

**Cisco University**  
**Multi-Unit (MxU) Networking**  
**Using Long-Reach Ethernet (LRE)**

**Module 3**  
**Technologies**

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## Module Objectives

- **Upon the completion of this module, you will be able to:**
  - Describe the basics of LRE technologies and the LRE chipset**
  - Discuss differences between competing LRE technologies**
  - List examples of LRE applications**

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## LRE Technology Overview

- Enables the use of Ethernet over existing, unconditioned, telephone-grade wire
- Enables Ethernet to coexist with “plain old telephone service” (POTS), Integrated Services Digital Network (ISDN) or private branch exchange (PBX) signaling services
- Uses newest DSL coding and digital modulation techniques with Ethernet
- Provides a point-to-point transmission that can deliver a symmetrical, full-duplex, data rate of up to 15 Mbps
- LRE products are simple to install and interface with any existing Ethernet solution

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## Copper Access Technologies

- DSL —digital subscriber line
- HDSL —high-data-rate digital subscriber line
- ADSL —asymmetric digital subscriber line
- Universal ADSL
- VDSL —very-high-data-rate digital subscriber line
- Home PNA
- EtherLoop™ technology

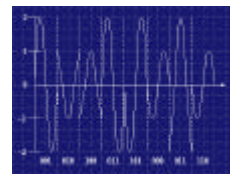
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## LRE Technology —Modulation

- **Uses quadrature amplitude modulation (QAM)**
  - Modulation using two carriers out of phase by  $90^\circ$  and modulated by separate signals
  - Uses both signal amplitude and phase to define each symbol
  - Uses various QAM modulations (QAM-256, QAM-128, QAM-64, QAM-32, QAM-16, QAM-8, QAM-4) based on line specification and the rate definition
- LRE supports multi-QAM in order to achieve performance as close to the physical limit as possible while maintaining low cost and power



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## LRE Technology —Frequency Domain

- **Transports data over telephone wires originally intended for 300 Hz - 3.4 kHz**
- **Uses frequency division duplexing (FDD)**
  - Enables service providers to overlay LRE on existing POTS, ISDN or PBX signaling services



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## LRE Technology —Errors and Interference

- **Ethernet data is encapsulated onto a continuous stream of cells**
- **System applies a self-synchronizing scrambler mechanism to this cell stream**
- **Scrambler is initialized to a random value**
- **A Reed-Solomon (RS) error-correction code is applied to the data stream**
- **Ethernet data is reassembled upon reception**



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## LRE Technology —Bandwidth

- **LRE technology operates at up to 17 Mbps**  
Enables transport of Ethernet data up to 15 Mbps
- **Transport overhead does not reduce the Ethernet bandwidth**

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## LRE Technology —Topography

- **LRE system is a point-to-point communication system**
- **Core data pump is a blind modem**
- **Operation avoids the need for the collision-detection scheme**
- **Physical Ethernet interface is a standard RJ-45 socket**



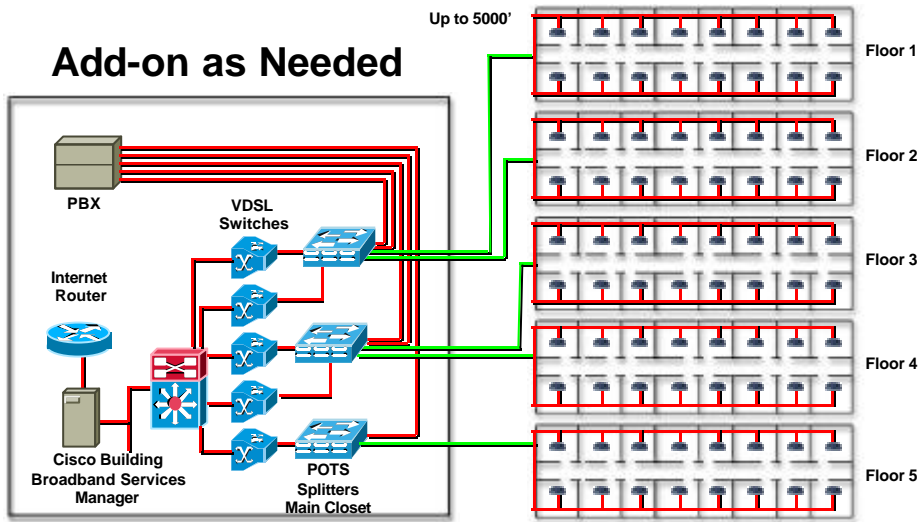
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# LRE Overview

Add-on as Needed



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Cisco LRE CPEs

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# Competing Technology Solutions

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## Cable Modems

- Offer a dedicated service over shared media  
Performance will vary on number of users
- Largely targeted toward residential community — not to business environment
- LRE advantages:
  - Two-way transmission
  - Cost-effectiveness
  - Security
  - Choice of Internet service providers (ISPs)



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## DSL Technologies

- Types: DSL; HDSL; ADSL; VDSL
- Data Rates  
ADSL is high-speed —up to 8 Mbps downstream and 640 kbps return rate
- Distances
  - ADSL —18,000 ft
  - HDSL —15,000 ft
  - VDSL —4500 ft
- Voice and data  
ADSL and VDSL coexist on same wire with POTS or ISDN  
Splitter is used at both ends to separate voice from data
- Protocols —ATM cell- and packet-based
- Privacy and security  
Would need to physically connect to the wire, demodulate the signals and decode the data

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## EtherLoop™ Technology

- **Developed by Elastic Networks, an independent unit of Nortel**
- **Voice and data**
  - Uses frequencies from 30 KHz to 3 MHz
  - Offers voice and Ethernet services simultaneously
- **Data rates and distances**
  - 6 Mbps up to 3000 ft, lower data rates up to 21,000 ft
- **Protocols and interference**
  - Utilizes burst technology —vulnerable to burst noise
  - Half-duplex connection —line must be shared with 2-way traffic
  - Uses only error checking and retransmission
- **LRE advantages**
  - Two-way transmission —full duplex, greater distances
  - Security —uses scrambler with RS forward -error-correction algorithms



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## Home Phone Line Networking Association (HPNA) Technology

- **Developed by Tut Systems Inc.**
  - To provide home networking over POTS twisted pair with voice services
  - Does not work in bundles, intended only for in-home wiring
  - Similar to EtherLoop in use of DSL -type technologies and Ethernet packet-delivery algorithms
  - Distance —up to 500 ft
  - Data rate —up to 1 Mbps
- **LRE Advantages**
  - Higher data rates: 10 Mbps vs. 1 Mbps
  - Full duplex
  - Strong Reed-Solomon (RS) encoding
  - Strong error-detection/correction
  - Continuous, reduced-power transmission
  - Same-bundle coexistence with ADSL



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## LRE —A Chipset Solution

- **Highly integrated**
  - Small-footprint solution fits on SIMM
- **Self contained**
  - Embedded controller; needs no external support
  - Embedded RAM supports Interleaver and buffers on-chip
- **Standard Ethernet interfaces**
  - Glue-less, drop in replacement for 10/100BaseT designs
- **Low power consumption**
  - Less than 1.5 W; even less in sleep mode

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## LRE VDSL Physical Layer Performance

- Frequency-division duplexing (FDD)
- Quadrature amplitude modulation (QAM) —4 up to 256
- Low power transmission —up to -60 dBm/Hz
- Works with harsh FSAN/Telco interference and noise models
- Fast synchronization, blind timing recovery < 100mSec
- Adaptive equalizer overcomes bridge taps, other distortions
- RS forward-error-correction protects against errors
- Interleaver protects against interruptions —up to 300 mSec

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## LRE —A New Kind of Ethernet Physical Layer

- Overlays existing POTS/ISDN/Digital Extension Signaling (smart phones) on same wire
- Coexists with xDSL services on same bundle
- Power back-off supports near and far locations on same bundle
- Interfaces directly with Ethernet devices using MII, RMI or SMII:
  - As a PHY directly with switch devices
  - As a MAC directly with 10/100BaseT PHY devices
- 10 Mbps, full duplex up to 4000ft (depends on wire quality)
  - Other speed/distance combinations possible

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## LRE Ethernet Built in

- **Standard, common interfaces: MII, RMII, SMII, 7 wire**
- **IEEE 802.3x flow control and back pressure**
- **Address filtering —up to 32 addresses; supports bridging functionality**
- **Proprietary encapsulation over VDSL transport**
- **Embedded 16-kB receive, 8-kB transmit buffers**
- **Ethernet MIB counters supported**
- **MI Serial Management Interface supports access to full, local and remote, internal address space**



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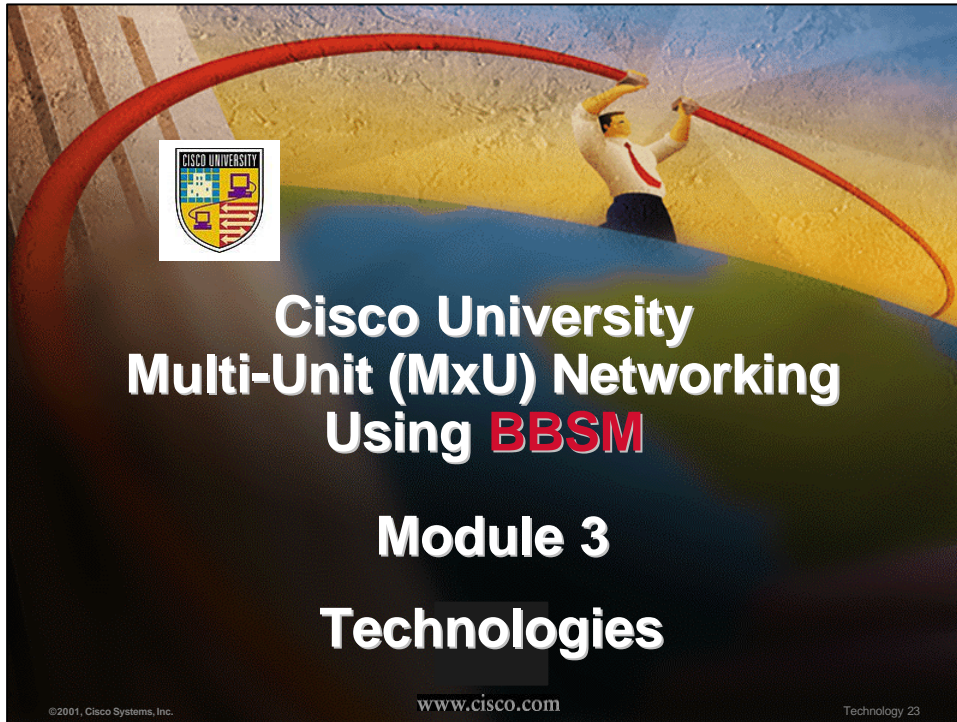

