

Section 14: Remote Connectivity

106. Telephony Technologies

**Need to understand how the telephone system works to pass the Net+

-Telephones installed into individual locations and then the lines from those locations led to a central office Usually no more than 3 miles away from a phone.

-In the central office a person made a physical connection between you and the person you are trying to call.

The Challenge was talking to people that were far away. What was done for this was that central offices were connected by Trunk lines called "Frequency Division Multiplexing", which allowed you to handle more than one call by raising the frequencies across the line between the central offices.

Starting the 1950s and completed in the 1970s in the US we left the analog system (above) and moved to digital signals.

With a digital system your conversation with the central office was still analog but when it goes to the central office it would be broken up into individual digital samples (DS0 signal). 8 bit samples/8000 times per second.

Each piece was 64k. Now the trunkline are changed from "Frequency Division Multiplexing" to "Time Division Multiplexing". This separates the signal and then combines them into a DS1 (Digital signal 1).

*DS1 = 24 DS0

*DS1 runs on a **T1 cabling system**

* $24 \text{ DS0} = 24 \times 64\text{k} = 1.5\text{Mbps}$

*DS3 = 28 DS1s simultaneously **T3 Cabling system**

In Europe there is E1 and E3

*A DS0 can carry 64 kilobits per second. 24 DS0 lines can be combined to create a DS1 line with a 1.544 megabit per second bandwidth. DS0 lines are 64kbps, not 32 or 128 kbps.

MEMORIZE THIS FOR THE NETWORK+:

Carrier	Channels	Speed
T1	24	1.544 Mbps
T3	672	44.736 Mbps
E1	32	2.048 Mbps
E3	512	34.368 Mbps

These T carriers are Point to Point carrier systems.

**On each end of a T1 line are CSU/DSU connections.

**CSU/DSU is an endpoint

**BERT Test (Bit Error Rate Test)

Also on Net+ -> **T1 Crossover**

T1 Crossover - Take two routers that have built in CSU/DSU and you can take a T1 Crossover and plug it from one router to the next to emulate a full blow T1 Connection.

Review:

*Frequency Division Multiplexing Vs. Time Division Multiplexing

*Know the T connections.

*Original telephone systems used frequency division multiplexing; today they use time division multiplexing

*T1 = 24 DSOs - Runs at 1.544 (~1.5) Mbps

*T3 = 28 DSOs - Runs at 44.736 (~45) Mbps

*E1 and E3 are European carriers

107. Optical Carriers

The top of the internet is basically all fiber optic cabling.

SONET (Synchronous Optical Networking) - Uses OC lines

The slowest OC line is OC-1

SONET Optical Level	Line Speed	Signal Method
OC-1	51.85 Mbps	STS-1
OC-3	155.52 Mbps	STS-3
OC-12	622.08 Mbps	STS-12
OC-24	1.244 Gbps	STS-24
OC-48	2.488 Gbps	STS-48
OC-192	9.955 Gbps	STS-192
OC-256	13.22 Gbps	STS-256
OC-768	39.82 Gbps	STS-768

ONLY MEMORIZE OC-1, OC-3, and OC-12 for the Network+

"STS" is the frame type OC # is the same as the STS number

SONET is starting to fade out because it is competing with Gigabit or 10 Gigabit Ethernet.

SONET has come out with DWDM (Dense Wavelength Division Multiplexing) to compete.

DWDM - Basically uses multiple light colors in a single fiber and can take an existing connection and multiply it by as much as 150X.

Review:

*first 3 OC lines

* $51.85\text{Mbps} \times \text{OC\#}$

*SONET

$\text{OC1} = \text{STS1} = 51.85 \text{ Mbps}$

$\text{OC3} = \text{STS3} = 155.52 \text{ Mbps} (51.85 \times 3)$

$\text{OC12} = \text{STS12} = 622.08 (51.85 \times 12)$

108. Packet Switching

Two big technologies you need to know:

1. Frame Relay - Been around since the 1980s, and its job was to come up with packet switching type that didn't care about errors but it was very quick. Faded out for ATM
2. ATM (Designed to work with voice)- Asynchronous Transfer Mode - A complete networking system. Used on SONET but its beginning to fade out.

