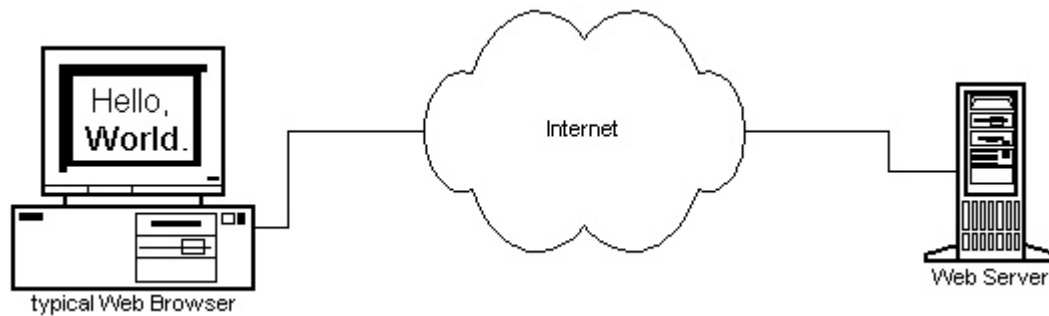


Network requirements for RoIP and VoIP

Presented to the WWCIC

How many of you used the Internet today?

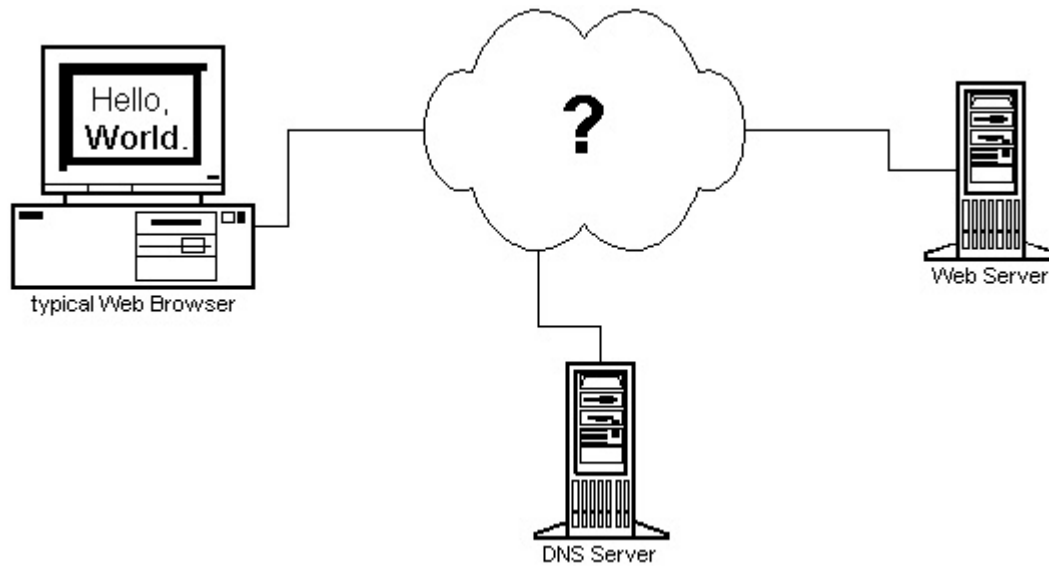


The radio guys could think of Ethernet like FM, but then the IT guys wouldn't understand.

Network requirements for RoIP and VoIP

Presented to the WWCIC

How many know how it happened?



We converted the Internet Address or URL that was entered into the browser address bar, by asking a DNS Server to convert the URL into a real Internet “IP Address”.

Once the browser has the IP Address it makes a TCP/IP connection to port 80 on the Web Server and requested the site’s default page.

Network requirements for RoIP and VoIP

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Open Systems Interconnection Model

OSI – Part 1. Under the Wire

Line Standards on the Wire

- Bitrate / Timing
- Voltage levels
- Cable loss
- Pinouts

Ethernet Speeds, types

- Protocol overhead
- Broadcast
- Multicast
- MAC Address

LAN, WAN, Internet definition

OSI Model			
	Data unit	Layer	Function
Host layers	Data	7. Application	Network process to application
		6. Presentation	Data representation and encryption
		5. Session	Interhost communication
	Segment	4. Transport	End-to-end connections and reliability
Media layers	Packet	3. Network	Path determination and logical addressing
	Frame	2. Data Link	Physical addressing (MAC & LLC)
	Bit	1. Physical	Media, signal and binary transmission

Network requirements for RoIP and VoIP

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OSI – Part 2. On the Wire

Protocol Standards for Levels 1 – 7

- DNS, FTP, SSH, DHCP, POP, SMTP, HTTP are examples of protocols using the OSI Model

What do you need to know?