## Summary of LRE Key Technology Features

- **Standard 10-Mbps Ethernet over regular twisted pair copper wire**
- **Distances of up to 4000 ft (1.25 km) at full-duplex 10 Mbps, 15 Mbps high-speed mode**
- **Simultaneous data and POTS, ISDN or PBX signaling services over the same line**
- **Utilizes the most advanced multi-QAM modulation techniques**
- **Minimum interference with other wire pairs and other services**
- **Full-duplex point-to-point transmission**
- **Longer distances can be reached at lower rates**
- **Low power-implementation, minimum heat-dissipation issues**
- **Supports testing and management capabilities**

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**Cisco University**  
**Multi-Unit (MxU) Networking**  
Using **BBSM**

**Module 3**  
**Technologies**

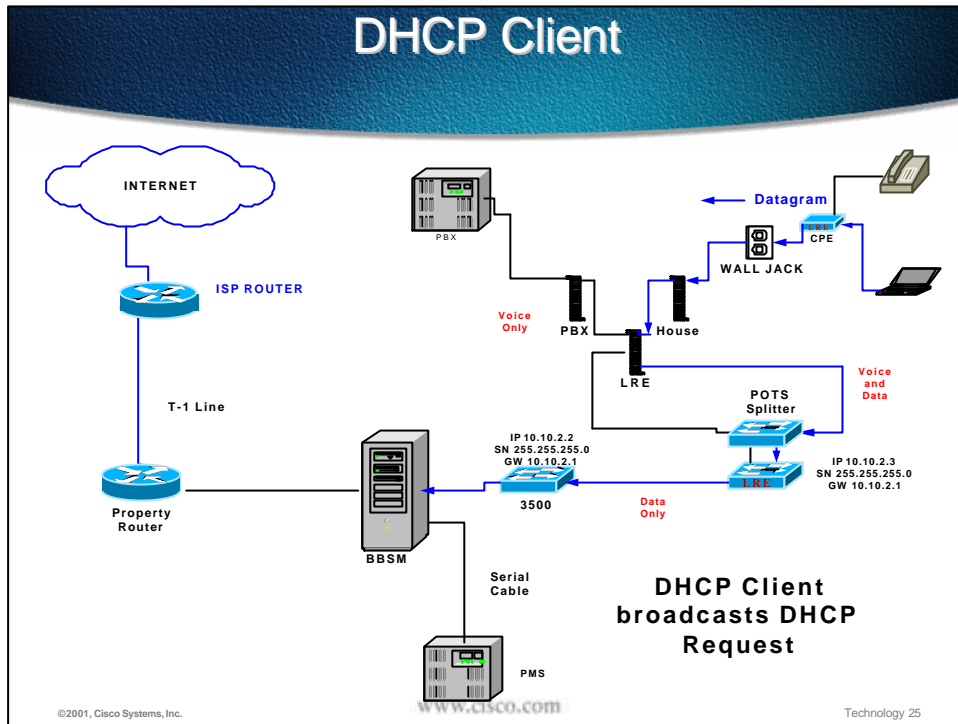
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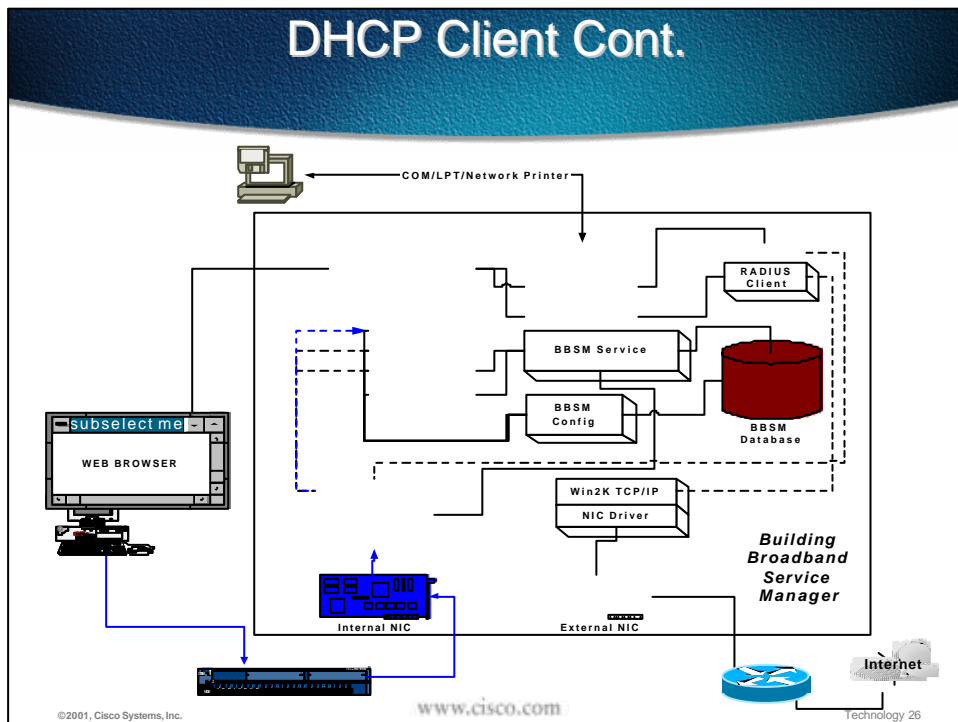
**BBSM Client**  
**Configuration**