Todays switching technology is IP centric.

One of them (The most common) is called MPLS (Multiprotocol Label Switching). This is for IP based networks. MPLS works on all lines.

All these packet switching technologies could fade away in a world that we would call "All IP". This would be the entire internet consists of Ethernet.

Review:

*Know your types of telephony packet switching

*Frame relay and ATM are being replaced with MPLS

*ATM is limited to small 53 byte frames, Ethernet frames are 1500 bytes.

109. Connecting with Dial-Up

External Modem: (There are also Internal Modems that you are able to snap into your computer).

*Dial up runs at 56kbps

How to set up a modem and create a dial up connection:

1. Set up connection
2. choose dial up
3. Input the phone number, username, and password that was provided by your ISP.

Connects using PPP protocol



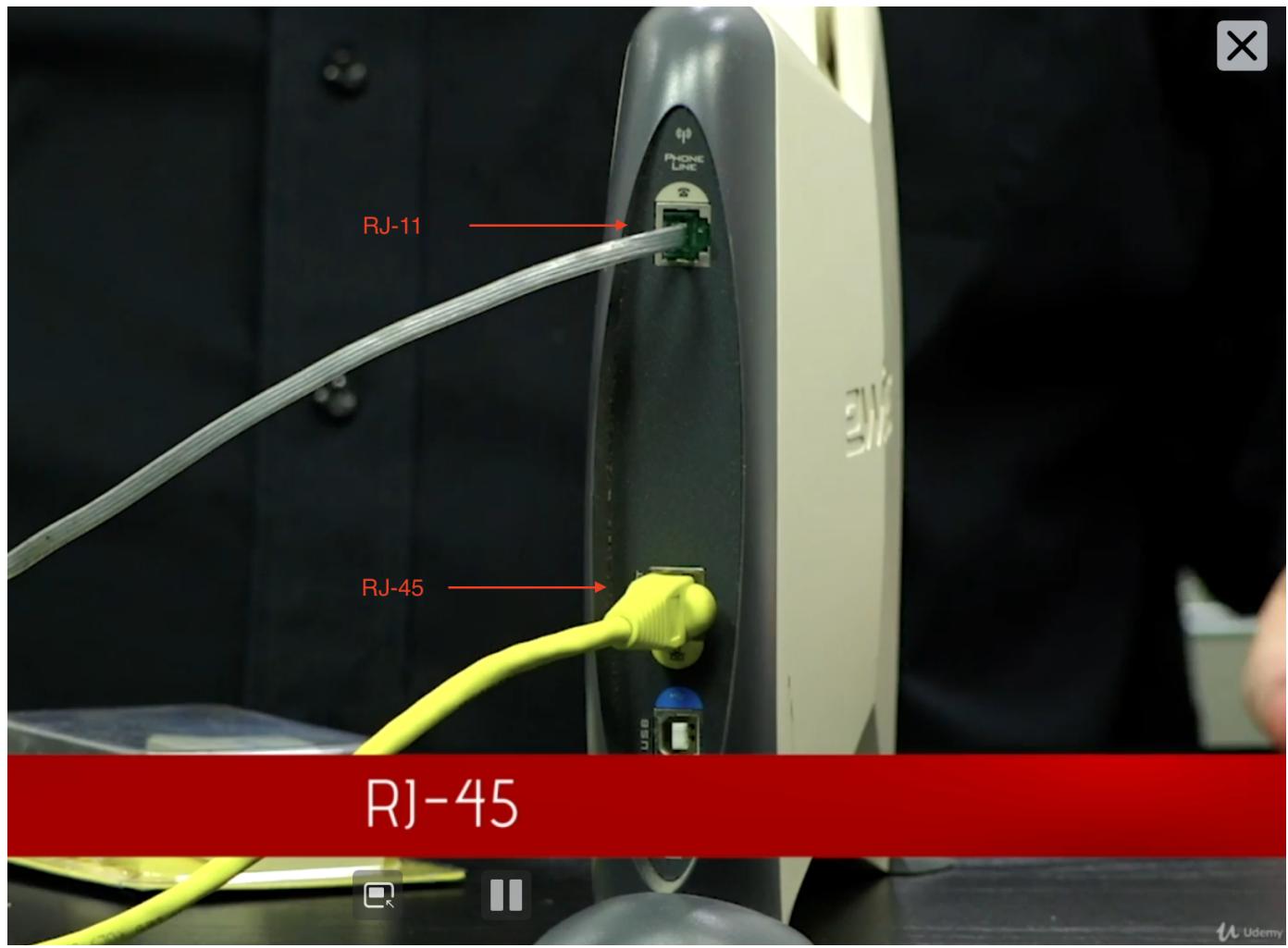
Review:

