

TOMORROW starts here.



Cisco *live!*

Implementing Network Automations - Power Tools for Catalyst Switching Network Operations

BRKCRS-3090

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Systems Engineer

Power Play Q: - Who's Most Powerful?

Steve Morse makes it look easy

Consists of Instrumentalists from
Symphony, singers and Deep
Purple

Was it Steve?

Was it the music or singers?

Was it bass or drummer?



Answer:



- The Conductor!
- Only one in control of multiple instruments!
- Network Engineers need tools to move up to “conductor level”
- Cisco Smart Operations can help

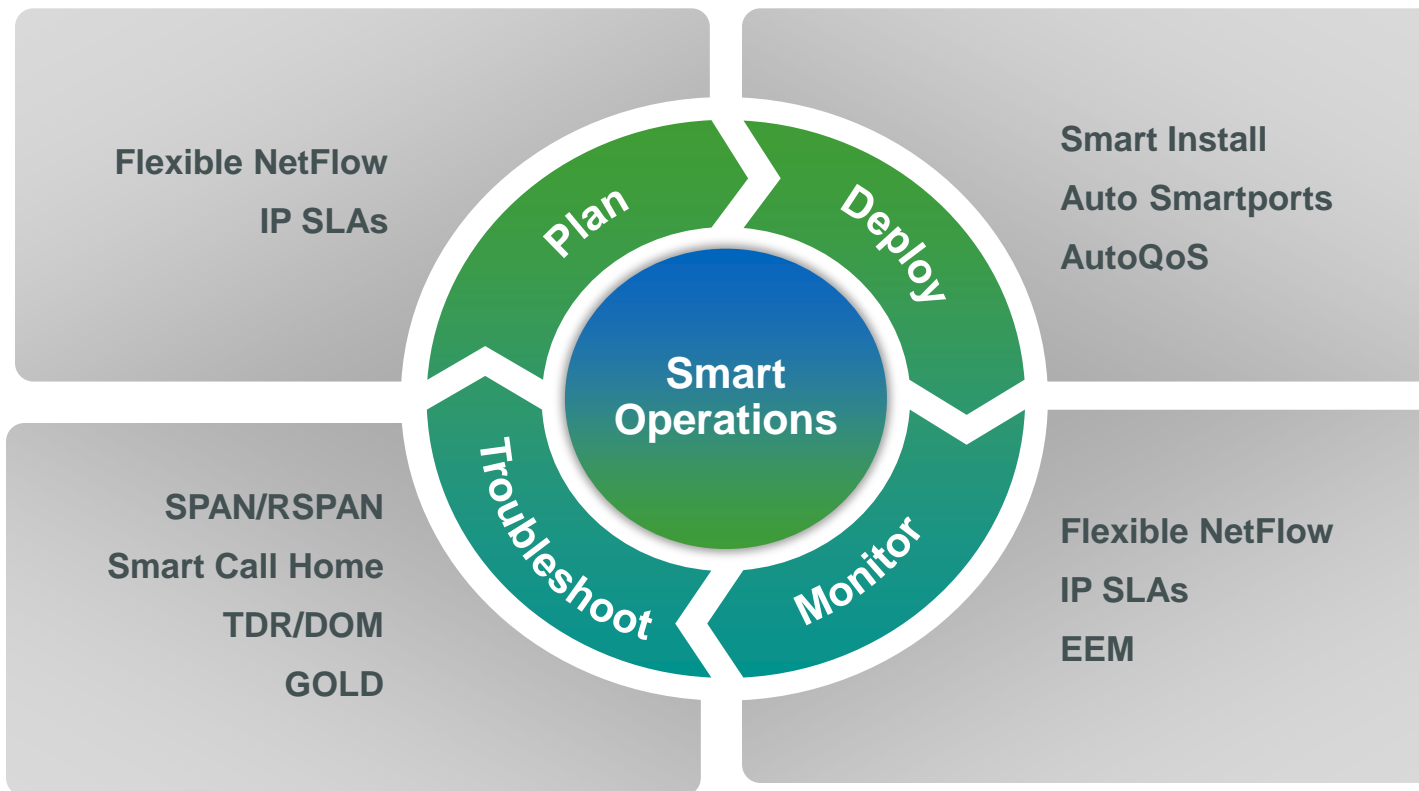
Agenda

- **Context – Why Smart Operations?**
 - **Smart Operations tool portfolio**
- Smart Install
- Auto Smartports
- EEM