Cisco.com

# DHCP Client

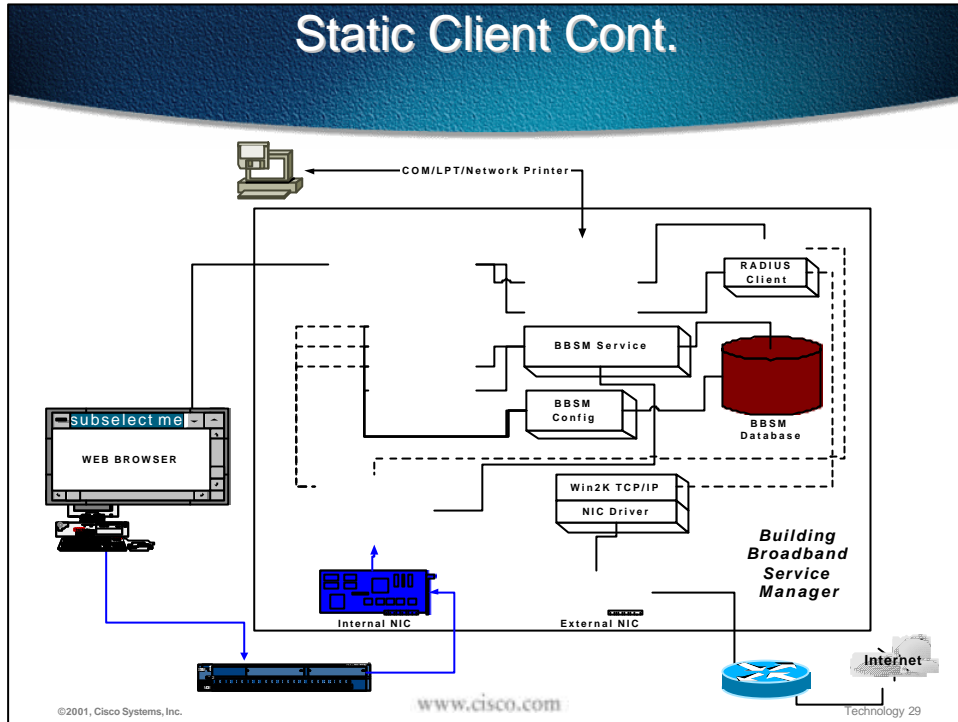


# DHCP Client Cont.

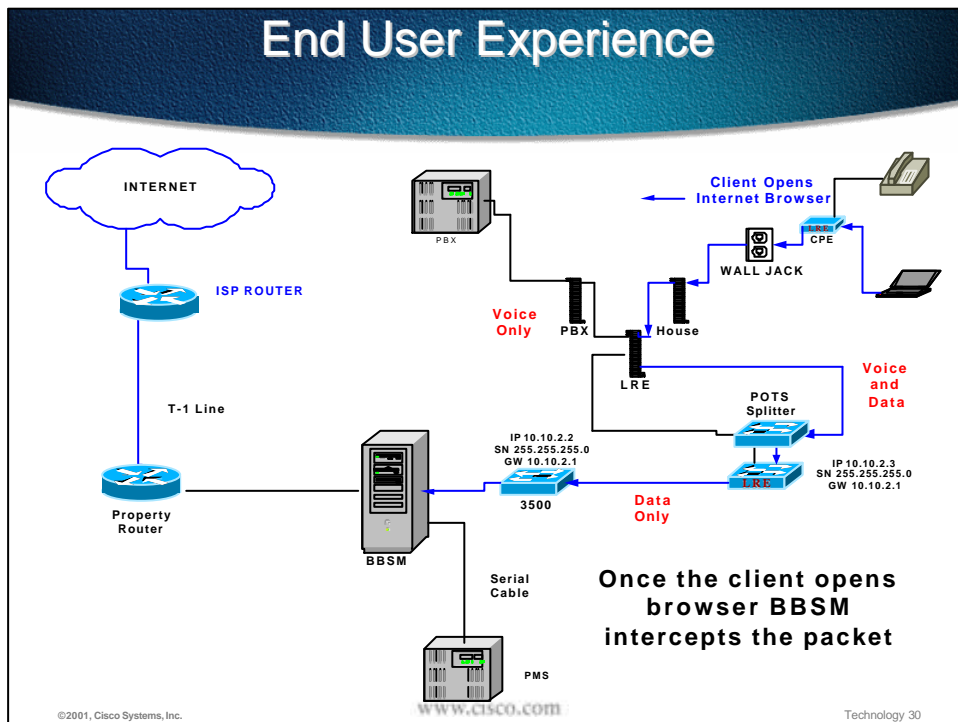




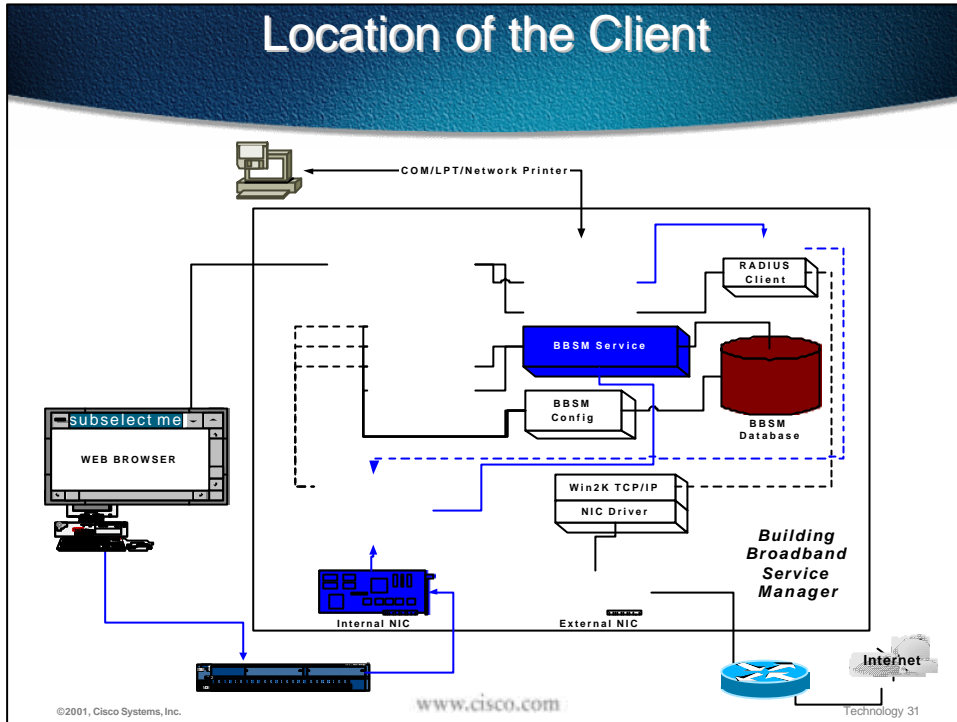
## Static Client Cont.



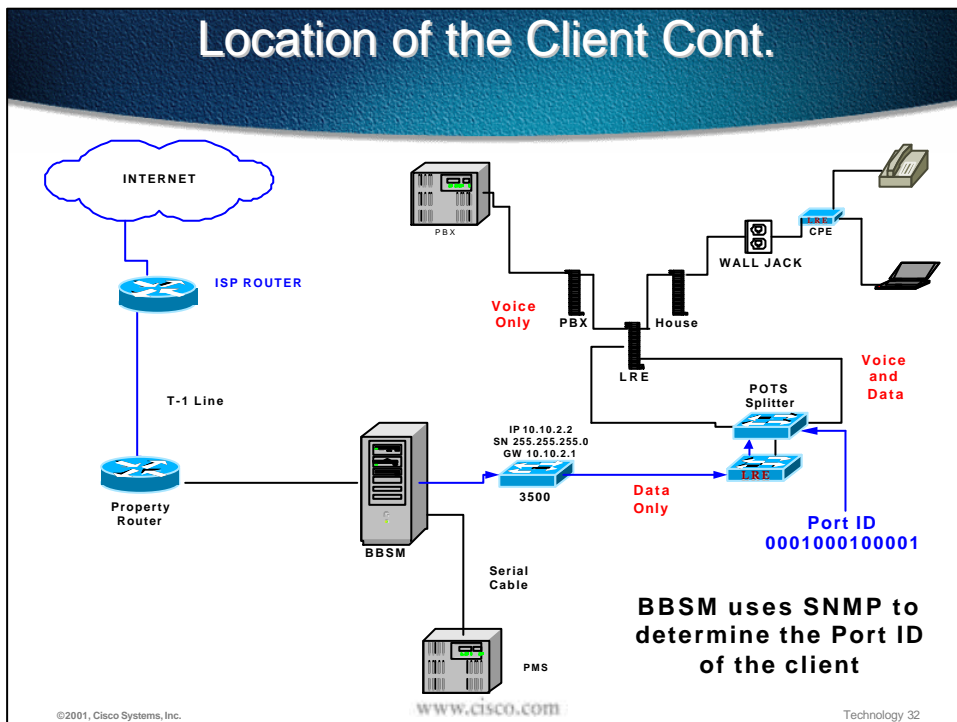
## End User Experience



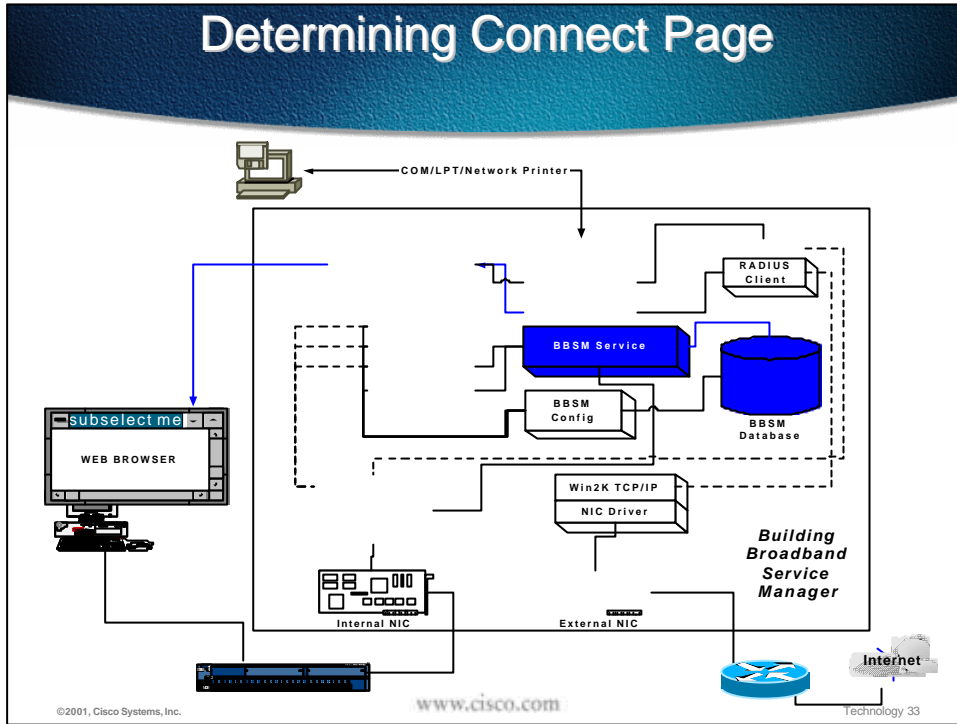
## Location of the Client



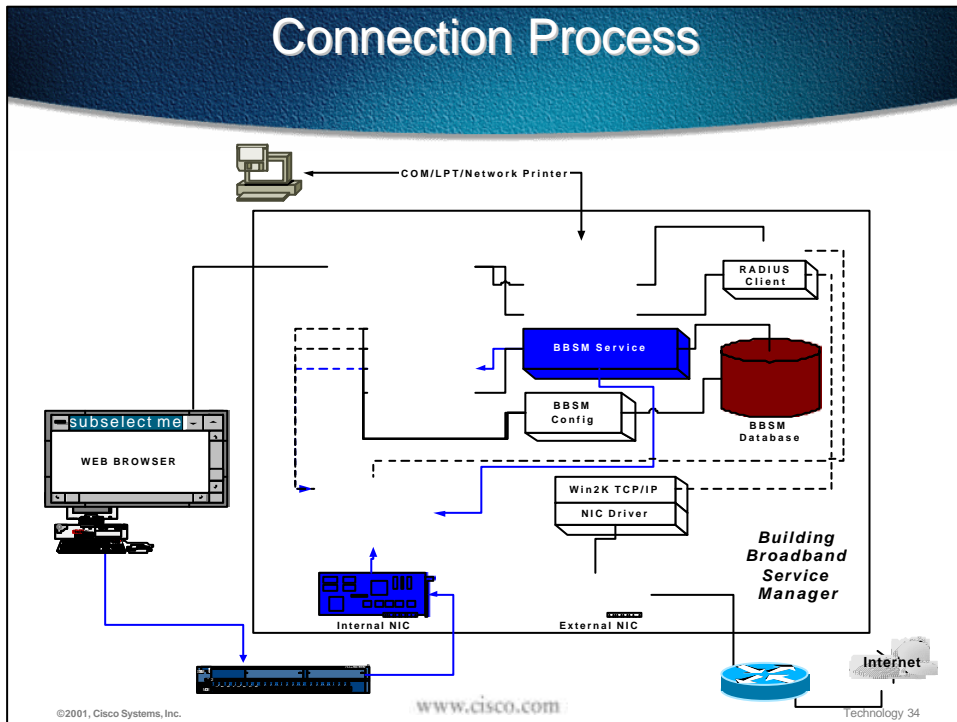
## Location of the Client Cont.