- Dial-up is slow and is not reliable back up
- Dial-up requires a modem
- An ISP will give a username and password
- Dial-up uses the PPP Protocol (Point to Point)

110. Digital Subscriber Line (DSL)

-Exists on telephone lines.

-uses a DSL Modem



RJ-45

There are two versions on DSL

1. Symmetric DSL (Download and Upload Speeds are the same)
2. Asymmetric DSL (High speed Download and Slow upload speeds)

DSL filters filter out DSL noise from phone connections



DSL filter

VDSL (Very-High-bit-rate DSL) - uses fiber to the premises.

Review:

- DSL is either symmetric or asymmetric mode, asymmetric is the common application
- DSL filtering is used to clear the phone line of the DSL noise

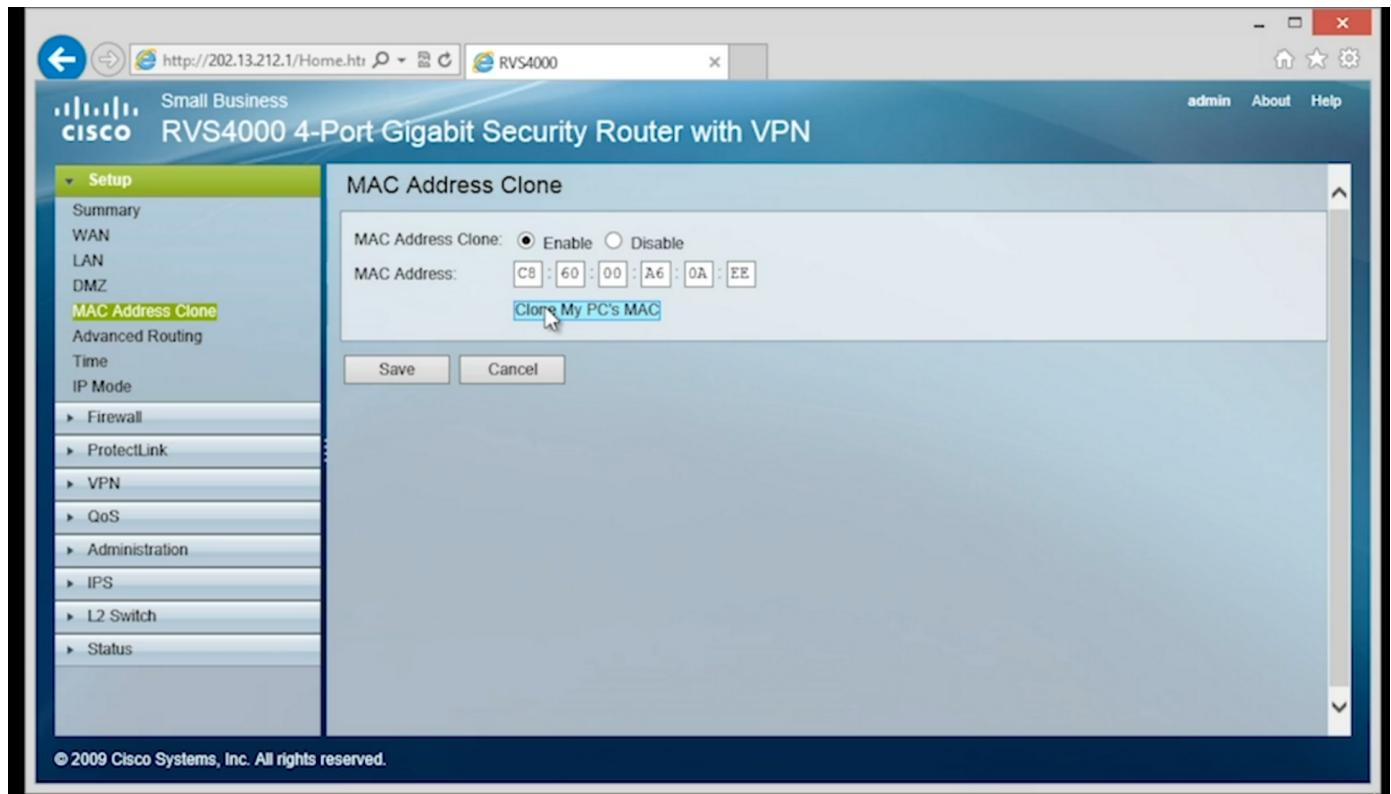
111. Connecting with Cable Modems

Back of a cable modem:

Yellow wire is a RJ-45, and a cable connection



Cable modems have problems when you change MAC addresses. If you unplug a computer and plug a router into it, it can cause problems with the cable company. One of the tricks you can use is you can fool cable modems into thinking you are something they have already been plugged into using MAC Address Clone.



Review:

- Cable is faster than DSL
- DSL is always using a PPPoE and cable almost never does (PPPoE - pointToPoint protocol over Ethernet)
 - *Cable modems come from the cable company
 - *Cable modems use F-type connectors (Coaxial)

112. Connecting with Satellites

*Satellite (today are Asynchronous with downloads around 12Mbps and Uploads around 3Mbps).

