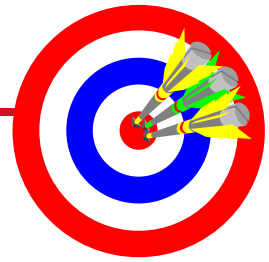




IP Networking 102: IP on the VIDA Network

assuredcommunications®

Overall Content



- IP Review
- COTS Network Equipment
- The VIDA Network
- P25 Site Equipment
- Questions

IP Review Content

- **Data Transfer on a Network**
- **The IP Protocol Stack**
- **IP Protocol Properties**
- **IP Addressing**
- **TCP & UDP Protocols**
- **Classless Addressing**
- **IP Services and Protocols**
- **Inherent Benefits of IP for Radio Network**

Data Transfer on a Network

- **Circuit Switched**

- Connection-oriented
 - Have a dedicated connection between two points
 - Set up an end-to-end path before any data is sent
- Capacity of the network is fixed
- Cost is by time

- **Packet Switched**

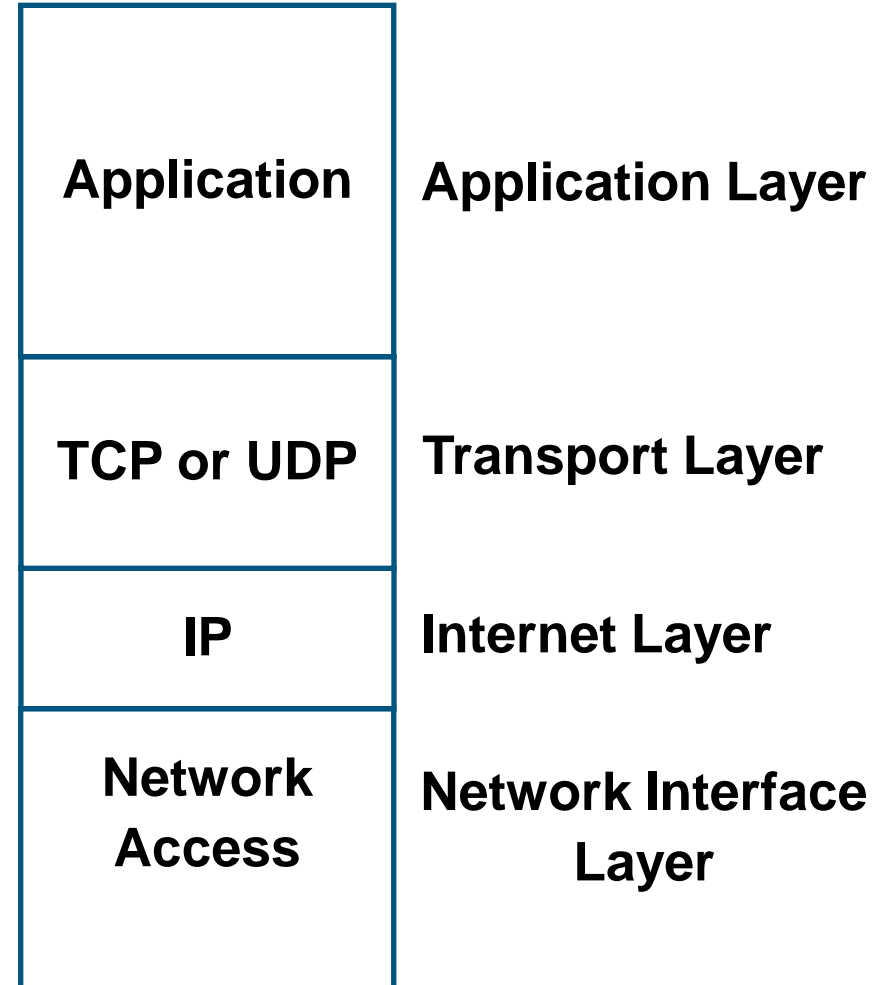
- Connectionless or Dynamic Connection
 - No dedicated path between source & destination
 - Data is segmented into smaller units
 - The network delivers the packets to the destination
- Can't guarantee capacity of the network
- Cost is by number of bits

The IP Protocol Stack

- **The IP protocol stack**

- The protocols were developed first, then the model
- Designed to allow many different remote computers to communicate
- Partitioned into 4 layers

Internet Protocol



IP Protocol Properties

- **IP provides for:**
 - Addressing
 - Type of service specification
 - Fragmentation and re-assembly
 - Security
- **Basic transfer unit is a datagram**
 - Header & data area
 - Maximum length of 65,535 bytes (including the 20-byte header)

IP Protocol Properties

- **IP is a connection-less unreliable best-effort service**
 - There is no guarantee that the data will reach the intended host
 - The layer protocols above IP are responsible for being sure correct data is delivered
 - TCP provides this service inherently
 - When UDP is used, the application must provide for whatever level of guaranteed delivery is required.
- **All transport protocol data packets such as UDP or TCP are encapsulated in IP data packets to be carried from one host to another**

Transport Control Protocol

- **TCP**
 - Connection-oriented protocol
 - Connection oriented means both the client and server must open the connection before data is sent
 - Connections are established & released
 - Provides reliable end-to-end byte stream over an unreliable IP network
 - Handles re-sequencing of datagrams

User Datagram Protocol

- **UDP**
 - Unreliable connectionless-oriented protocol
 - Adds very little transmission overhead
 - Connections are not established
 - Send raw datagrams - no sequencing
 - Application should handle reliability
 - The following protocols or services use UDP:
 - DNS
 - SNMP
 - TFTP

IP Addressing

- **An IP address consists of four bytes – 32 bits (IPv4)**
- **A byte is an eight bit integer**
- **These bytes are also known as octets.**
- **Dotted decimal notation**
 - Each octet is converted to a decimal integer
 - Each decimal integer is separated by a decimal point
 - Each octet ranges in value from 0 to 255.
- **The full range of IP addresses is from 0.0.0.0 through 255.255.255.255.**

10010011 01110101 10011110 10101010

147.117.158.170

IP Network Mask

- **Network masks**
 - Network (subnet) masks accompany an IP address and the two values work together.
 - Applying the subnet mask to an IP address splits the address into two parts
 - An extended network address (Network ID)
 - A host address (Host ID)
- **IP addresses are not complete without a network mask**
 - Defines which part of the address is the network ID and which is the host ID
 - The most significant part of the mask with bits set to 1's specifies the network address
 - The lower part of the address with bits set to 0's will specify the host address.

11111111 11111111 00000000 00000000
255.255.0.0

Classless Addressing

- **A system called Classless Inter-Domain Routing (CIDR) is used to allocate IP addresses more efficiently**
 - May be used with subnet masks to establish networks rather than the class system
 - A class C subnet may be 8 bits but using CIDR, it may be 12 bits.
- **CIDR addresses reduce the size of routing tables and make more IP addresses available within organizations**
- **Single IP address can be used to designate many unique IP addresses.**
- **A CIDR IP address looks like a normal IP address except that it ends with a slash followed by a number, called the IP network prefix**

- **For example: 172.200.0.115/17**
- **The first part indicates the IP address of the host**
- **The second part (**network prefix**) indicates the netmask value**
 - In this case the first 17 bits are set as the subnet mask
 - This makes the netmask value: 255.255.128.0

IP Services and Protocols

- **ARP** - Address Resolution Protocol converts an Internet Protocol (IP) address to its corresponding physical network (MAC) address.
- **DNS** – Domain Name System servers return the requested mapping (either address-to-name or name-to-address) to the requester.
- **ICMP** - Internet Control Message Protocol is useful in IP network management and administration. It is used to report:
 - errors in the underlying communications of network applications
 - availability of remote hosts
 - network congestion
- **SNMP** – Simple Network Management Protocol is a protocol for managing and trapping events on devices connected to an IP network.

IP Services

Provided by:

- **Routers** – provide next hop routing of packets from network to network based on routing protocols and network address.
- **Switches** – connect components within a network.
- **Gateways** – connect dissimilar networks.
- **Other Servers** – provide some of the various services

Inherent Benefits of IP for Radio Network?

- **Non-proprietary (standard, with multiple vendors)**
- **Can take advantage of services and features developed to enhance the IP standard**
- **Dynamic re-routing (with good network planning)**
- **Speeds development/availability of new Radio Network features**
- **Security features, including a market of utilities available**

COTS Network Equipment

- [What are COTS?](#)
- [Why COTS?](#)
- [Customer Advantages with COTS](#)
- [Known Vulnerabilities](#)

What are COTS?

- **Commercial-Off-The-Shelf (COTS) technologies:**
 - TCP/IP network protocol
 - Shared Ethernet and T1 back haul
 - Cisco network switches and routers
 - Dell, Sun, and HP servers/workstations

COTS and Standards have many customer advantages!