# Determining Connect Page



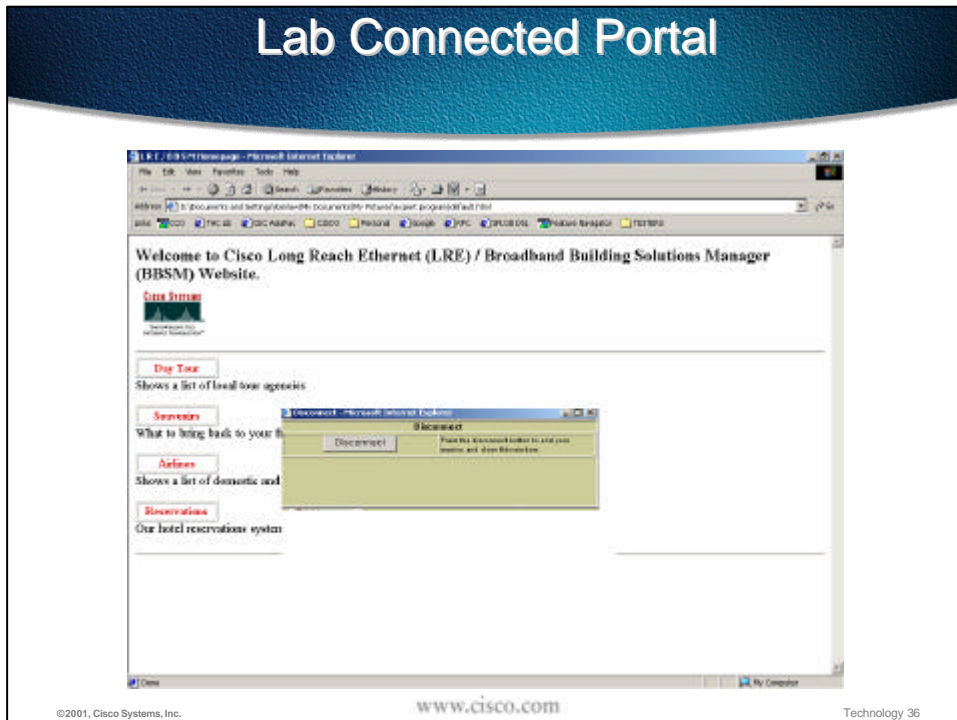
# Connection Process

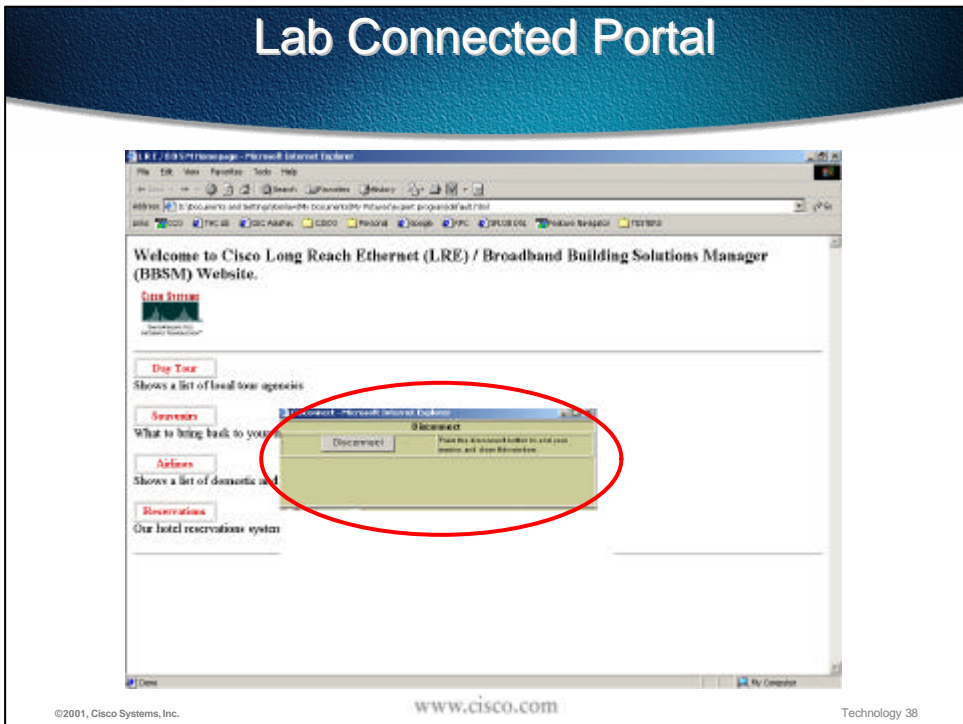
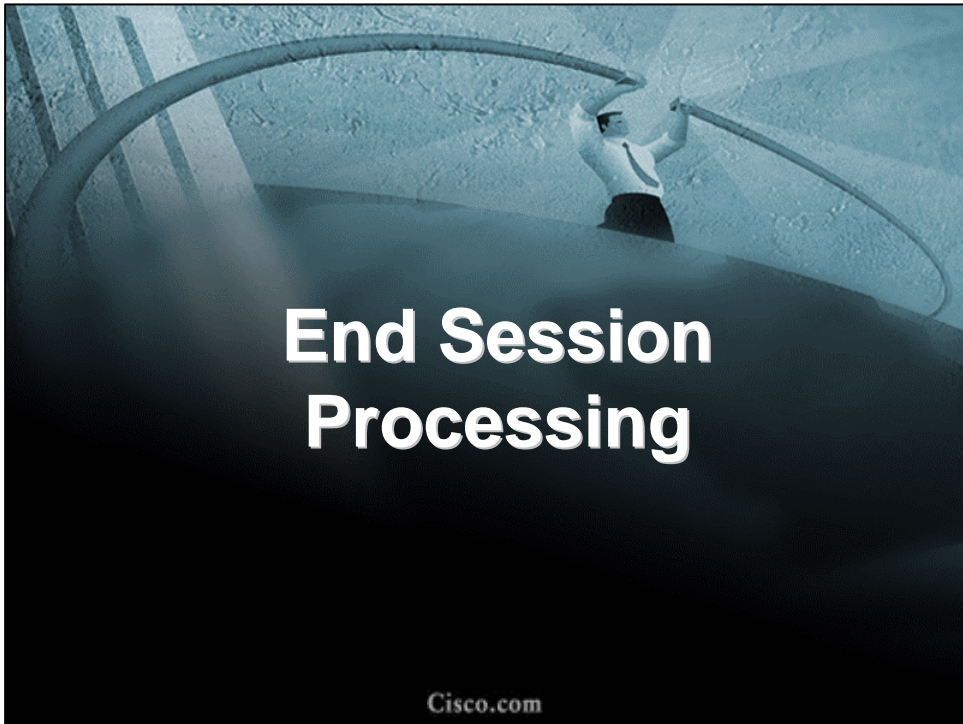