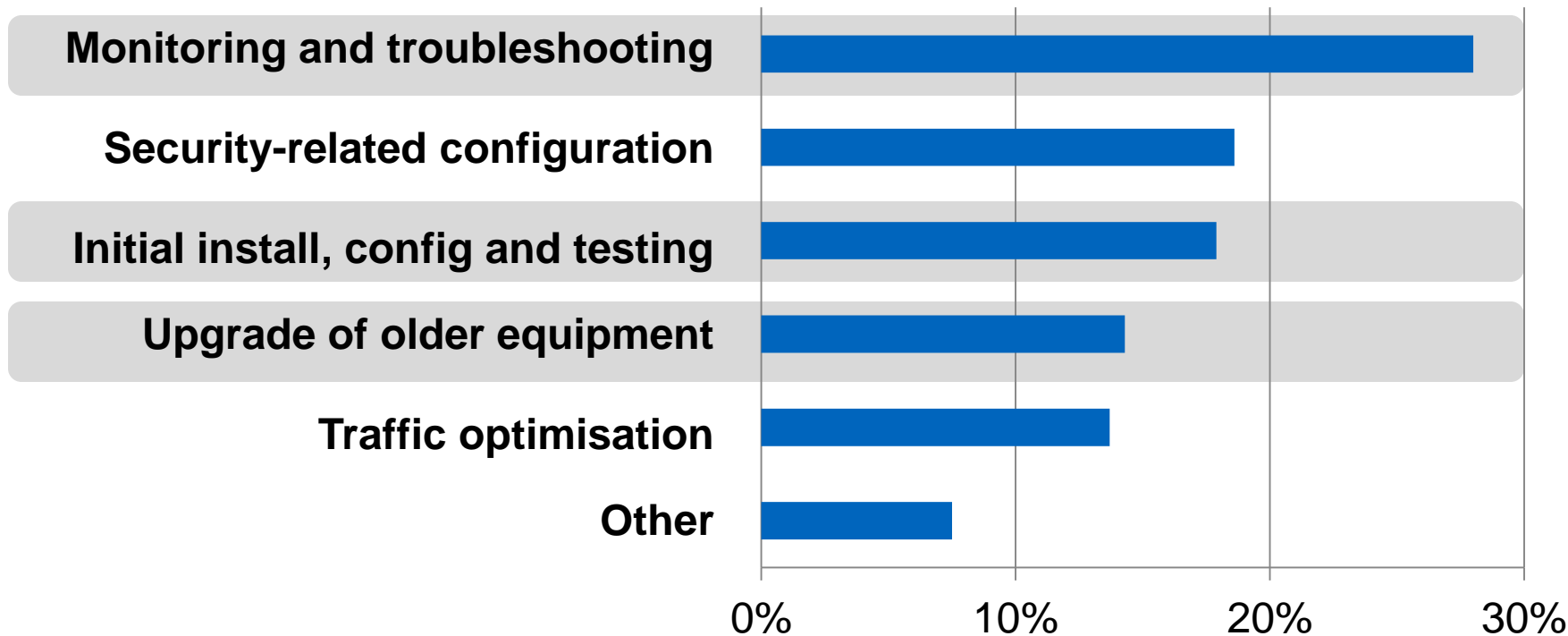
Smart Operations: Automates the trivial and repetitive tasks



Smart Operations Includes Tools for all Phases of the Network Life Cycle



Administrators Spend Most Their Time Keeping the Network Operational



Source: The Total Economic Impact™ of Cisco Catalyst Access Switching,
A Commissioned Study Conducted by Forrester Consulting On Behalf of Cisco Systems, January 2012

Smart Operations is:

Time-saving

- Tools that **automate** and **simplify** network administration

LAN-focused

- Focused on **branch and campus** switch network operations

Free

- Included in IOS** on the Catalyst 2K, 3K and 4K

A Cisco Priority

- Reducing Total cost of Ownership is an ongoing priority.