Why COTS?

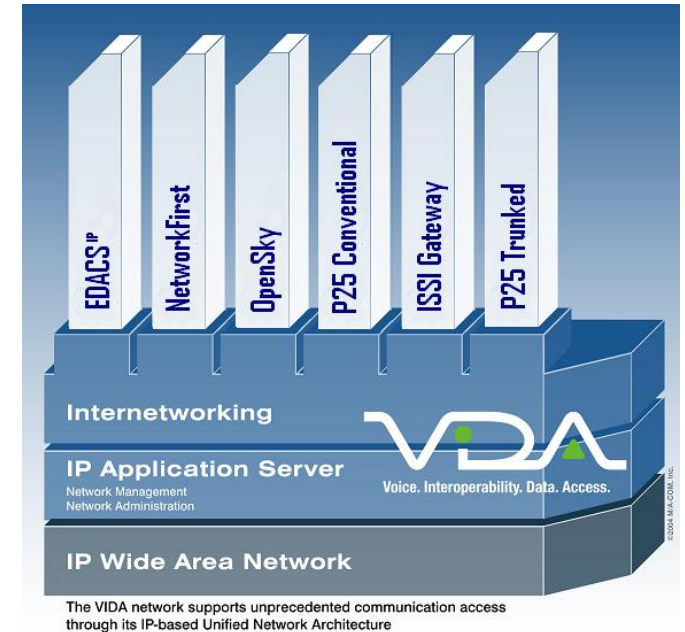
- In the past, LMR systems were implemented with:
 - Proprietary air links
 - Proprietary internal protocols
 - Proprietary network connections
 - Proprietary hardware and operating systems



Proprietary Upgrade Nightmares and Locked-In Customers!

Customer Advantages with COTS

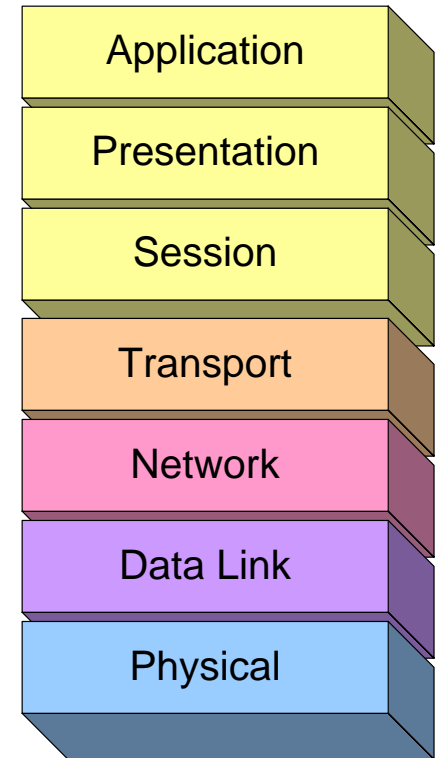
- **COTS and IP Infrastructure Advantages Include:**
 - Easier integration of IT applications
 - Multi-vendor support
 - Frequent technology refreshes
 - Standard administrative skills
 - Better customer pricing
 - Improved flexibility
 - Reuse of existing fiber



The same IP infrastructure supports all Harris' offerings!

Known Vulnerabilities

- The advantage of using COTS – the platform openness – is also its major disadvantage.
- Known vulnerabilities exist in COTS IT equipment.
- However, these vulnerabilities can be patched and/or otherwise mitigated.
- Many security utilities exist by many vendors.

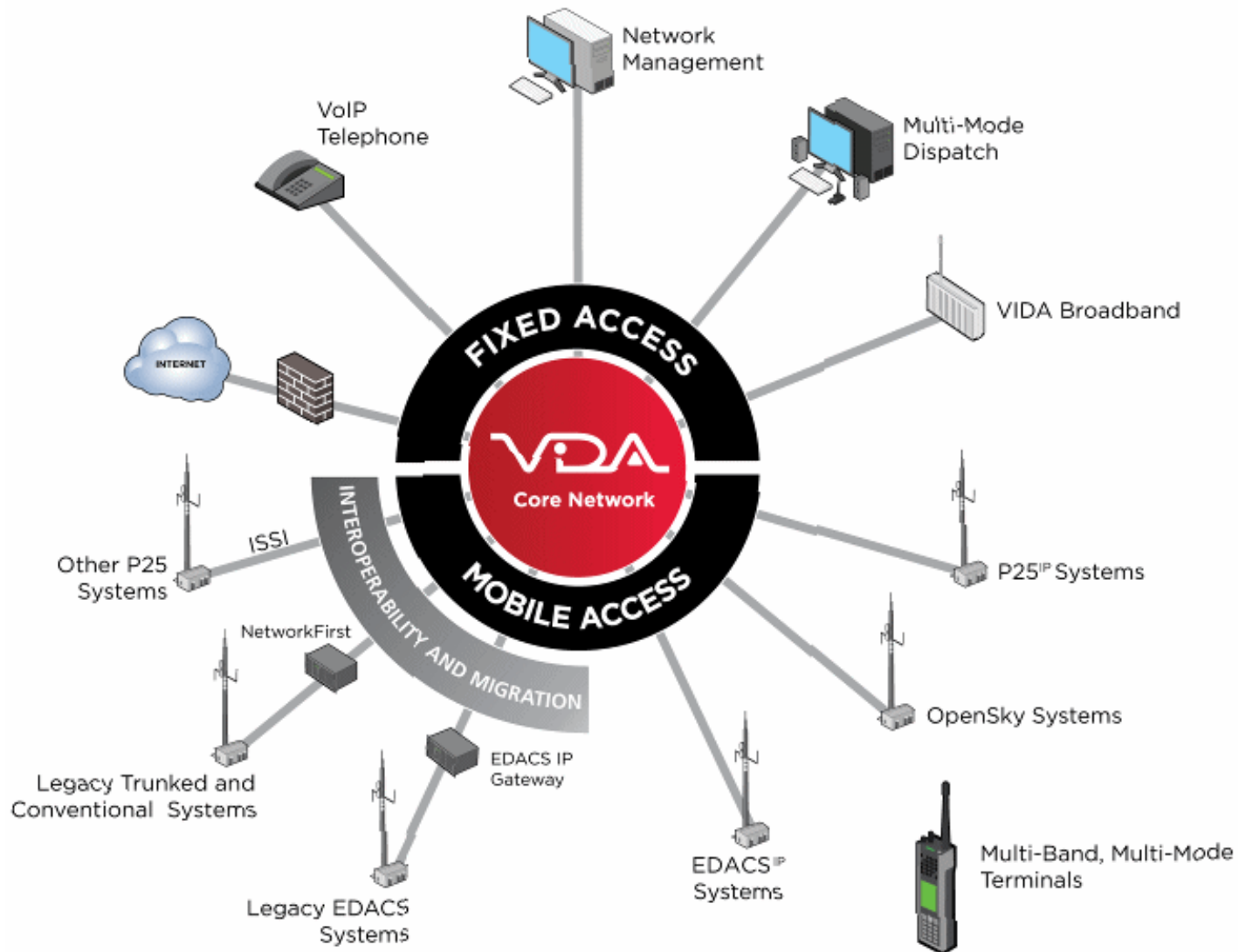


Vulnerabilities exist, but exploits can be mitigated!