# Connected Portal

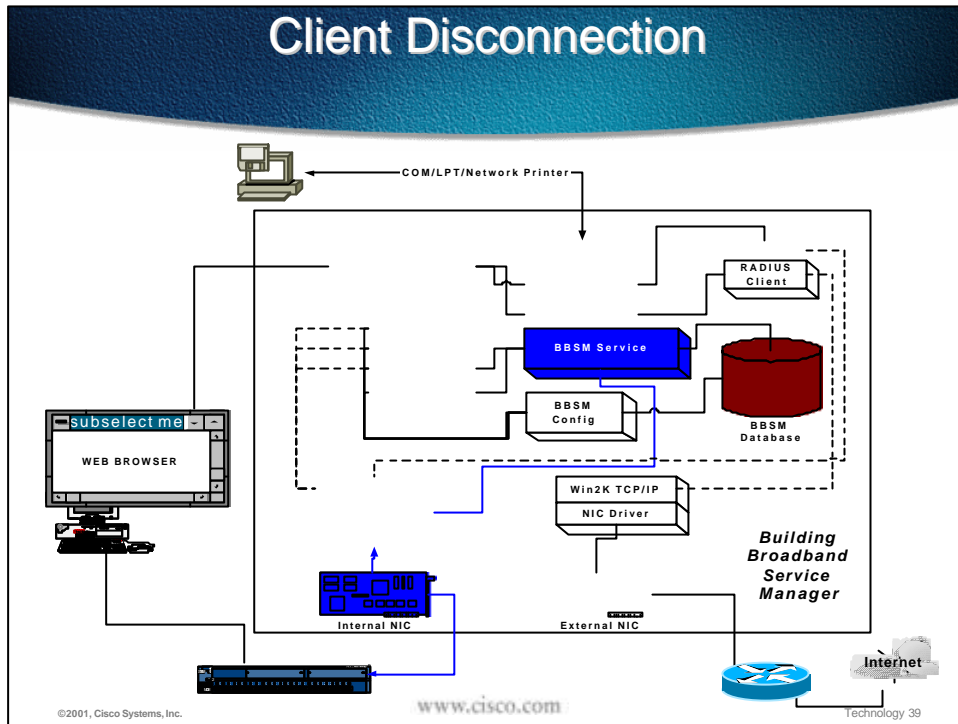


# Lab Connected Portal

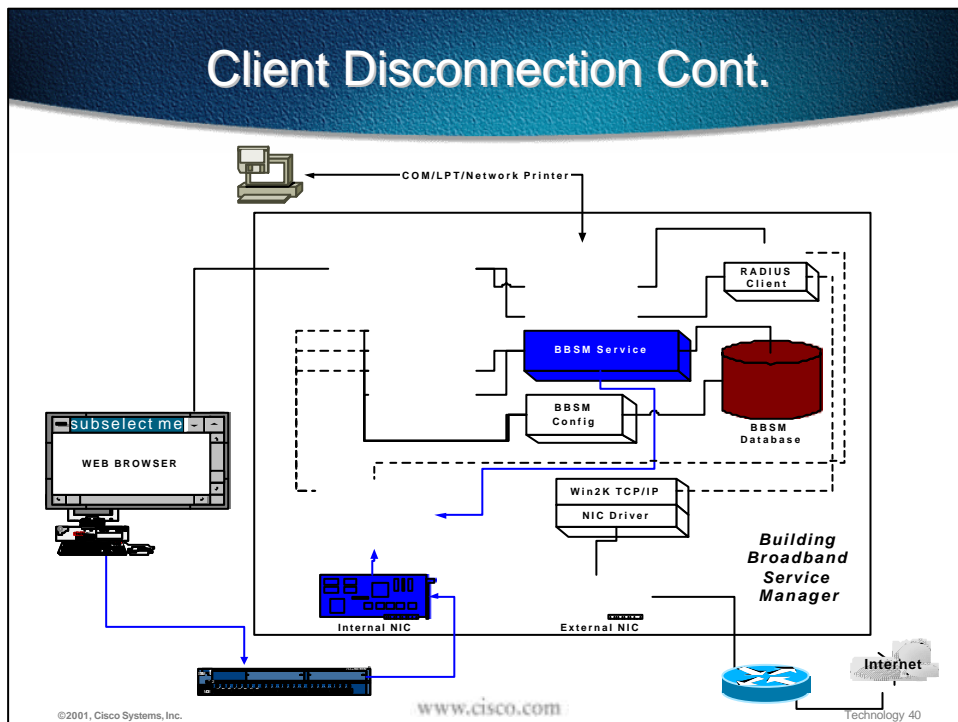




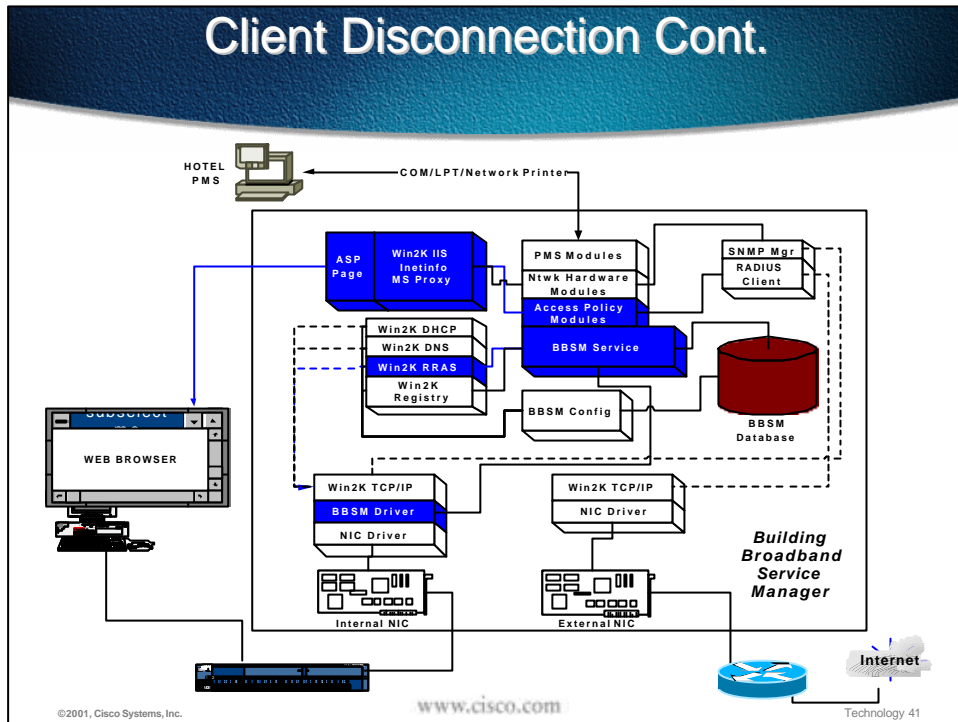
# Client Disconnection

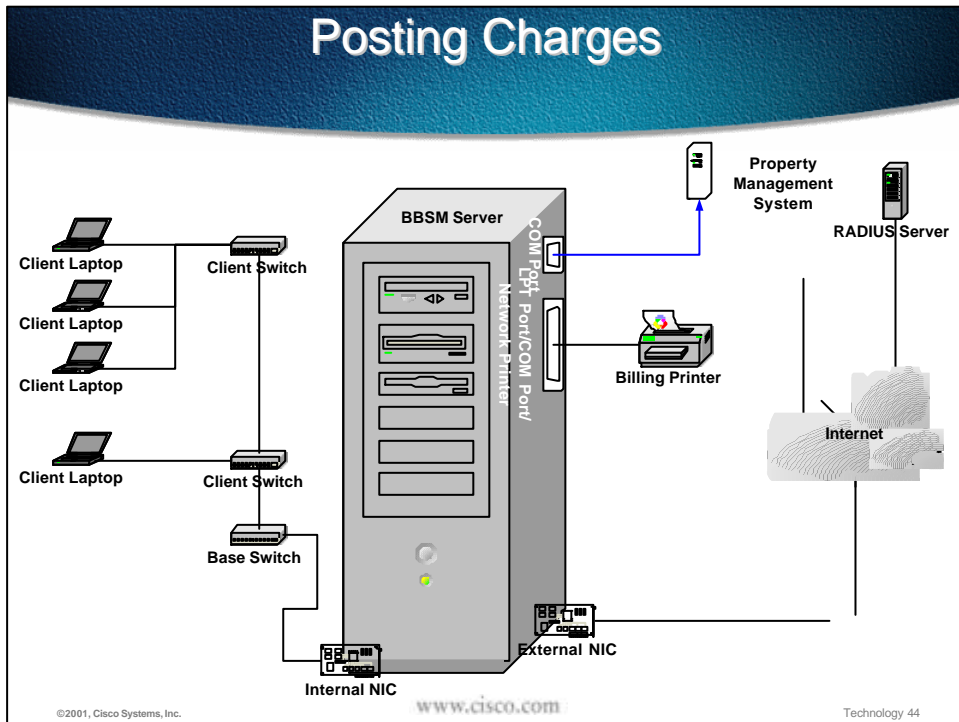
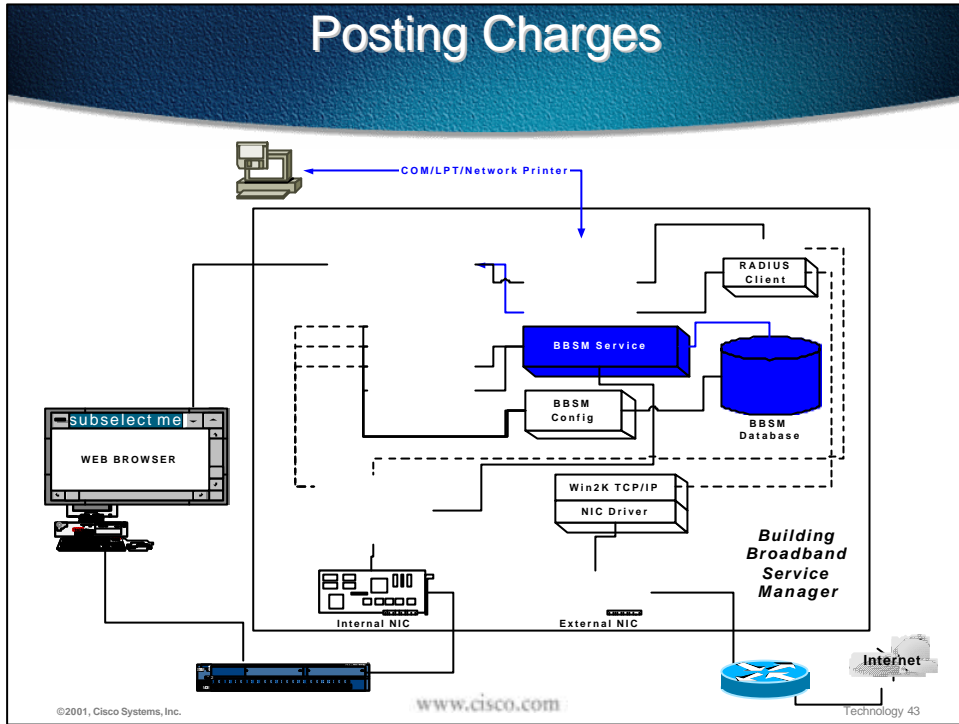


# Client Disconnection Cont.



## Client Disconnection Cont.





## Property Management Systems

- Protocol Technologies (Bell HOBIC)
- MSI (Bell HOBIC)
- Promus 21 (Bell HOBIC)
- Encore (Bell HOBIC)
- Logistics (Bell HOBIC)
- Fidelio 7.0
- XIOX
- Hilton H.1, H.2

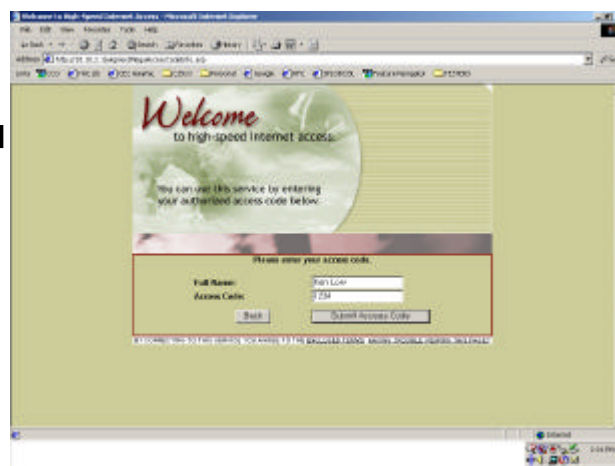
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## 1. Access Codes

- Codes created by Admin
- Expiry specified by Admin
- Unique or shared



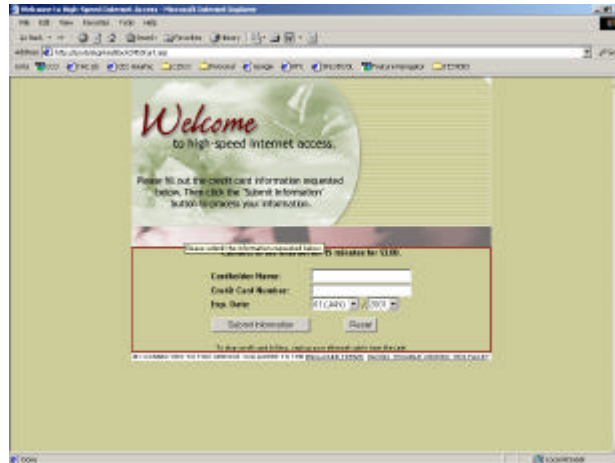
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## 2. Block CMS

- Credit Card billing
- CMS Credit Card (CAIS Internet Billing Server) – **CAIS Internet Customers ONLY**
- Block in minutes
- Unused min are forfeited
- Auto deactivated when expired



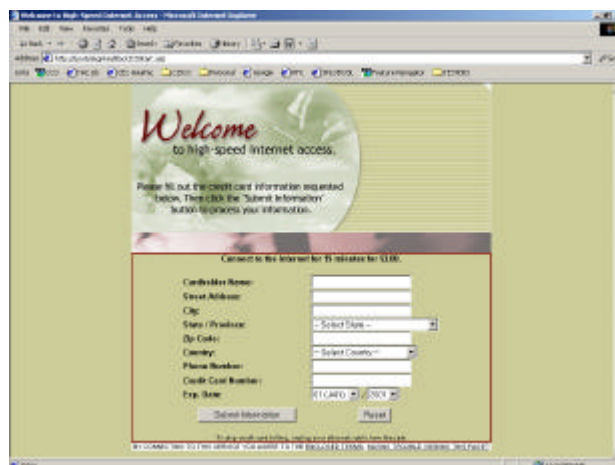
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## 3. Block ICS

- Credit Card billing
- ICS Credit Card (Cybersource Billing Server) – popular billing service
- Block in minutes
- Unused min are forfeited
- Auto deactivated when expired



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## 4. Timed (Per Minute)

- Available for CMS and ICS
- Per minute charge
- Credit Card or charge to hotel

The screenshot shows a web browser window displaying the Cisco High-Speed Internet Access payment page. The page has a green header with the text "Welcome to high-speed Internet access." Below this, there is a message: "Please fill out the information requested below. When finished, click the 'Connect' button to process your request." The main content area is titled "How do you want to pay for your internet connection?" and contains two radio button options: "Charge my hotel room" (which is selected) and "Charge my Credit Card". Under the "Charge my Credit Card" option, there are input fields for "Cardholder Name", "Credit Card Number", "Exp. Date" (with dropdown menus for month and year), and "CVV". There are "Back" and "Connect" buttons at the bottom of the form.

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## 5. Timed (Daily)

- Daily ICS
- 24 hours basis
- Site-wide start time or 24 hr from start time

The screenshot shows a web browser window displaying the Cisco High-Speed Internet Access payment page. The page has a green header with the text "Welcome to high-speed Internet access." Below this, there is a message: "Please fill out the credit card information requested below. Then click the 'Submit Information' button to process your information." The main content area is titled "Connect to the Internet for 24 minutes for \$100." and contains a form with the following fields: "Cardholder Name", "Street Address", "City", "State (Province)" (with a dropdown menu), "Zip Code", "Country" (with a dropdown menu), "Phone Number", "Credit Card Number", and "Exp. Date" (with dropdown menus for month and year). There are "Submit Information" and "Pay" buttons at the bottom of the form.