End to End - Connection vs. Connectionless

- Setup Time
- Round-Trips
- Header size
- Error tolerance

Package - TCP, UDP, Multicast

- TCP is guaranteed delivery
- UDP is catch this if you can
- Multicast is a special type of UDP

Network requirements for RoIP and VoIP

Presented to the WWCIC

Location - MAC Addressing, IP Addressing, Multicast Addressing

- Every NIC has a unique MAC Address
- Every NIC can have multiple IP Addresses
- Every IP Address has 65,535 ports each for TCP and UDP
- There are special ranges of IP Addresses
 - Multicast Addresses
 - 224.0.0.0 – 239.255.255.255
 - Non-Routable Intranet Address
 - 192.168.0.0- 192.168.255.255
 - 10.0.0.0-10.255.255.255
 - 169.254.x.x APIPA (Automatic Private IP Addressing)
 - Routable Internet Address

Name Resolution - DNS

- Maps a URL (Uniform Resource Locator) to an IP Address
 - www.hostnw.net = 207.244.156.63
- One IP Address can have many URL's
- Depends on a Registrar of Record for Internet Addressing
- Uses Port 53, for both UDP and TCP transactions

DHCP, Sub-netting and Classless Inter Domain Routing (CIDR)

Network requirements for RoIP and VoIP

Presented to the WWCIC

```
Ipconfig /all
```

```
C:\Documents and Settings\dgrant>ipconfig /all
```

Windows IP Configuration

```
Host Name . . . . . : TARKUS
Primary Dns Suffix . . . . . : p4private.hostnw.net
Node Type . . . . . : Hybrid
IP Routing Enabled. . . . . : No
WINS Proxy Enabled. . . . . : No
DNS Suffix Search List. . . . : p4private.hostnw.net, hostnw.net
```

Ethernet adapter TARKUS - p4d:

```

Connection-specific DNS Suffix . :
Description . . . . .: U.S. Robotics 10/100/1000 PCI NIC #2
Physical Address. . . . .: 00-14-C1-32-2B-FF
DHCP Enabled. . . . .: No
IP Address. . . . .: 10.0.1.238
Subnet Mask . . . . .: 255.255.255.0
Default Gateway . . . . .: 10.0.1.1
DNS Servers . . . . .: 10.0.1.202
                        10.0.1.212
Primary WINS Server . . . . : 10.0.1.202

```

Network requirements for RoIP and VoIP

Presented to the WWCIC

Netstat -a

C:\Documents and Settings\dgrant>netstat -a

Active Connections

Proto	Local Address	Foreign Address	State
TCP	TARKUS:epmap	TARKUS.p4private.hostnw.net:0	LISTENING
TCP	TARKUS:microsoft-ds	TARKUS.p4private.hostnw.net:0	LISTENING
TCP	TARKUS:1042	TARKUS.p4private.hostnw.net:0	LISTENING
TCP	TARKUS:3389	TARKUS.p4private.hostnw.net:0	LISTENING
TCP	TARKUS:6051	TARKUS.p4private.hostnw.net:0	LISTENING
TCP	TARKUS:8019	TARKUS.p4private.hostnw.net:0	LISTENING
TCP	TARKUS:http	TARKUS.p4private.hostnw.net:0	LISTENING
TCP	TARKUS:8080	TARKUS.p4private.hostnw.net:0	LISTENING
TCP	TARKUS:10080	TARKUS.p4private.hostnw.net:0	LISTENING
UDP	TARKUS:microsoft-ds	*.*	
UDP	TARKUS:isakmp	*.*	
UDP	TARKUS:1039	*.*	
UDP	TARKUS:4500	*.*	
UDP	TARKUS:ntp	*.*	
UDP	TARKUS:netbios-ns	*.*	
UDP	TARKUS:netbios-dgm	*.*	
UDP	TARKUS:ntp	*.*	

Network requirements for RoIP and VoIP

Presented to the WWCIC

Routing Tables, Netmask, Default Gateway, Metric, Route Print

C:\Documents and Settings\dgrant>route print

IPv4 Route Table

Interface List

0x1 MS TCP Loopback interface
0x10003 ...00 14 c1 32 2b ff U.S. Robotics 10/100/1000 PCI NIC #2