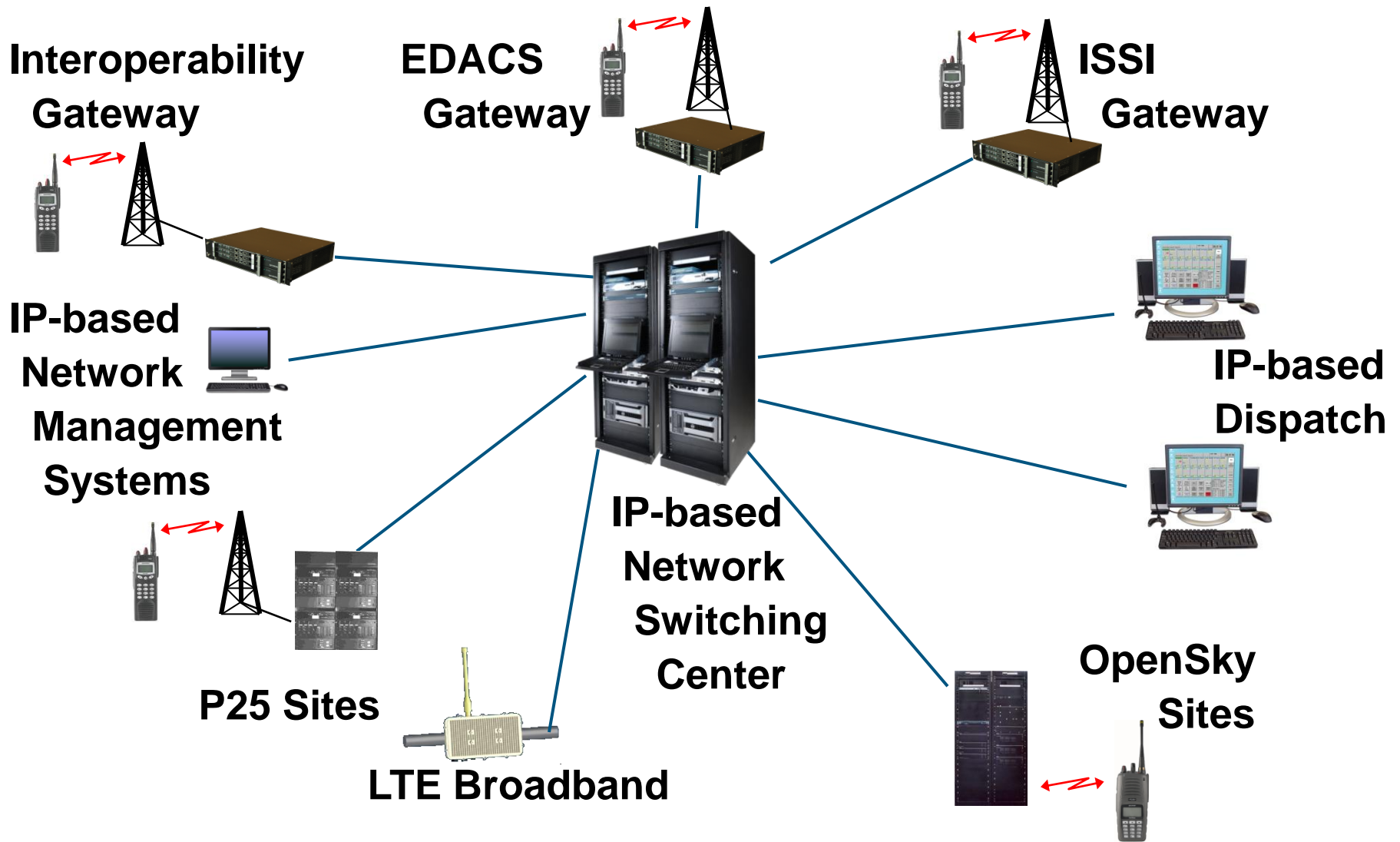
The Vida Network

- **The Scope of the VIDA Network**
- **VIDA Network Components**
- **High Availability Network Switching Center**
- **Unified Administration System (UAS)**
- **Regional Network Manager (RNM)**
- **IP Consoles**
- **Benefits of IP VIDA Network**

The Scope of the VIDA Network



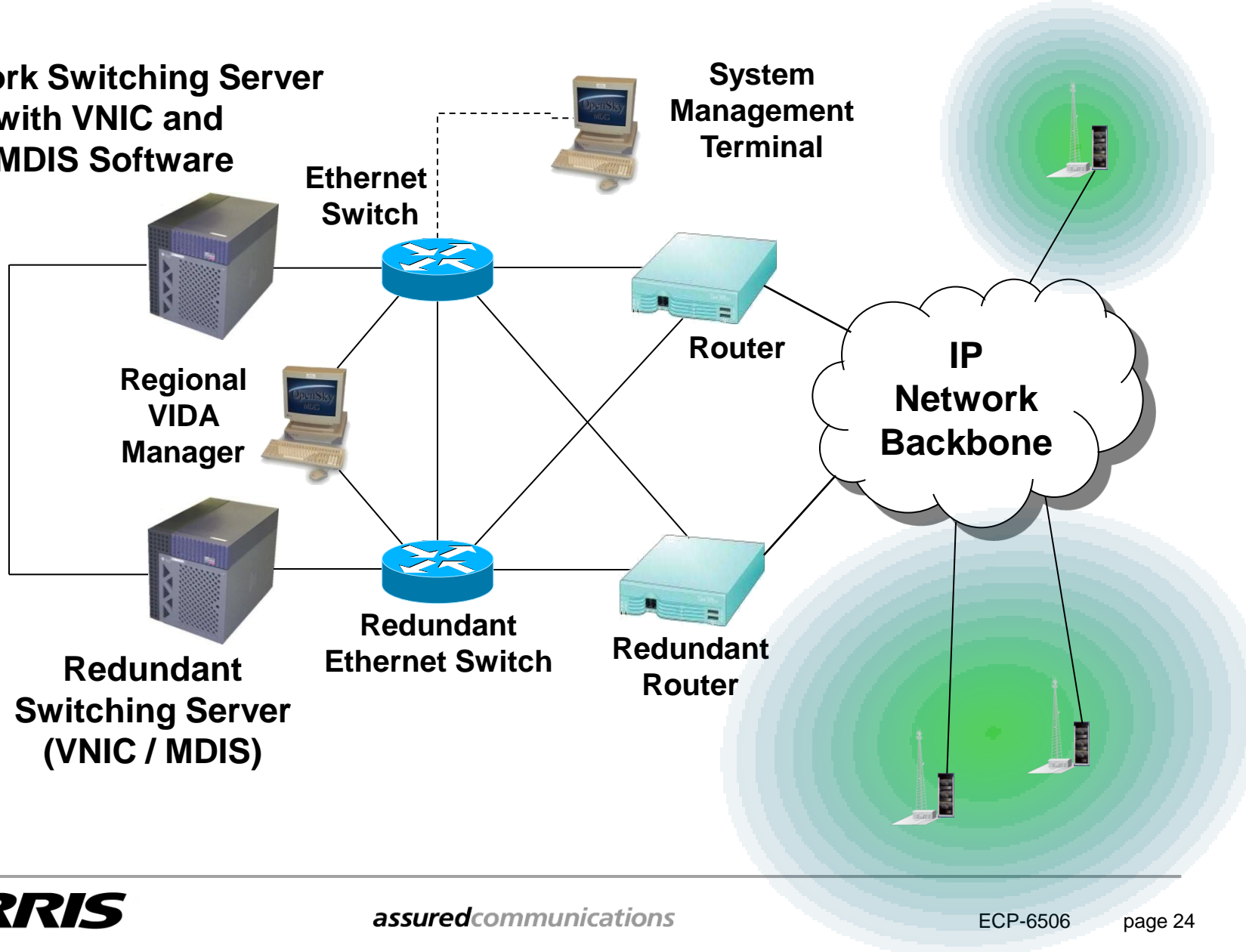
VIDA Network Components



High Availability Network Switching Center

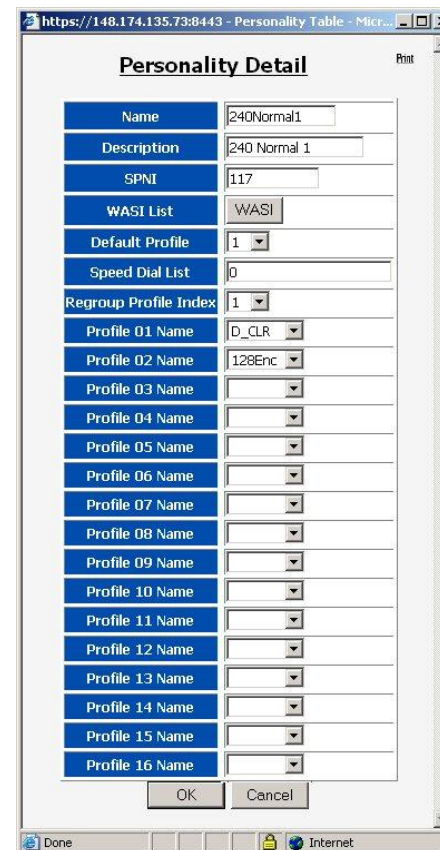
Network Switching Server
with VNIC and
MDIS Software

System
Management
Terminal



Unified Administration System (UAS)

- Only one is required for each Network (including Mixed Mode)
- Platform
 - Sun server with Sun Solaris operating system
 - Sybase relational database management system
 - Multi-user, client-server, web-based architecture
- Functions
 - Administers, configures and controls
 - IP addresses
 - Talk groups and talk group parameters
 - Operational databases (units, talk groups, etc.)
 - Radio provisioning (personalities in OpenSky)
 - Propagates and distributes database changes
- UAS Clients
 - Co-located or remote terminals
 - Password-protected access to the server