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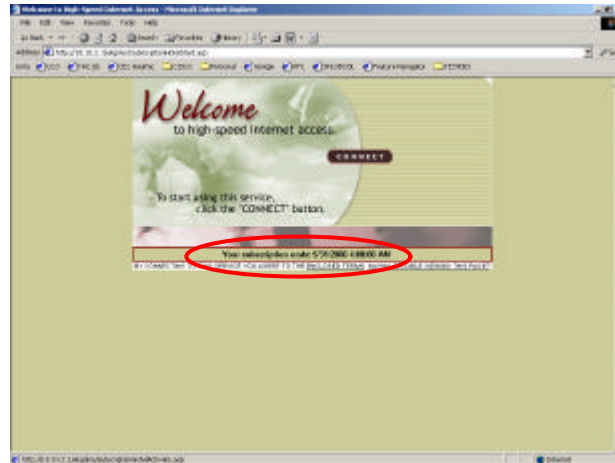
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## 8. Subscription

- **Subscription (ICS, Hotel, CMS, Home)**
- **User pre-pays**
- **Admin specifies date range for port**



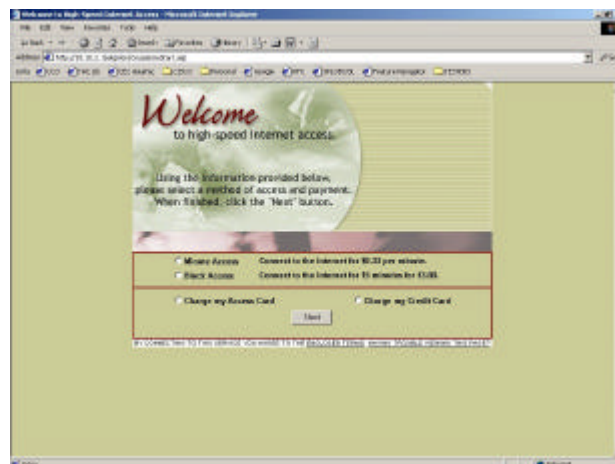
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## 9. Cruise Line

- **Users enter either credit card or access card information to access the Internet for a block of time or on a per minute basis**



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## New Features For BBSM 5.0

- Windows 2000 Server
- Microsoft Data Engine (MSDE) replaces Microsoft SQL Server
- WEB based GUI configuration.
- PMS API allows 3<sup>rd</sup> party developers to add new PMS interfaces
- Hardware API allows interfacing to new network equipment.

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## Application Description

- **BBSM Driver**
  - Provides Plug and Play (Bridged Network)
  - Redirects clients before authentication
  - Provides NAT (Static Clients)
  - Emulates Web Proxy
- **Microsoft Data Engine (MSDE)**
  - Database used to store information needed for the BBSM

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## Application Description Cont.

- **Internet Information Server (IIS)**
  - Manages BBSM Clients
  - Provides World Wide Web Services
  - Used to allow for remote configuration
- **BBSM Service**
  - Implements Plug and Play
  - Stores configuration and transaction tables
- **DHCP Server**
  - Provides non-static clients with IP addresses and related information

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## Application Description Cont.

- **DNS Server**  
Domain Name Server  
Transcribes a fully qualified domain name to an IP address, ie www.cisco.com to 198.133.219.25
- **Routing and Remote Access Service**  
Enables and disables client computer access to the Internet.
- **Active Server Pages**  
Contains the Billing Methods  
Customizable to the Property

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## Application Description Cont.

- **MSMQ**  
Provides data transport between IIS and MSDE
- **AtDial**  
Core of the BBSM service
- **Athdmn**  
Sends billing information to PMS Server

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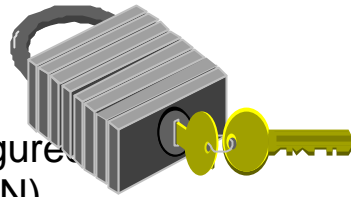
## BBSM Security

### Server Default Configuration:

Microsoft Networking (File and Print Sharing, Local Net BIOS disabled on both interfaces.

### Internal BBSM Network

Networking equipment configured for port-to-port security (VLAN).



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## Hardware Architecture

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## BBSM Server Platform

### Dell Server

- 1 Rack Unit
- Single Pentium III processor (733 Mhz)
- 1 Hard Drive (19 GB)
- 256MB memory
- 2 Intel NIC Cards (1 External 1 Internal)

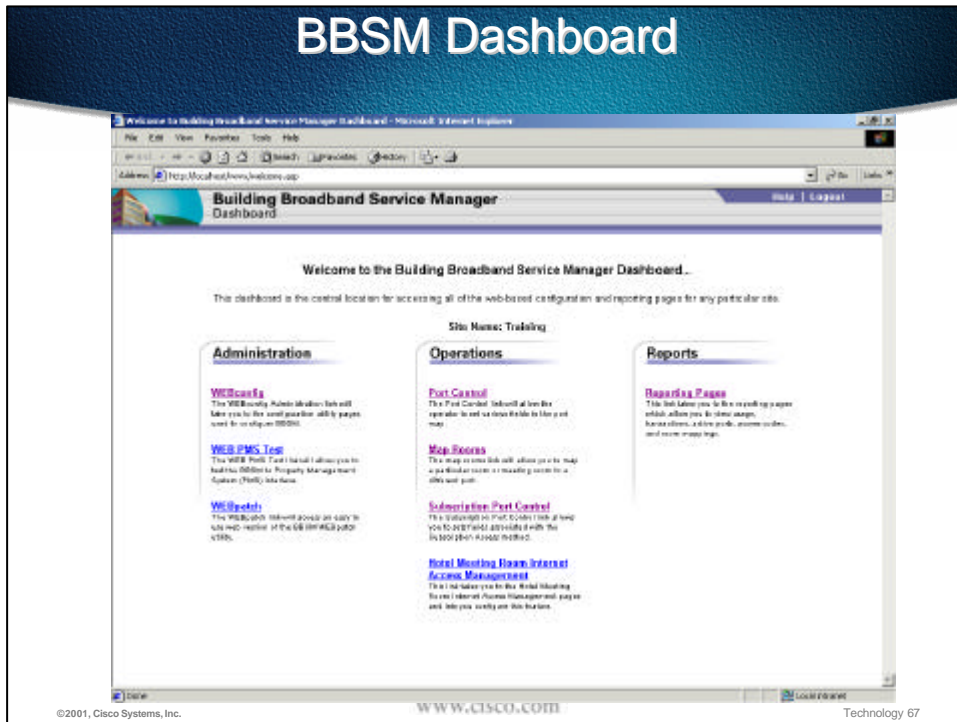
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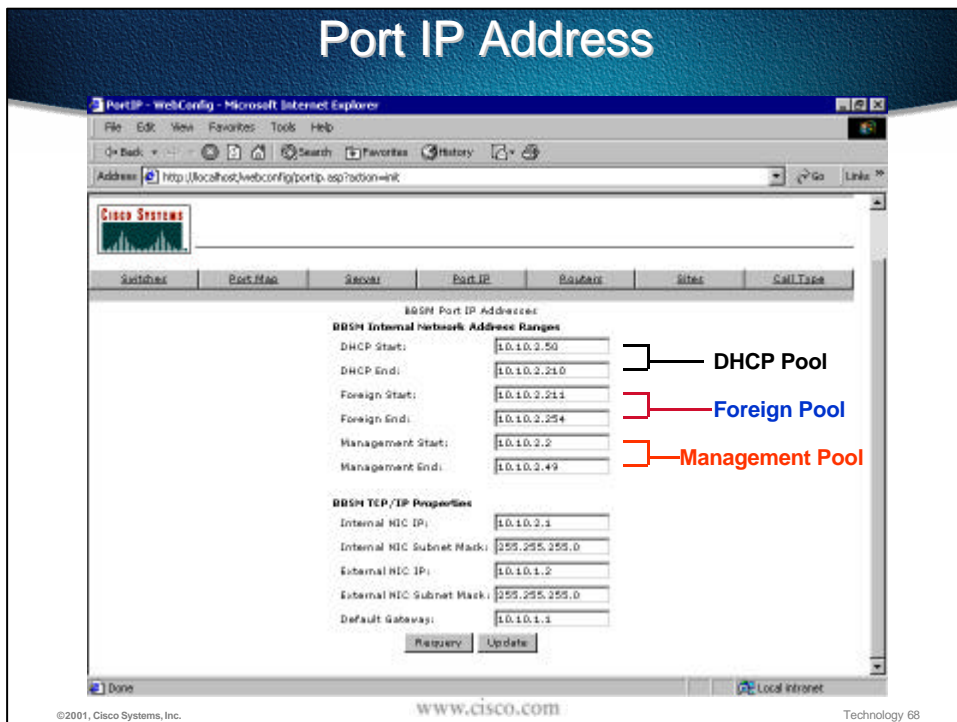
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# BBSM Dashboard



# Port IP Address



# Server Tab

The screenshot shows the 'Server Tab' configuration page. At the top, there is a navigation bar with 'Dashboard | Help | Logout'. Below this is the Cisco Systems logo and the text 'WEBconfig - Server'. A menu bar contains 'Port IP', 'Server', 'Sites', 'Routers', 'Switches', 'Page Sets', 'Port Map', 'Call Topics', 'RADIUS Servers', and 'Walled Garden'. The main content area is titled 'BBSM Server' and 'BBSM Version: "BBSM 5.0 Build 16.0"'. It is divided into two sections: 'Credit Card Server' and 'Network Configuration'. The 'Credit Card Server' section includes fields for 'Billing Server Address', 'Backup Billing Server Address', and 'Connect Timeout Seconds' (set to 30). The 'Network Configuration' section includes a checked 'Bandwidth Manager' checkbox, an unchecked 'Enable Transparent Proxy' checkbox, and an 'SMTP Forwarding IP Address' field. At the bottom of the configuration area are 'Request', 'Update', and 'Defaults' buttons. The browser's status bar shows '©2001, Cisco Systems, Inc.', 'WWW.CISCO.COM', and 'Technology 69'.