Active Routes:

Network Destination	Netmask	Gateway	Interface	Metric
0.0.0.0	0.0.0.0	10.0.1.1	10.0.1.238	20
10.0.1.0	255.255.255.0	10.0.1.238	10.0.1.238	20
10.0.1.238	255.255.255.255	127.0.0.1	127.0.0.1	20
10.255.255.255	255.255.255.255	10.0.1.238	10.0.1.238	20
127.0.0.0	255.0.0.0	127.0.0.1	127.0.0.1	1
224.0.0.0	240.0.0.0	10.0.1.238	10.0.1.238	20
255.255.255.255	255.255.255.255	10.0.1.238	10.0.1.238	1

Default Gateway: 10.0.1.1

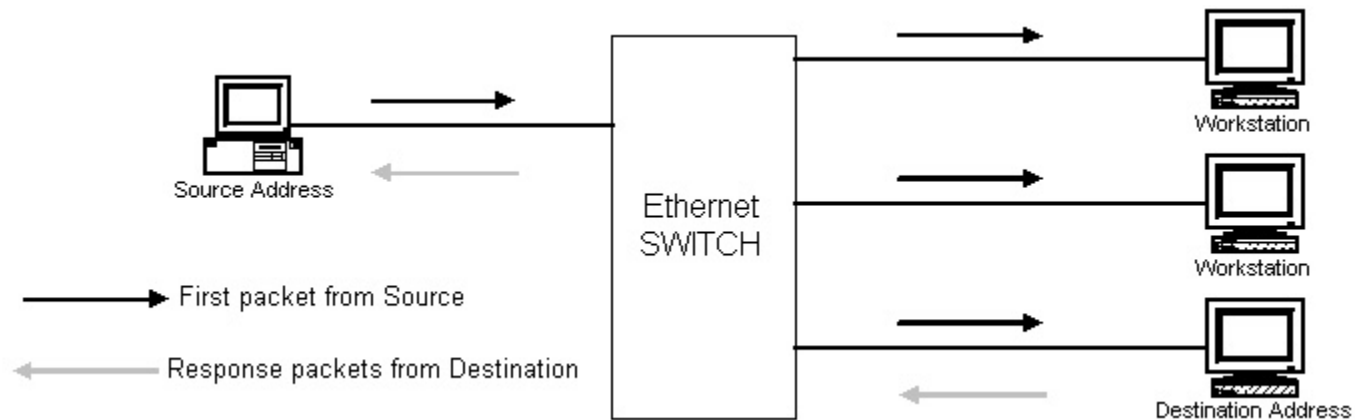
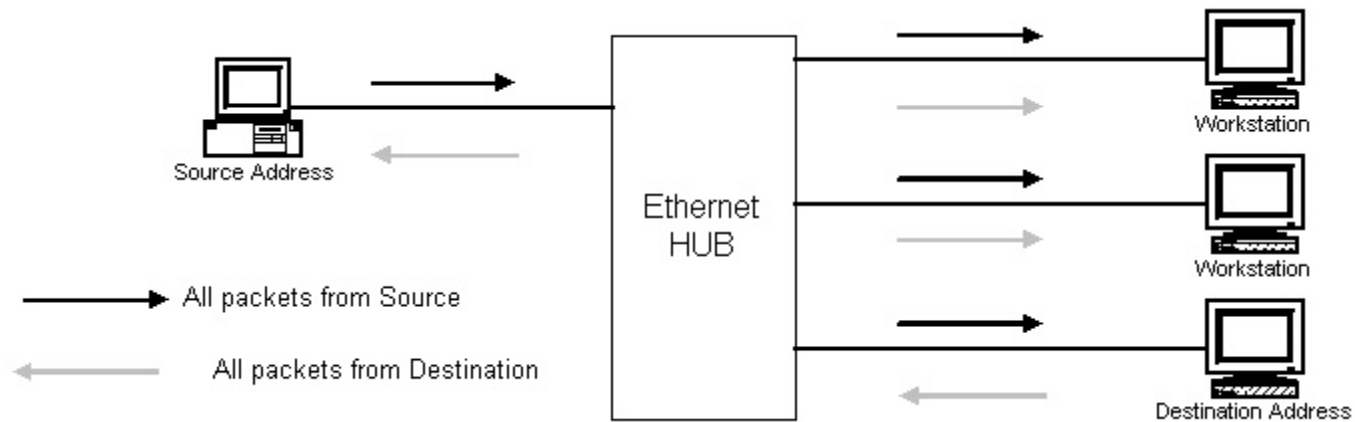
Persistent Routes:

None

Network requirements for RoIP and VoIP

Presented to the WWCIC

Difference between a HUB and a Switch



Network requirements for RoIP and VoIP

Presented to the WWCIC

Difference between a Switch and a Router

Ethereal / WireShark

Network requirements for RoIP and VoIP

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RoIP

Mission

- Provide PTT services to Land Mobile Radio via IP Networks
- Provide Enhanced Remote Radio Control via IP Networks
- Provide IP equivalent to a 4 Wire Audio Circuit

Standards

- Bridging System Interface (BSI) Draft
- APCO P25

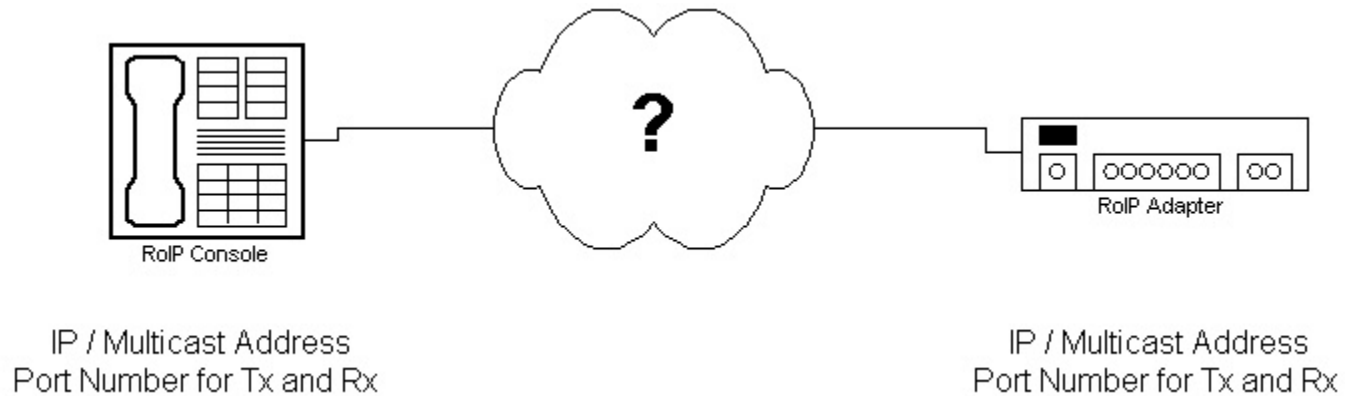
Protocols

- RTP (Real Time Protocol)
- Internet Group Management Protocol Version 2
- Differentiated Services Code Point (DSCP)
- Project 25 Console Subsystem Interface (P25 CSSI)
- Project 25 Inter Subsystem Interface (P-25 ISSI)

Network requirements for RoIP and VoIP

Presented to the WWCIC

What's it take to make a call



Network requirements for RoIP and VoIP

Presented to the WWCIC

VoIP

Mission

- Provide for the delivery of Voice Communications via IP Networks
- Provide for the support of PSTN and Mobile Advanced Features
- Provide PTT services to Land Mobile Radio via IP Networks