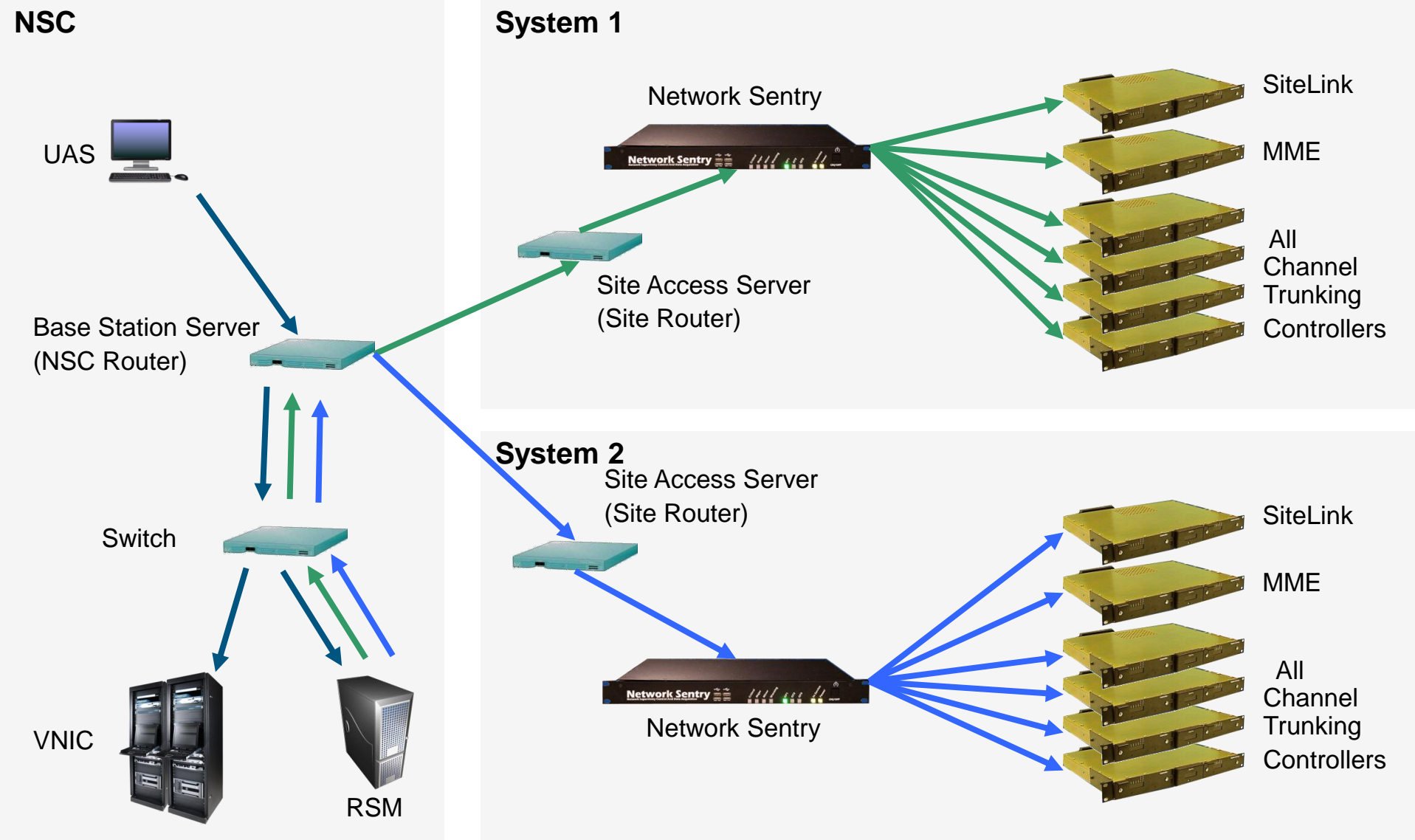


Personality Detail

Name	240Normal1
Description	240 Normal 1
SPNI	117
WASI List	WASI
Default Profile	1
Speed Dial List	0
Regroup Profile Index	1
Profile 01 Name	D_CLR
Profile 02 Name	128Enc
Profile 03 Name	
Profile 04 Name	
Profile 05 Name	
Profile 06 Name	
Profile 07 Name	
Profile 08 Name	
Profile 09 Name	
Profile 10 Name	
Profile 11 Name	
Profile 12 Name	
Profile 13 Name	
Profile 14 Name	
Profile 15 Name	
Profile 16 Name	

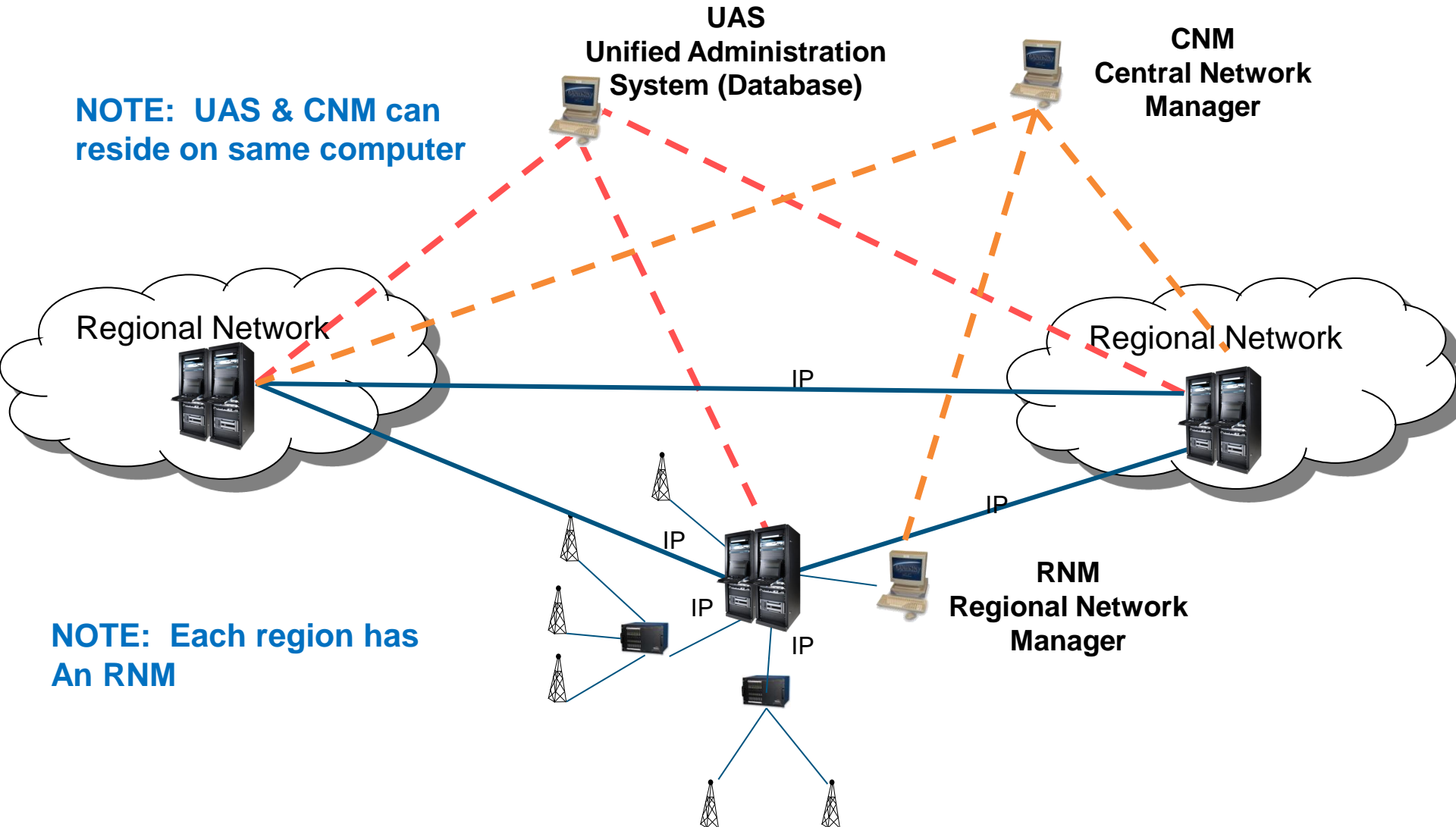
OK Cancel

UAS Database Download



RNM (Regional Network Manager)