**Credit Card Server Configuration**

**Bandwidth Management Configuration**

# Sites

The screenshot shows the 'Sites' configuration page. At the top, there is a navigation bar with 'Dashboard | Help | Logout'. Below this is the Cisco Systems logo and the text 'WEBconfig'. A menu bar contains 'Switches', 'Port Map', 'Server', 'Port IP', 'Routers', 'Sites', and 'Call Topics'. The main content area is titled 'BBSM Sites'. It is divided into several sections: 'General', 'Printing', 'Credit Card Billing', and 'Retail Billing'. The 'General' section includes fields for 'Site Number' (set to 1), 'Site Description' (set to 'Training'), and 'Site Location' (set to 'San Diego'). There is also an unchecked checkbox for 'Allow multiple concurrent RADIUS sessions'. The 'Printing' section includes fields for 'BBSM Printer', 'Price Per Page', and 'Max Price Per Job'. The 'Credit Card Billing' section includes a 'Setup ID Number' field (set to 0). The 'Retail Billing' section includes an 'Authdn IP Address' field, checkboxes for 'PMS Billing' and 'Print Billing', a 'PMS Protocol' dropdown menu, and a 'Billing Printer' field. At the bottom of the configuration area are 'Request', 'Delete', 'Update', and 'Defaults' buttons. The browser's status bar shows '©2001, Cisco Systems, Inc.', 'WWW.CISCO.COM', and 'Technology 70'.

**Site Description**

## Sites Tab Cont.

The screenshot shows the 'Building Broadband Service Manager' WEBconfig interface in Microsoft Internet Explorer. The browser address bar shows 'http://localhost/webconfig/sites.asp'. The page title is 'Building Broadband Service Manager WEBconfig'. The interface has a navigation bar with tabs: Port Map, Sites, Routers, Switches, Prop. Sets, Port Map, Call Traces, and FACILITY Services. The 'Sites' tab is active. The main content area is titled 'BBSM Sites' and contains a form with the following fields:

- General: Site Number (1), Site Description (Training), Site Location (San Diego), and a checkbox for 'Use Public Component (BBSM) (Default)'. There are also fields for 'Site Start' and 'Max Price Per Job'.
- Billing: 'Credit Card Billing' (checked), 'Setup ID Number' (empty), 'Mail Billing' (checked), 'Bill on ID Address' (checked), 'Bill Billing' (checked), and 'Print Billing' (checked).
- Protocol: A dropdown menu is open, showing 'PMS Protocol' selected. Other options include 'Bridges', 'Fabricated', and 'Other'.

Buttons at the bottom of the form include '<<', '<', '>', '>>', 'Request', 'Delete', and 'Update'. An arrow points from the text 'PMS Protocol For The Site' to the selected 'PMS Protocol' option in the dropdown menu.

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## Routers Tab

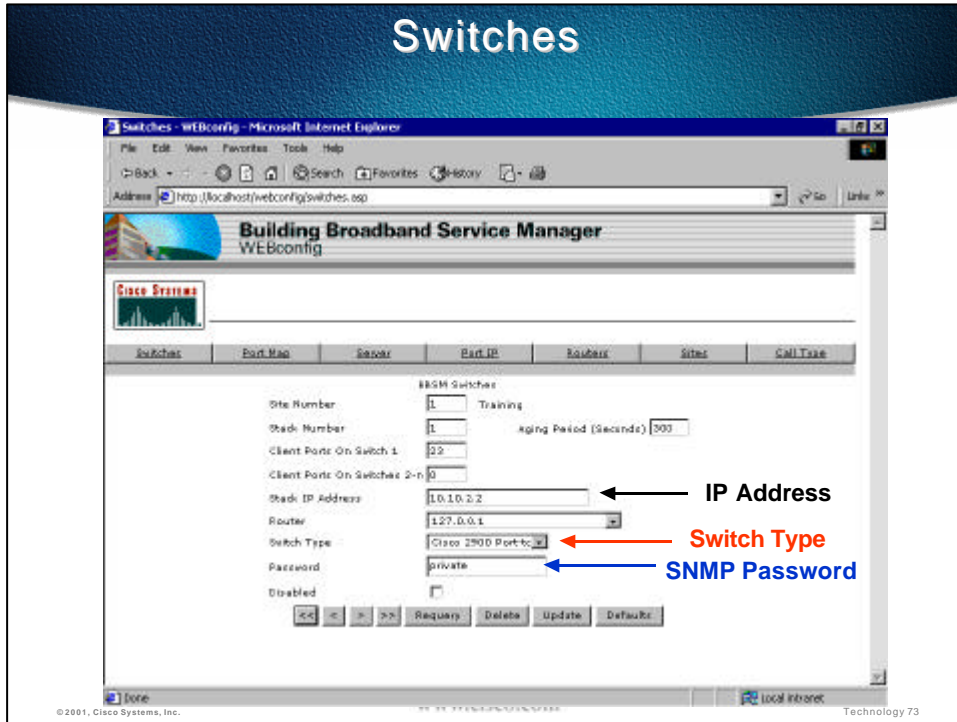
The screenshot shows the 'Building Broadband Service Manager' WEBconfig interface in Microsoft Internet Explorer. The browser address bar shows 'http://localhost/webconfig/routers.asp'. The page title is 'Building Broadband Service Manager WEBconfig'. The interface has a navigation bar with tabs: Port Map, Sites, Routers, Switches, Prop. Sets, Port Map, Call Traces, and FACILITY Services. The 'Routers' tab is active. The main content area is titled 'BBSM Routers' and contains a form with the following fields:

- Router Number (1)
- Router IP Address (192.168.1.1)
- Gateway to Router (10.10.2.3)
- Client Start (192.168.1.2)
- Client End (192.168.1.294)
- Client Subnet Mask (255.255.255.0)
- Password (password)
- Create DHCP Scope (checked)

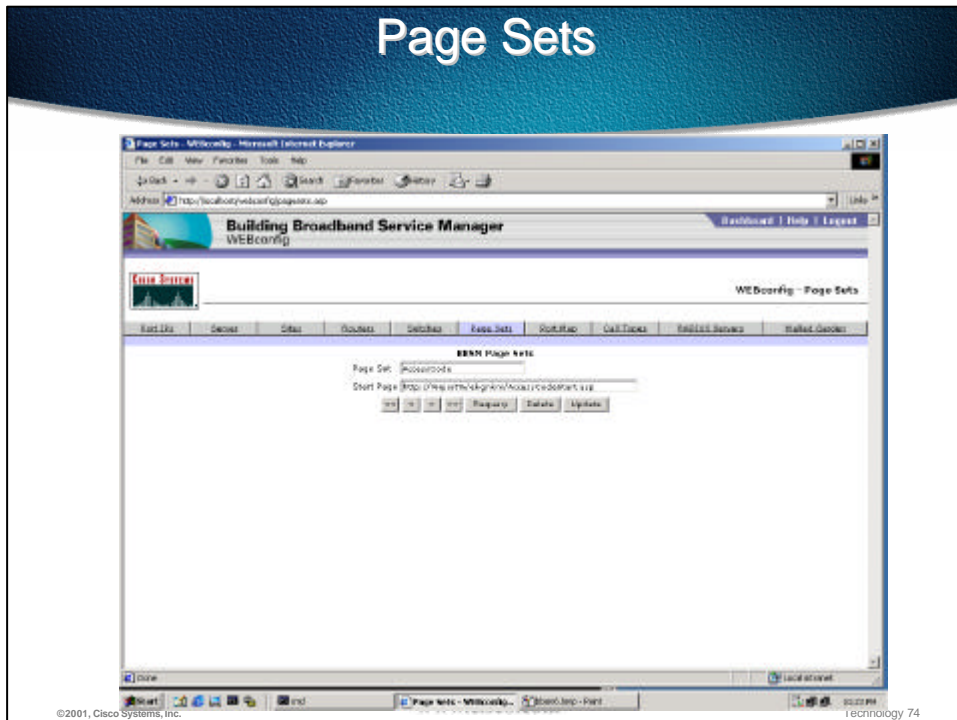
Buttons at the bottom of the form include '<<', '<', '>', '>>', 'Request', 'Delete', and 'Update'. An arrow points from the text 'Cable Modem' to the 'Client Start' and 'Client End' fields.

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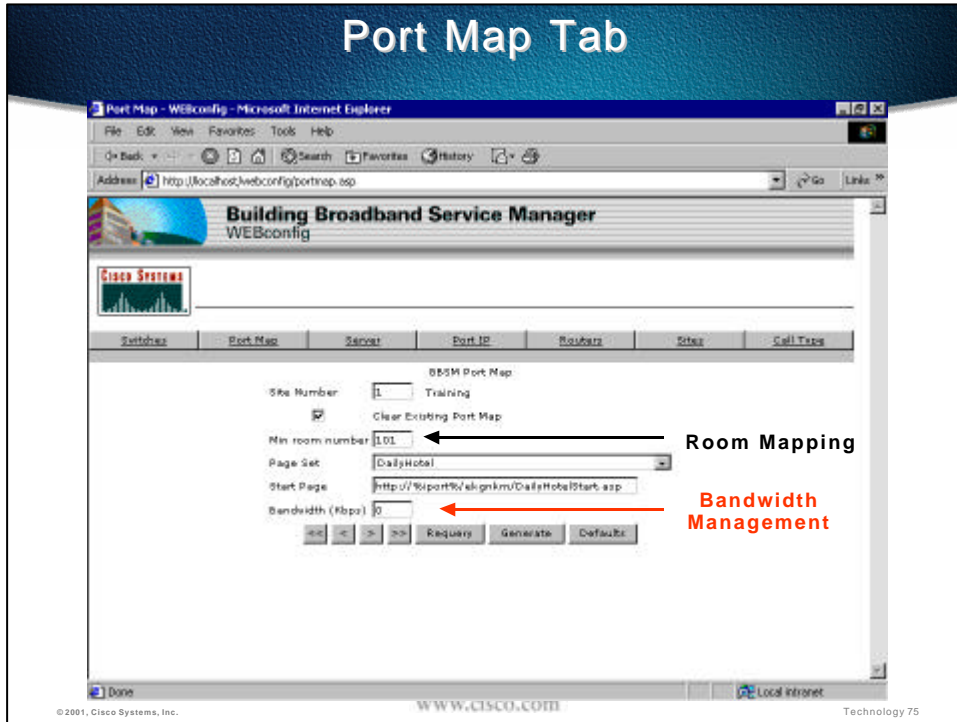
# Switches