*2 RG-6 Cables from satellite transmitter/reciever to the satellite modem and comes out as an RJ-45

Satellite Latency - Need to know for the Net+

Review:

- *Satellite modems enable connecting to the internet through a satellite
- *Satellite connections have terrible latency
- *Run an RG-6 cable from the dish to the modem

113. ISDN and BPL

ISDN (Integrated Service Digital Network) - An old way we used to make Last mile dial up connections.

1. It is digital
2. It has an associated Telephone number
3. Ran at 128k

4. There were no modems to connect to. You used a terminal adaptor. Which you plugged in ISDN Phones

Terminal Adaptor:



BPL (Broadband Over Powerlines) - Never taken off

1. using powerlines to give you electricity and internet
2. problem with interference
3. its dangerous

Know for exam:

ISDN

- older tech
- Digital
- Ran at 128k
- People still use it

BPU

- runs over powerlines themselves

Review:

*ISDN ran at two speeds: 64Kbps and 128Kbps

*ISDN has a telephone number

*BPL uses power lines to move internet data

Tight VNC - Port 5900

- Free product

- Works on every OS

- Comes out of the box with pretty much every MAC

Microsoft remote Desktop tools

- RDP Protocol (Remote Desktop Protocol) - Port 3389

- Remote help

Review:

- *Remember the port numbers for the exam

- *TightVNC runs on port 5900

- *Microsoft RDP runs on port 3389

- *Use remote help to control the desktop of the user you are assisting (Microsoft)

115. Advanced Remote Control Systems

ICS (Industrial Control Systems) - using automation to control the process of any type of system.