NOTE: UAS & CNM can reside on same computer



NOTE: Each region has An RNM

RNM – Illustrates Network Components

Displays the current status of managed objects

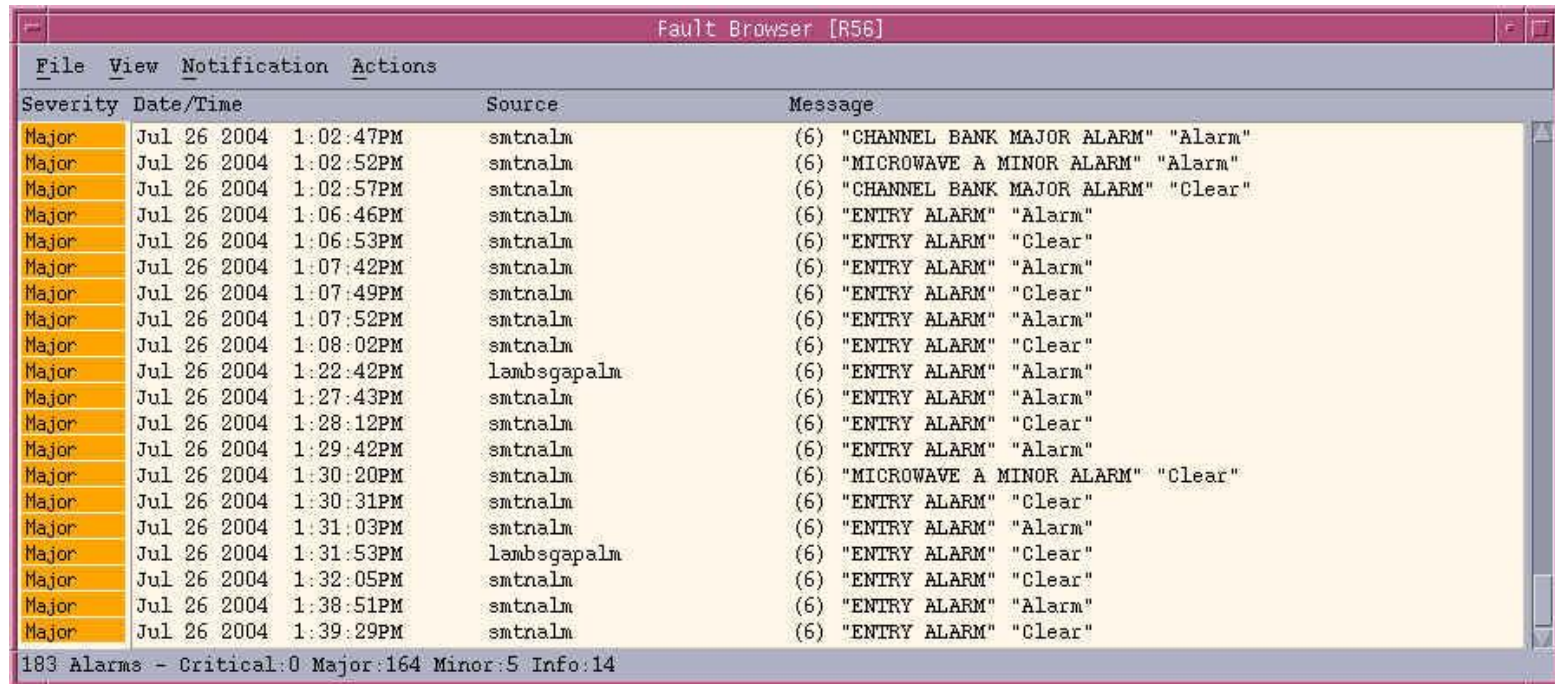
- Graphical manner
- Hierarchical manner

The screenshot shows the Network Viewer [SampleMap] interface. On the left is a Hierarchical View tree showing a structure under 'r200' including 'AOCsr200', 'Police', 'Utils', 'SITESr200' (with sub-items Adam01, Duke01, Gord01, Jack01, Adam02, Adam03), 'INFr200', and 'MISr200'. A Toolbar is located above this tree. The main area displays a Substate Mask Bar with filters for Connectivity, Operation, Fault, Performance, and Quality. Below this is a Children View showing a network diagram with nodes like MISr200, esw1r200, rncr200, esw2r200, sags1r200, bss1r200, abr200, bss2r200, and sags2r200. A Substate Mask Bar is also on the right side of the diagram. At the bottom is a Faults Panel with a table of 6 faults.

Severity	Time ↓	Object name	Object class	Message
Info	Aug 17 2004, 11:15:44 AM	Adam01bs1	BS	BSC; (103) Intervals Changed b
Info	Aug 17 2004, 11:15:44 AM	Duke01bs1	BS	BSC; (103) Intervals Changed b
Minor	Aug 17 2004, 11:15:21 AM	MUSERSr200	VNIC-Musers	(120) Unknown MesID - MesID [2
Info	Aug 17 2004, 11:15:11 AM	vnicr200	VNIC-Operation	(101) Bootup succeeded
Info	Aug 17 2004, 11:15:04 AM	vnicr200	VNIC-Operation	(112) VNIC cfg OK

RNM – Fault Browser

Displays all trap events that have not been deleted



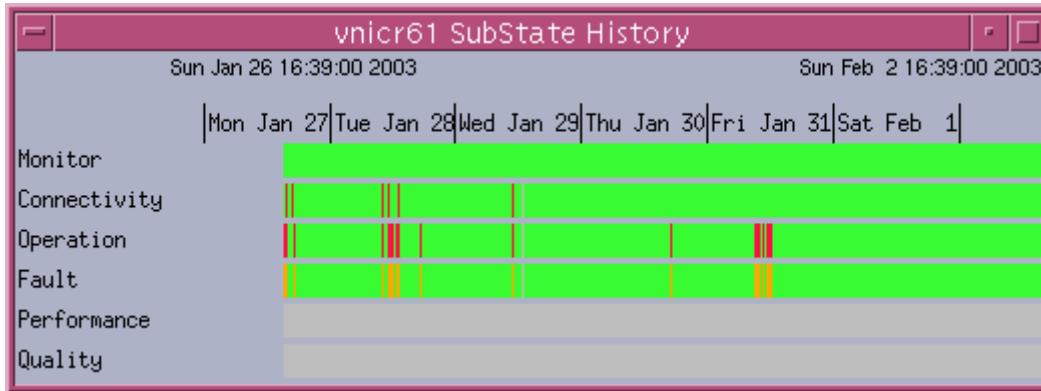
The screenshot shows a window titled "Fault Browser [R56]" with a menu bar containing "File", "View", "Notification", and "Actions". The main area displays a table of trap events with the following columns: Severity, Date/Time, Source, and Message. The events are listed in chronological order from July 26, 2004, 1:02:47PM to 1:39:29PM. The severity of the events varies, with most being "Major" and some being "Info". The sources include "smtncalm" and "lambegapalm". The messages describe various alarm events, such as "CHANNEL BANK MAJOR ALARM", "MICROWAVE A MINOR ALARM", and "ENTRY ALARM", with status indicators like "Alarm" or "Clear".

Severity	Date/Time	Source	Message
Major	Jul 26 2004 1:02:47PM	smtncalm	(6) "CHANNEL BANK MAJOR ALARM" "Alarm"
Major	Jul 26 2004 1:02:52PM	smtncalm	(6) "MICROWAVE A MINOR ALARM" "Alarm"
Major	Jul 26 2004 1:02:57PM	smtncalm	(6) "CHANNEL BANK MAJOR ALARM" "Clear"
Major	Jul 26 2004 1:06:46PM	smtncalm	(6) "ENTRY ALARM" "Alarm"
Major	Jul 26 2004 1:06:53PM	smtncalm	(6) "ENTRY ALARM" "Clear"
Major	Jul 26 2004 1:07:42PM	smtncalm	(6) "ENTRY ALARM" "Alarm"
Major	Jul 26 2004 1:07:49PM	smtncalm	(6) "ENTRY ALARM" "Clear"
Major	Jul 26 2004 1:07:52PM	smtncalm	(6) "ENTRY ALARM" "Alarm"
Major	Jul 26 2004 1:08:02PM	smtncalm	(6) "ENTRY ALARM" "Clear"
Major	Jul 26 2004 1:22:42PM	lambegapalm	(6) "ENTRY ALARM" "Alarm"
Major	Jul 26 2004 1:27:43PM	smtncalm	(6) "ENTRY ALARM" "Alarm"
Major	Jul 26 2004 1:28:12PM	smtncalm	(6) "ENTRY ALARM" "Clear"
Major	Jul 26 2004 1:29:42PM	smtncalm	(6) "ENTRY ALARM" "Alarm"
Major	Jul 26 2004 1:30:20PM	smtncalm	(6) "MICROWAVE A MINOR ALARM" "Clear"
Major	Jul 26 2004 1:30:31PM	smtncalm	(6) "ENTRY ALARM" "Clear"
Major	Jul 26 2004 1:31:03PM	smtncalm	(6) "ENTRY ALARM" "Alarm"
Major	Jul 26 2004 1:31:53PM	lambegapalm	(6) "ENTRY ALARM" "Clear"
Major	Jul 26 2004 1:32:05PM	smtncalm	(6) "ENTRY ALARM" "Clear"
Major	Jul 26 2004 1:38:51PM	smtncalm	(6) "ENTRY ALARM" "Alarm"
Major	Jul 26 2004 1:39:29PM	smtncalm	(6) "ENTRY ALARM" "Clear"

183 Alarms - Critical:0 Major:164 Minor:5 Info:14

RNM – History Browser

Displays the historical data on the performance of the system



The screenshot shows a window titled "NumAverageUsers [counter]" displaying a table of performance metrics. The table has columns for "Average", "Deviation", "Min.", and "Max.". The "Attributes" menu is open, showing options like "CongLevel", "PeakUserCongLevel", and "AverageUserCongLevel".