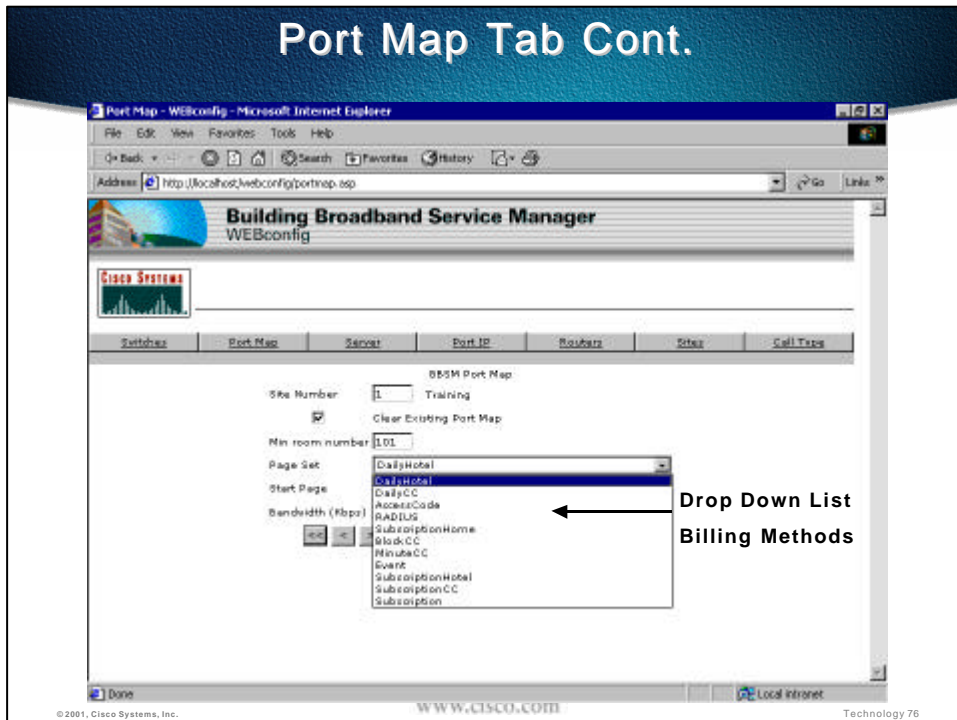
# Page Sets



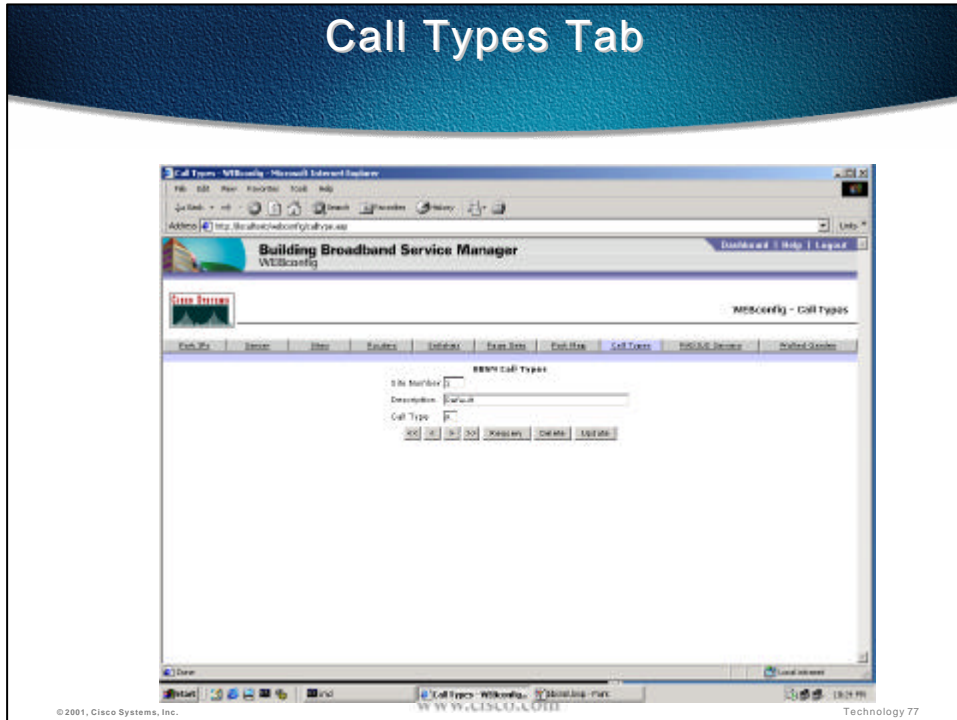
# Port Map Tab



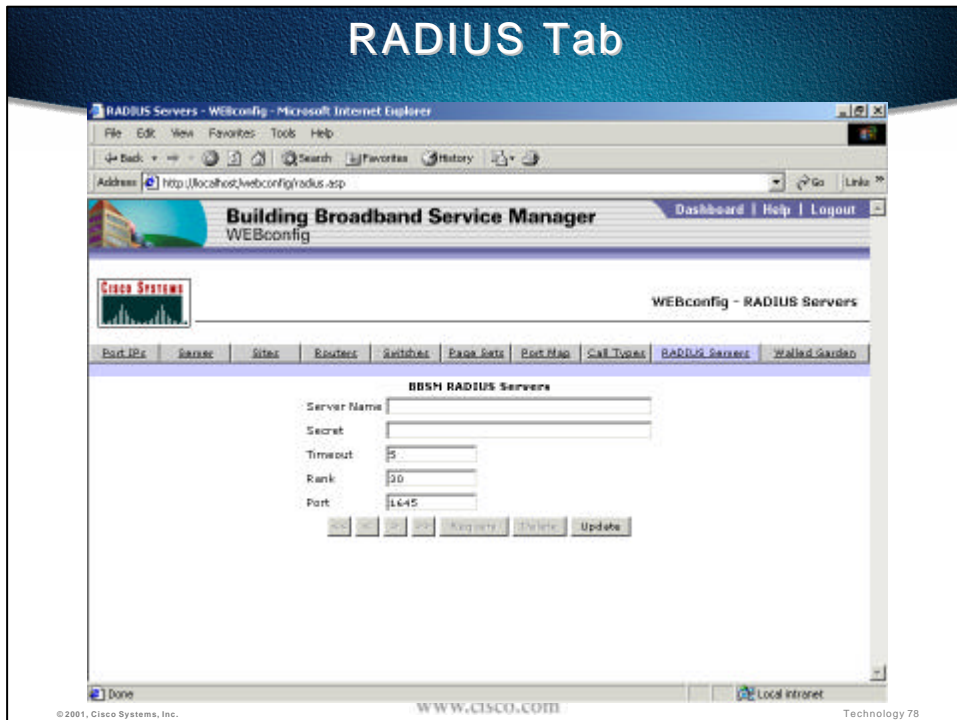
# Port Map Tab Cont.



## Call Types Tab



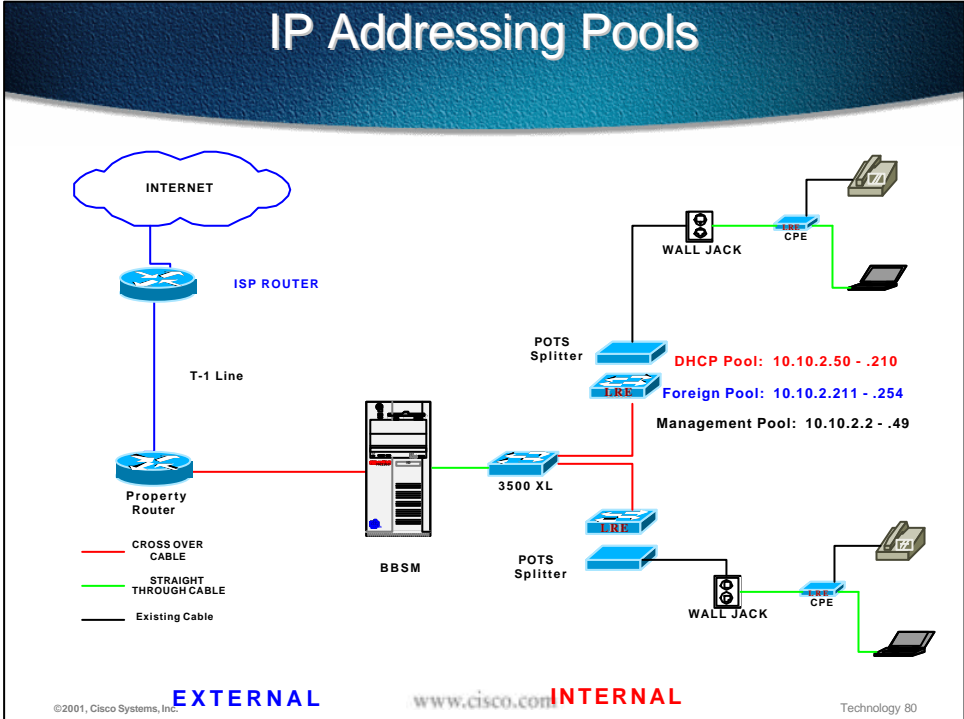
## RADIUS Tab





# BBSM Equipment Layout And IP Addressing

Cisco.com



## IP Addressing Scheme

### Note :

**Routable (Public IP) addresses for Internal and External segment**  
**Non-routable (Private IP) addresses for Internal and External segment**  
**For non-routable IP addresses, configure NAT at router**

### Sample Configuration of Router

```
interface FastEthernet0
ip address 10.0.0.253 255.255.255.0
ip nat inside    [ to BBSM External NIC ]
!
interface Serial0
ip address 2.2.2.1 255.255.255.0
ip nat outside   [ to Internet ]
!
ip nat inside source list 1 pool test1 overload    [ NAT config ]
ip route 0.0.0.0 0.0.0.0 2.2.2.2    [ Default Route ]
ip route 10.10.1.0 255.255.255.0 10.0.0.1 [ Static route back to BBSM
Internal NIC segment ]
access-list 1 permit 10.10.1.0 0.0.0.255
```

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## BBSM Bugs and Fixes

### Problem 1:

- BBSM not redirecting to your URL after successful authentication

### Resolution :

- Need to enable DNS forwarding. How ??

Start\Programs\Administrative Tools\DNS - right click BBSM, go to properties, 2nd tab is Forwarders - enable it and enter the DNS server IP's

### Problem 2:

- Client unable to browse Walled-garden sites. Proxy configured in browser and problem resolved.

### Resolution :

- Need to download patches from CCO

<http://www.cisco.com/cgi-bin/tablebuild.pl/bbsm>

<ftp://ftp.cisco.com/cisco/cable/bbsm>

\*\*\*Please note that WEBPatch50SP1.exe must be installed before installing the Service Pack 1 (BBSM50SP1.exe), and that both should be installed to the BBSM server via the WEBPatch application.\*\*\*

### Other documents include :

- The Release Notes for BBSM 5.0 Service Pack 1

[http://www.cisco.com/univercd/cc/td/doc/product/aggr/bbsm/bbsm50/relnotes/sp1\\_rn.htm](http://www.cisco.com/univercd/cc/td/doc/product/aggr/bbsm/bbsm50/relnotes/sp1_rn.htm)

- Software Developers Kit :

<http://www.cisco.com/warp/public/570/comlob/index.html>

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