Standards

- SIP, RTP, IMS, Skype

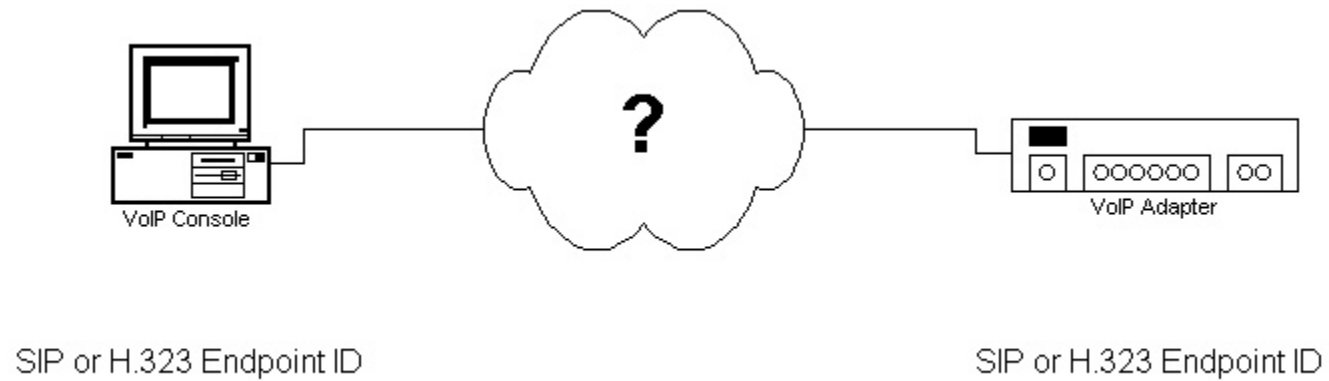
Protocols

- Session Initiation Protocol (SIP) RFC 3261
- H.323v2 (International Telecommunications Union)
- RTP (Real Time Protocol)
- Internet Group Management Protocol Version 3
- Multicast Listener Discovery Protocol Version 2 (MLDv2) for Source-Specific Multicast.
- Multicast VoIP
- Differentiated Services Code Point (DSCP)
- Project 25 Console Subsystem Interface (P25 CSSI)
- Project 25 Inter Subsystem Interface (P-25 ISSI)

Network requirements for RoIP and VoIP

Presented to the WWCIC

What's it take to make a call



Network requirements for RoIP and VoIP

Presented to the WWCIC

Typical usage of the OSI Layers

#	Layer Name	Misc. examples	IP suite	SS7^[5]	AppleTalk suite	OSI suite	IPX suite	SNA	UMTS
7	Application	HL7 , Modbus	NNTP , SIP , SSI , DNS , FTP , Gopher , HTTP , NFS , NTP , DHCP , SMTP , SMTP , SNMP , Telnet , RIP , BGP	INAP , MAP , TCAP , ISUP , TUP	AFP , ZIP , RTMP , NBP	FTAM , X.400 , X.500 , DAP , ROSE , RTSE , ACSE	RIP , SAP	APPC	
6	Presentation	TDI , ASCII , EBCDIC , MIDI , MPEG	MIME , XDR , SSL , TLS (Not a separate layer)		AFP	ISO/IEC 8823, X.226, ISO/IEC 9576- 1, X.236			
5	Session	Named Pipes , NetBIOS , SAP , Half Duplex , Full Duplex , Simplex ,	Sockets. Session establishment in TCP . SIP . (Not a separate		ASP , ADSP , PAP	ISO/IEC 8327, X.225, ISO/IEC 9548- 1, X.235	NWLink	DLC?	

Network requirements for RoIP and VoIP

Presented to the WWCIC

		SDP	layer with standardized API.), RTP						
4	Transport	NBF	TCP , UDP , SCTP		DDP	ISO/IEC 8073, TP0, TP1, TP2, TP3, TP4 (X.224), ISO/IEC 8602, X.234	SPX		
3	Network	NBF , Q.931 , IS-IS	IP , IPsec , ICMP , IGMP	SCCP , MTP	ATP (TokenTalk or EtherTalk)	ISO/IEC 8208, X.25 (PLP), ISO/IEC 8878, X.223 , ISO/IEC 8473-1, CLNP X.233.	IPX		RRC (Radio Resource Control) Packet Data Convergence Protocol (PDCP) and BMC (Broadcast/Multicast Control)
2	Data Link	802.3 (Ethernet), 802.11a/b/g/n MAC/LLC , 802.1Q (VLAN), ATM , HDP , FDDI , Fibre Channel , Frame Relay , HDLC , ISL , PPP , Q.921 ,	OSPF , PPP , SLIP , PPTP , L2TP	MTP , Q.710	LocalTalk , AppleTalk Remote Access , PPP	ISO/IEC 7666, X.25 (LAPB), Token Bus , X.222, ISO/IEC 8802-2 LLC Type 1 and 2	IEEE 802.3 framing, Ethernet II framing	SDLC	LLC (Logical Link Control), MAC (Media Access Control)

Network requirements for RoIP and VoIP

Presented to the WWCIC

		Token Ring , CDP , ARP (maps layer 3 to layer 2 address)							
1	Physical	RS-232 , V.35 , V.34 , I.430 , I.431 , T1 , E1 , 10BASE-T , 100BASE-TX , POTS , SONET , SDH , DSL , 802.11a/b/g/n PHY		MTP , Q.710	RS-232 , RS-422 , STP , PhoneNet	X.25 (X.21bis , EIA/TIA-232 , EIA/TIA-449 , EIA-530 , G.703)		Twinax	UMTS L1 (UMTS Physical Layer)

Charts courtesy of Wiki.