Attribute	Average	Deviation	Min.	Max.
CongLevel	2.00	0.00	2	2
PeakUserCongLevel	2.00	0.00	2	2
AverageUserCongLevel	2.00	0.00	2	2
NumPeakUsers	2.00	0.00	2	2
NumAverageUsers	2.00	0.00	2	2
NumAverageHomedUsers	2.00	0.00	2	2
NumNewRegistration	2.00	0.00	2	2
MeasurementDuration	2.00	0.00	2	2



RNM – Realtime Viewers

UAS1:1 - GO-Global for UNIX

RSM Site Activity

File Configure Mode

Real-time Mode

Channel	State	Time	Caller	Callee	Call type	Call detail	Voice	Confirmed	Call origin	Queue
Site_1ch01	Free	May 10, 12:59:30.057 PM	001-001-0040 Train-40	101 TRNG-1	Group	MES	✓	✗	Local	
Site_1ch02	Control	May 10, 12:59:38.922 PM								
Site_1ch03	Busy	May 10, 12:59:34.284 PM	001-001-0031 Train-31	112 ADMIN-2	Group	MES	✓	✗	Local	
	Queued									
	Denied									
	Busy									
	Conv2Callee									
Site_2ch01	Free	May 10, 12:59:38.114 PM								
Site_2ch02	Free	May 10, 12:59:38.114 PM								
Site_2ch03	Control	May 10, 12:59:38.114 PM								
	Queued									
	Denied									
	Busy									
	Conv2Callee									
Site_3ch01	Free	May 10, 12:59:39.772 PM								
Site_3ch02	Control	May 10, 12:59:39.772 PM								
	Queued									
	Denied									
	Busy									
	Conv2Callee									
Site_4ch01										
Site_4ch02										
	Queued									
	Denied									
	Busy									
	Conv2Callee									

C3 Maestro^{IP} Dispatch Consoles



Purpose:

- Monitors & controls multiple Groups at a single physical position
- A single Microphone/PTT and Selected & Unselected Speakers
- Adds Patch & Simulselect capability to the P25 System
- Provides EMERGENCY control

Physically:

- Can be programmed to monitor up to 1024 Groups
- Simultaneous audio controlled by Talk path licenses
 - Standard – 6 talk paths
 - Maximum – 20 talk paths

VIP Console

- Provides a flexible solution for keeping track of radio system communications
- For administrative and backup dispatch users
- Can be installed on customer PC
- Communication and Monitoring of 4 Group Calls
 - Emergency Status Indication
 - Patch
 - SimulSelect
 - Call History



...Benefits of IP VIDA Network

- **Interoperability**
 - Mixed mode P25 and OpenSky
 - Feature-packed with EDACS Gateway
 - Connect P25 Networks with ISSI Gateway
 - Connect to legacy networks with Interop GW
- **One UAS Database updates dynamically, available from virtually anywhere via web.**
- **RNM/CNM allows network and traffic visibility/control from virtually anywhere via XWindows Client.**

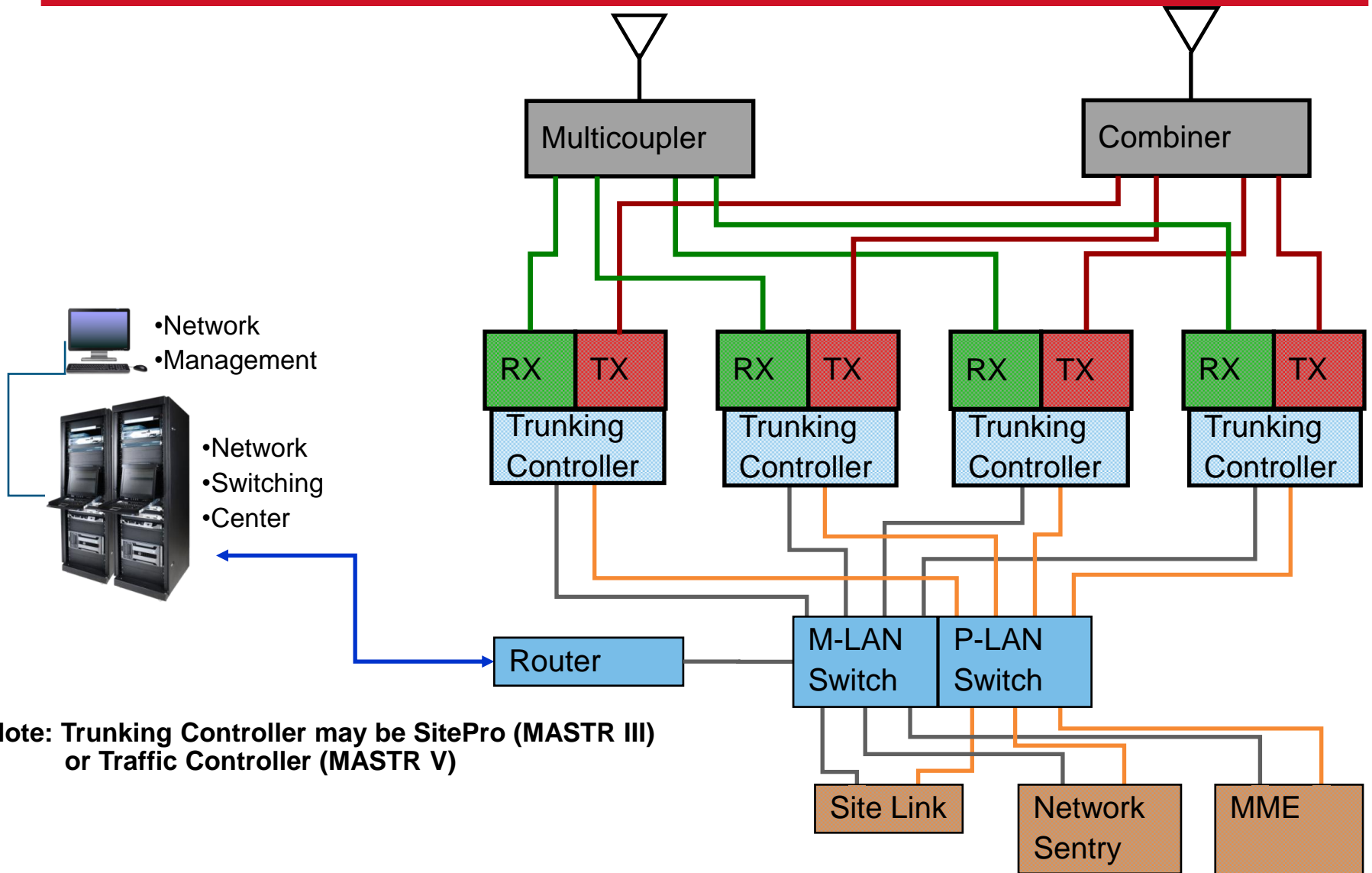
More Benefits of IP VIDA Network?

- **High Availability Network Switch enables redundant switch and network paths**
- **IP Consoles can reside anywhere on the network!**