Terms:

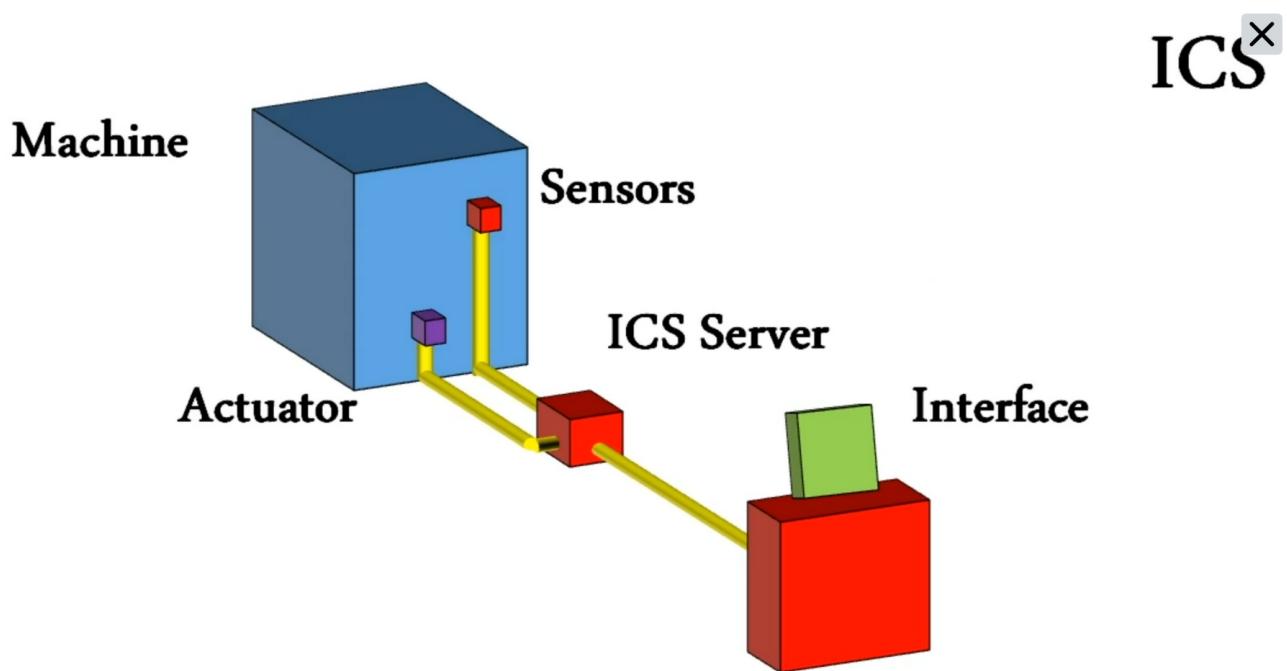
Machine - a Single device that needs to have some kind of control and monitoring

