld video device with two-way VoIP. All these systems use standards including H.264 and SIP and work together to create a unified video conferencing environment.

Radio and Voice Interoperability with Cisco IPICS

As has been made painfully obvious in recent large-scale emergencies, different agencies coming together to provide mutual aid and support are often hampered by the lack of radio interoperability that is inherent in today's public safety environment. Responders often have to struggle with different bands (for example, UHF, VHF, 800 Mhz, and so on) and different proprietary radio protocols. The Cisco IPICS solution uses the Land Mobile Radio (LMR) feature set in Cisco IOS® Software and the numerous radio systems onboard the NERV to enable radio interoperability across any legacy radio technology. The IPICS solution not only enables radio-to-radio interoperability, but also allows any voice device, whether it is a Windows-based PC, a Cisco IP phone, a traditional phone, or a mobile phone, to participate in radio communications. The Cisco NERV conference room allows decision makers to manage crises with a wealth of voice, video, radio and data communications at their fingertips (Figure 3).

Figure 3. Cisco NERV Conference Room

Network-Based Video Survellience

Video surveillance increases the situational awareness of field personnel and commanders by enabling them to observe nearby activities and to record or retransmit that video for the benefit of others. The Cisco Video Surveillance solution encompasses a suite of products that can incorporate both analog legacy closed circuit TV cameras as well as newer IP-based cameras into a unified monitoring and recording environment. Clients, whether using a web browser or the Cisco Video Surveillance client software, can monitor the feeds from anywhere on the network or from the public Internet with appropriate access controls in place.

Additionally, the NERV also has a Cisco Digital Media Encoder 2000 onboard. The DME is a video encoding and streaming device that is configured to take in any of the vehicle's eight video feeds and then record or stream the video in any number of formats, such as Windows Media Player and MPEG-4. With the DME 2000, the crew can encode and stream real-time television news or weather information to the desktops of first responders, providing exactly the right information to them while minimizing satellite bandwidth usage, as clients are going to a local resource, not a remote one, for live news.

CUSTOMER RESULTS

The first emergency deployment of a Cisco NERV was in late 2007, during the Harris fires in San Diego County, California. Since then, Cisco NERV vehicles have been sent to a number of major incidents, where they enabled critical communications in the most challenging of circumstances (Table 1).

Table 1. Recent Cisco NERV Emergency Deployments

Event	Year
Harris Fire, San Diego, CA	2007
Floods, Cedar Rapids, IA	2008
Evans Road fire, NC	2008
Hurricane Gustav, LA	2008
Hurricane Ike, TX	2008
Fiber-optic Cut, Morgan Hill, CA	2009
Earthquake, Port-Au-Prince, Haiti	2010

Plane Crash, Palo Alto, CA	2010
Fourmile Canyon Fire, Boulder, CO	2010
Gas Pipeline explosion, San Bruno, CA	2010
Earthquakes, Christchurch New Zealand	2010/2011
Floods, Queensland Australia	2011
Floods, Brazil	2011
Earthquake, Japan	2011

Customer response to the NERV has been uniformly enthusiastic. While praising the obvious restoration of communications where previously there was none, customers have also reported that once they adjusted their operations to a network-centric model, they would look to adopt some or all of the technology onboard the NERV for their post emergency day-to-day operations.

The Cisco Tactical Operations team has continued to make refinements to the technology and operational processes based on extensive customer feedback and debriefings from incidents.

TRANSFORMING MOBILE COMMAND AND CONTROL

It was not all that long ago that public safety communications centered solely on radio communications. Today, however, this is no longer the case. Responders need access to more than just radio to effectively manage an incident. The operational history of the NERV vehicles shows the enhanced command and control that can be realized when IP-based communications systems are at the nexus of crisis communications. The ability to interoperate with legacy systems, as well as enabling new forms of communication and collaboration, means that agencies can continue to use what they know works, while enabling a transparent path to future network-based communications and applications. The Cisco NERV provides a forward-thinking example implementation for the future of emergency communications and remains a critical resource for those who need it today.

FOR MORE INFORMATION

Cisco NERV vehicles are available for emergency response throughout the Continental United States during the acute phase of an emergency. Customers can engage a Cisco NERV or any of the other services Cisco Tactical Operations provides by contacting their Cisco account team. For further questions, contact nerv-info@cisco.com.

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