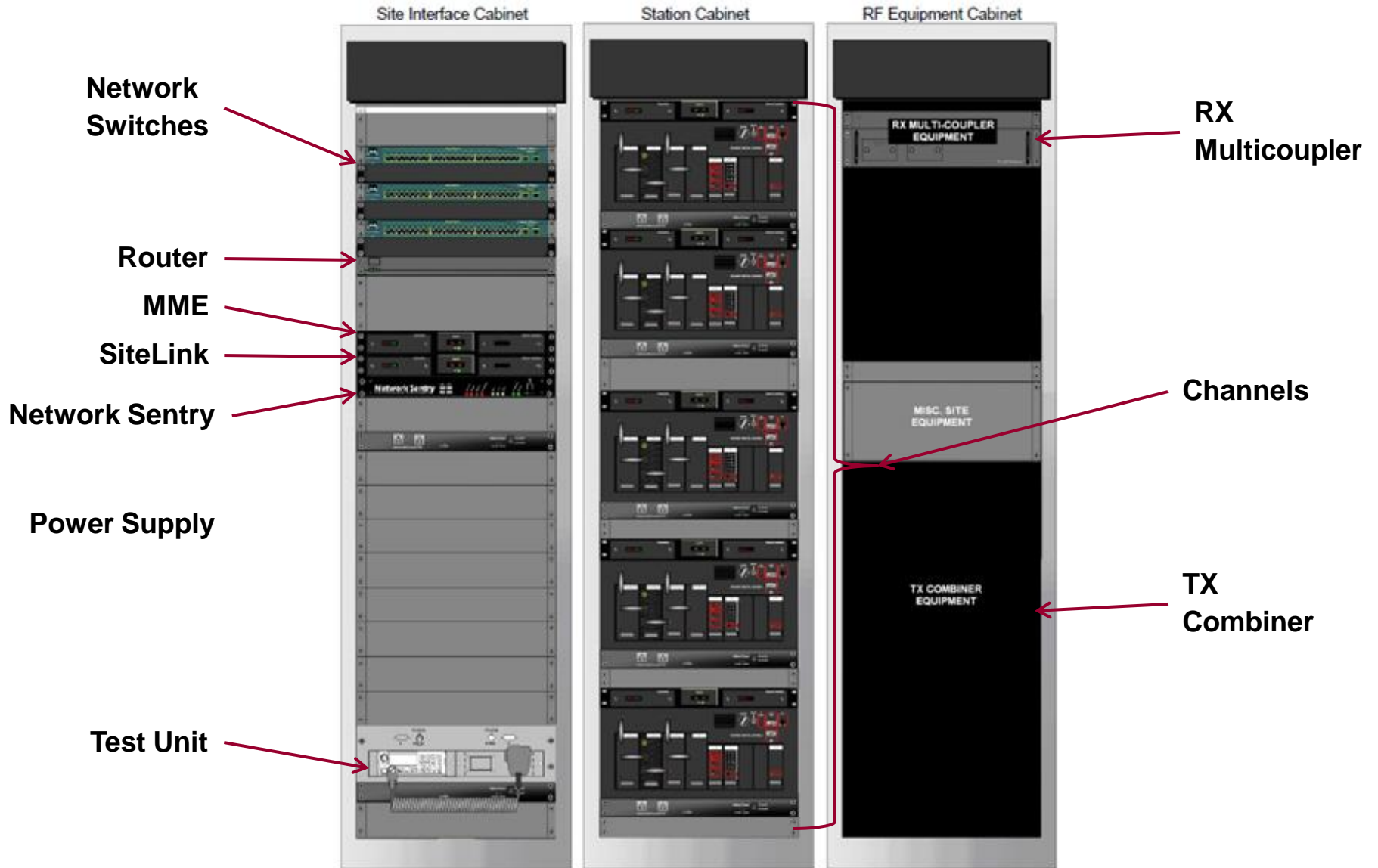
P25 Site Equipment

- **P25^{IP} Trunked System**
- **Site Cabinets**
- **Mastr III –P25^{IP} Repeater**
- **Mastr III Additions**
- **Mastr V**
- **P25 Station SitePro**
- **SiteLink**
- **Network Sentry**
- **Mini Mobility Exchange (MME)**
- **Basic 3-Site P25 Network**

P25^{IP} Trunked System



Site Cabinets



MastrIII Additions

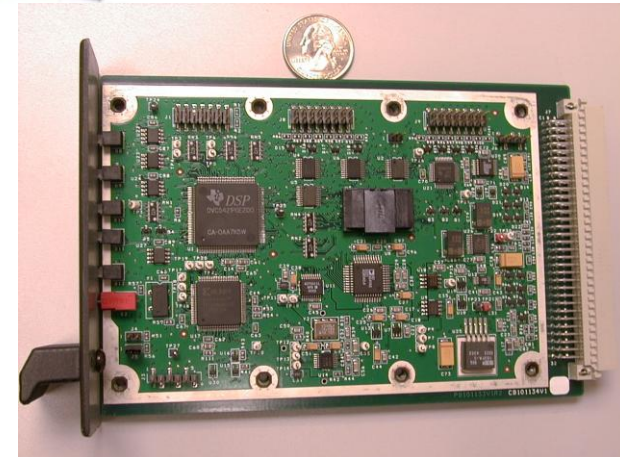
- **DSP Module**

- Software modulates and demodulates a digital 4 Level signal
- Receives a 455KHz IF input from the RX IF Module
- Transmits a 4800 symbol/sec (9600 bit/sec) signal to the System Module enroute to the Transmit Synthesizer
- Supports analog I/O through the base station's 2- or 4- wire landline interface.



- **DSP Module Programmer**

- Upload DSP Module software
- Configure and upload DSP Module personality



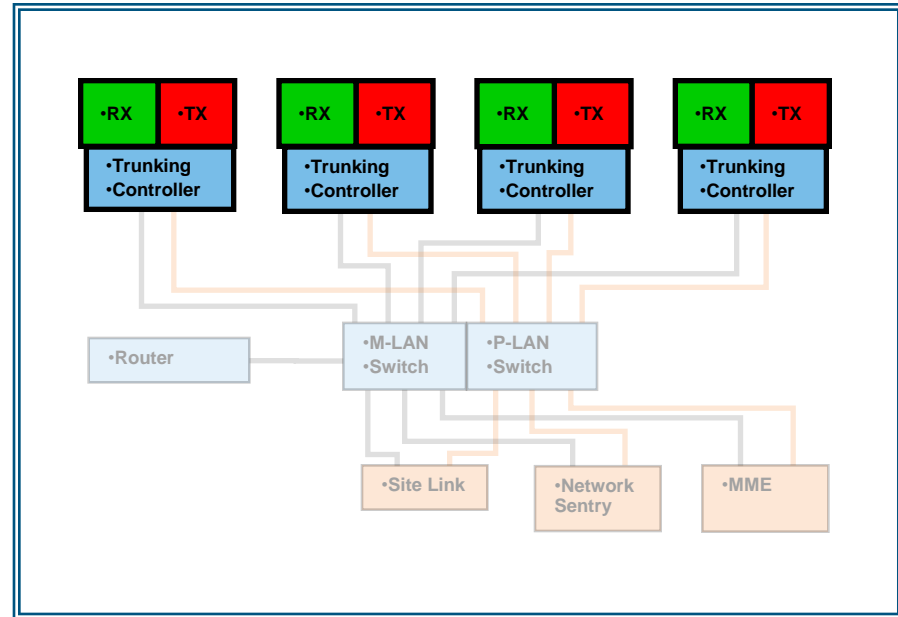
MASTR V

Purpose:

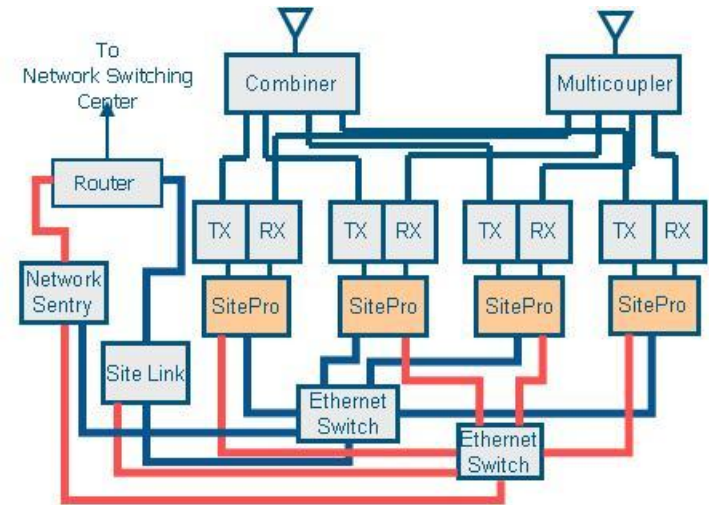
- Provides Trunked Base Station function
- Repeats received digital signal
- Transmit a remotely supplied digital audio signal (consoles, multisite, etc)

Physically:

- One chassis can handle up to four repeater channels (up to two chassis in a standard cabinet)
- Includes Traffic Controller for each channel
- Handles functions of both the Repeater and Trunking Controller
- Requires configuration programming
- Programming and Software upgrades done through an IP connection
- RF alignments are handled internally by the station



P25 Station SitePro



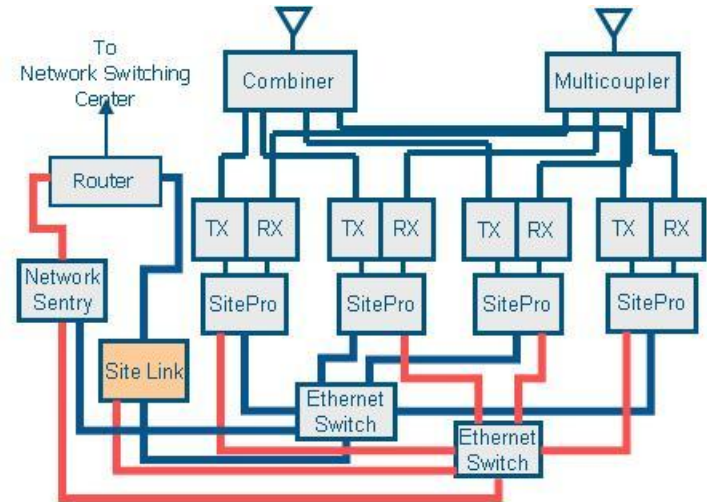
- **Purpose:**

- Directly controls base station functions
- Assigns RF Channel number to the Repeater
- Validates Units and Groups with database from the VNIC