Controller (ICS Server) - a PC that is designed to handle processing

Sensors - e.g. watching for temp, fluid levels etc

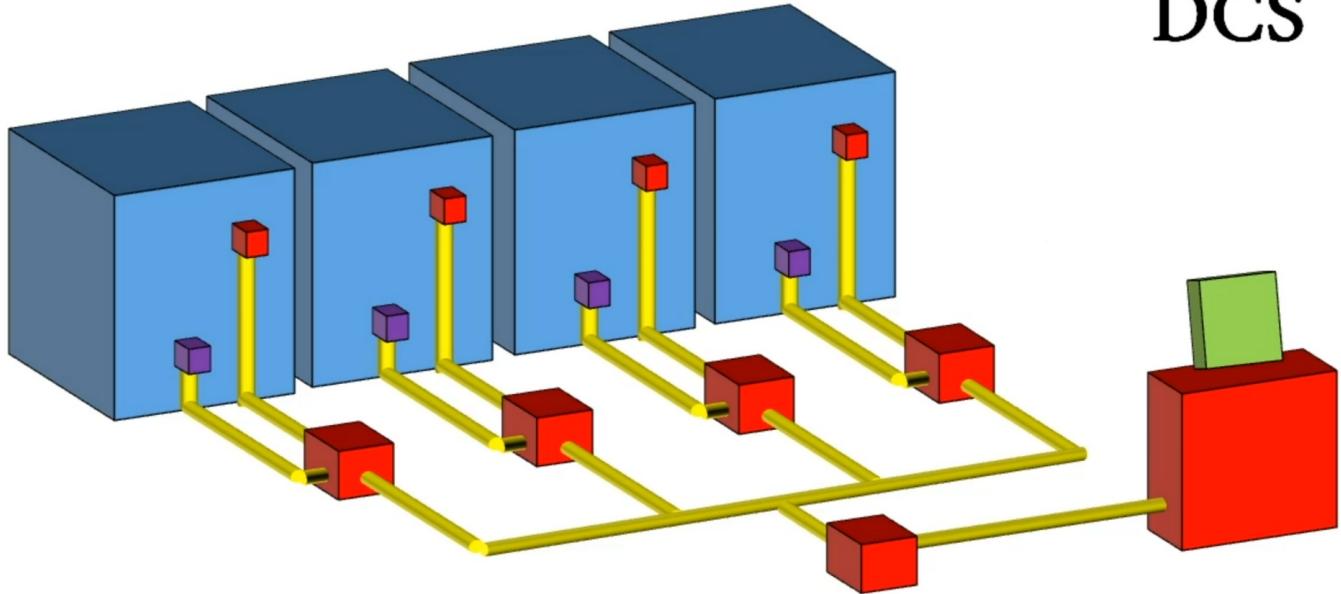
Actuator - e.g a pump, a light, a motor etc (Actuate based on sensors)

Interface - where the humans talk to the ICS server



DCS (Distributed Computer Systems) - an extension of ICS

DCS



When talking about an ICS or DCS we are usually talking about a process that takes place in one physical location.

SCADA (Supervisory Control and Data Acquisition) - Still ICS but designed for long distance. ICS controllers have to be more autonomous.

Actual ICS Server itself is usually a PLC (Programmable Logic Controller)

Programmable Logic Controller



On the interface you usually have a HMI (Human Machine Interface)

SCADA - Is ICS but has a part that you don't typically see on an ICS and that is a RTU (Remote Terminal Unit). A high power PLC.

Remote Terminal Unit



Review:

- Industrial control systems control machines with sensors and actuators connected to an ICS server
- Supervisory Control and Data Acquisition (SCADA) systems handle ICS over a large area
- Key pieces: programmable logic controller, human machine interface, and remote terminal unit.

QUIZ

1. A DS0 line has what bandwidth?
 - a. 1.544mbps
 - b. 32kbps
 - c. 64kbps**
 - d. 128kbps
2. What is the speed of an OC-1 line
 - a. 1.544mbps
 - b. 64kbps
 - c. 155mbps
 - d. 51.85mbps**

3. Which of the following is NOT a packet switching technology?

a. **Circuit switch**

b. Frame Relay

c. ATM

d. MPLS

4. Dial-up connections require which piece of equipment?

a. **Modem**

b. Cable Modem

c. NIC

d. Multi-speed switch

5. What kind of download and upload speed does ADSL provide?

a. Same download and upload speed

b. slower upload speed than download speed

c. Faster upload speed than download speed

d. Half duplex operation provides the same upload and download speed but uploading and downloading cannot happen simultaneously.

6. The primary technical disadvantage to satellite internet is what?

a. Slow upload

b. Slow Download

c. Latency

d. Expense

7. Remote desktop is a term that describes what?

a. Installing two keyboards and two monitors on the same computer that it can run two different sessions, simultaneously

b. Duplicating the output of a monitor to another monitor

c. Separating the monitor from a computer so it can be operated over a distant connection

d. using a computer to take over the screen and keyboard of another computer

8. SCADA differs from ICS/DCS for what major reason?

a. SCADA uses conventional computers while ICS/DCS uses highly specialized computers

b. ICS/DCS uses conventional Computers while SCADA uses highly specialized computers

c. ICS/DCS operates over long distances while SCADA is local

d. SCADA operates over long distances while ICS/DCS is local