- **Physically:**

- One for each base station repeater
- Provides digital signaling
- LEDs and 8 character display provide operating status

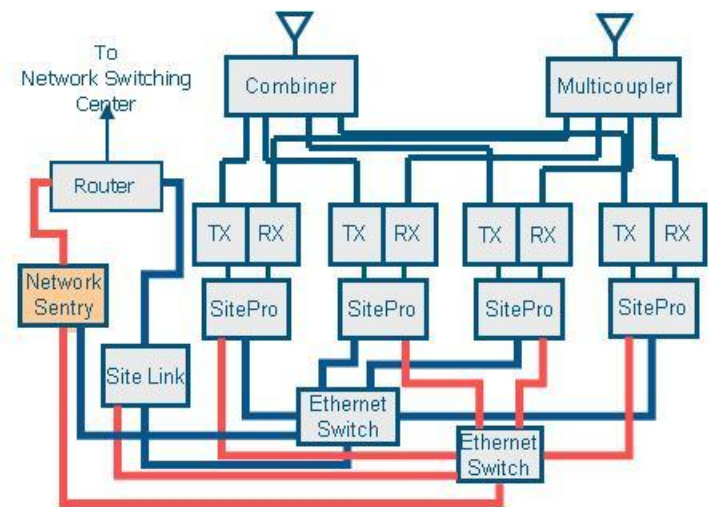
P25 Site Link



Site Link

- Serves as a Proxy for the P25 radios to the VNIC
- Translates between:
 - P25 Unit IDs
 - UAS/VNIC User IDs
- Informs VNIC of users (mobiles and portables) at the site
- Routes voice traffic between site and NSC

P25 Trunked Site Network Sentry



Network Sentry

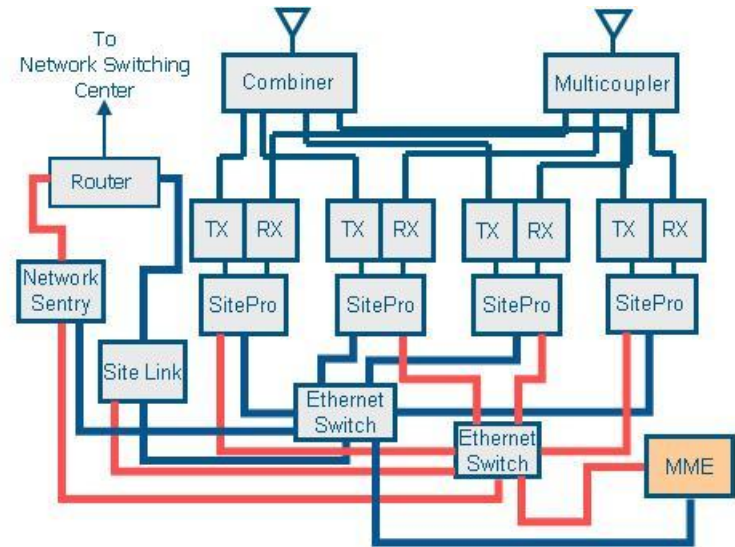
Alarm and reporting pathway for traps and polling

- Passes the database from the RSM to the SitePro's

Site Management Interface (SMI)

- Collection of software components
- Provides administration and monitoring services to Station SitePro Controllers

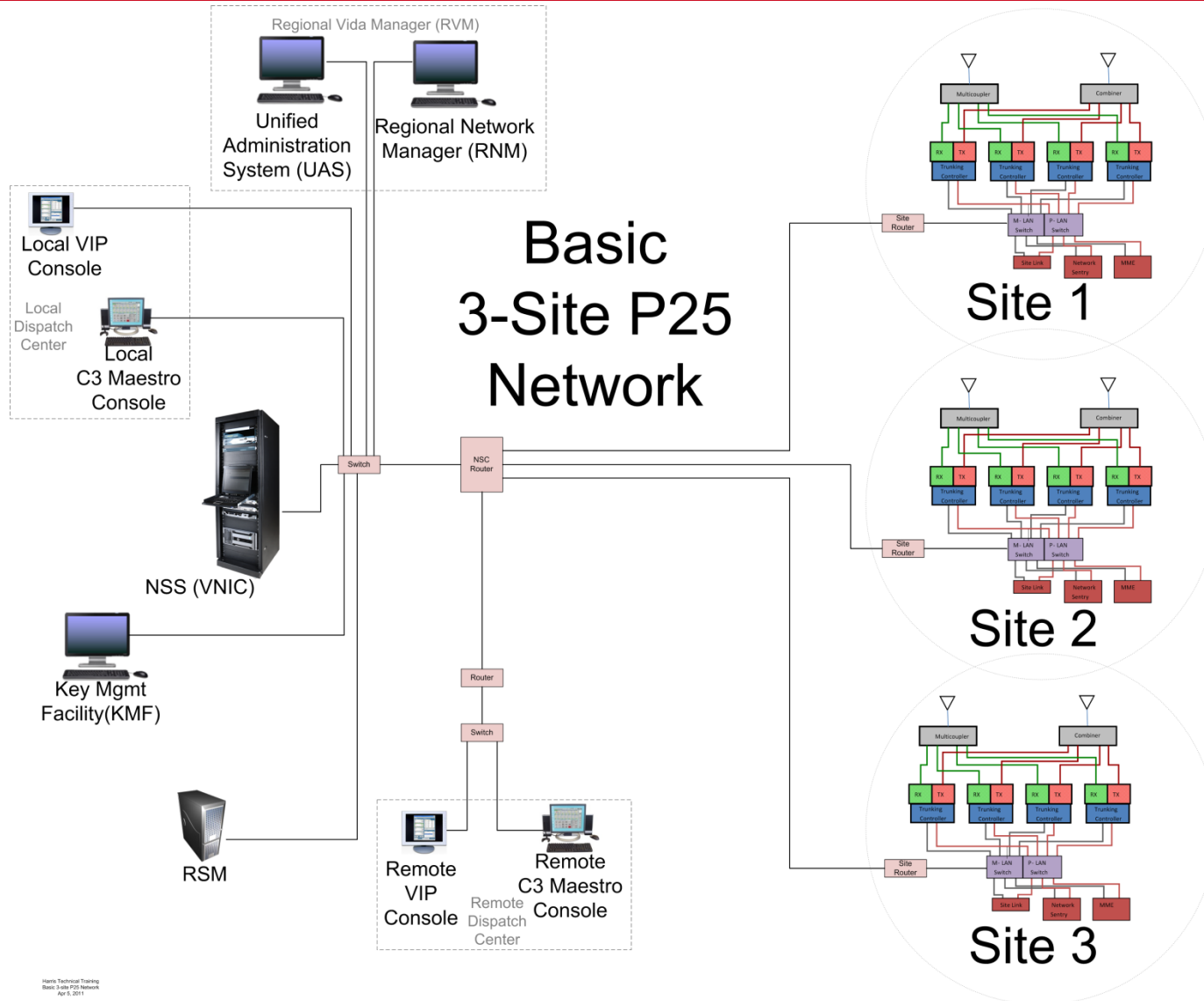
Miniature Mobility Exchange



• MME

- Provides seamless routing of data calls to mobile users throughout the coverage area of the system
- Acts as Foreign Agent to setup radio bound data calls
 - OTAR (KMF)
 - OTAP (ProFile™ Manager)
 - Radio TextLink and third party applications
- Performs mobile IP registrations on behalf of radios
- Provides radio identification to IP address mapping

Basic 3-Site Harris P25 Network



Harris Technical Training
Basic 3-Site P25 Network
April 5, 2011

Additional Benefits of P25

- **Competitive procurement of equipment**
- **Spectrum efficiency**
- **OTAR – Over-The-Air Rekeying allows you to send encryption keys and related key management messages over-the-air to radios.**
 - Allows keys to be quickly, conveniently and securely updated when necessary using an RF interface.
 - Rekeys groups of subscribers with one command.
 - Don't have to touch radios.
- **The TIA continues to work on standardizing other interfaces, like the Network Mgmt Interface and the Console Interface.**

QUESTIONS?