Smart Operations Feature Support

FYI

Jan 2014

Tool	Catalyst 6500	Catalyst 4500	Catalyst 3xx0	Catalyst 2xx0
Smart Install (Director)	●	●	●	○
Auto Smartports	○	●	●	●
AutoQoS	●	●	●	●
Flexible NetFlow	●	●	● **	***
IP SLAs	●	●	●	◐ Responder only
EEM	●	●	●	○
Smart Call Home	●	●	●	●
GOLD	●	●	●	○
SPAN/RSPAN	●	●	●	●
Protocol analyser/Wireshark	●	●	○ *	○
TDR	●	●	●	●

*Roadmap features (3850 supports with IOS XE release 3.3.0 SE)

** Specific hardware required (native support in 3850, 3650 but 3750-X require hardware module)

*** 2960X & 2960XR support Flexible Netflow

Agenda

- Context – Why Smart Operations?
- **Smart Install**
 - Feature overview
 - Use cases
 - Example configuration
 - Best practices
 - Questions???
- Auto Smartports
- EEM

Smart Install – Solving the Scale Issue



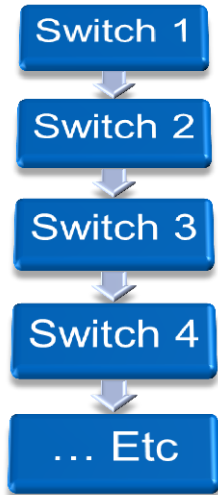
Good News!!!
Refresh Switches have arrived

Bad News
Rack and Install process begins

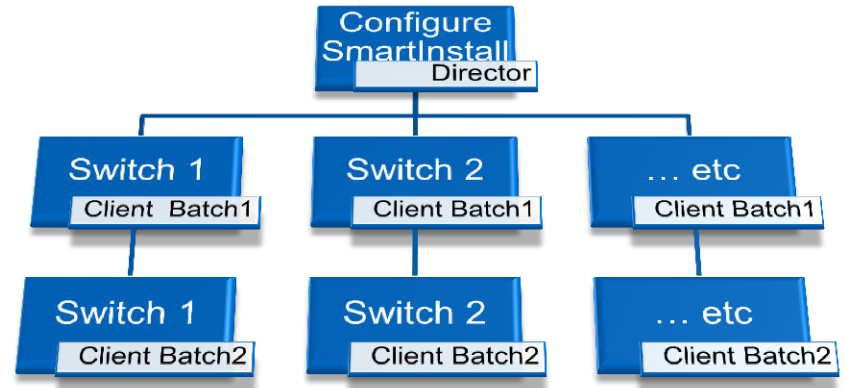
Good News!!!
Smart Install is on the team!!
Solving the repetitive tasks!!

Rack and Stack

Typical Process— no SmartInstall



SmartInstall Process – Multi-Tasking!



Remove the human bottleneck up 20x or more

Smart Install Benefits

Zero-touch Deployment and Maintenance

Zero-touch Installation

- Anyone can install a switch:
 - Reduce travel
 - Less skilled labor
- Speeds up deployment
 - Network does IOS SW image install

Centralised Image and Config Management

- Catalyst switch update from a single point of control
- Ensure Configuration consistency across Catalyst switches
- Prevents manual configuration errors

Automated Replacement

- RMA supported
- Configurations automatically backed up
- New Switch automatically configured same as old.

Smart Install Components and Terminology

Client

Receives image and configuration from Director

Groups

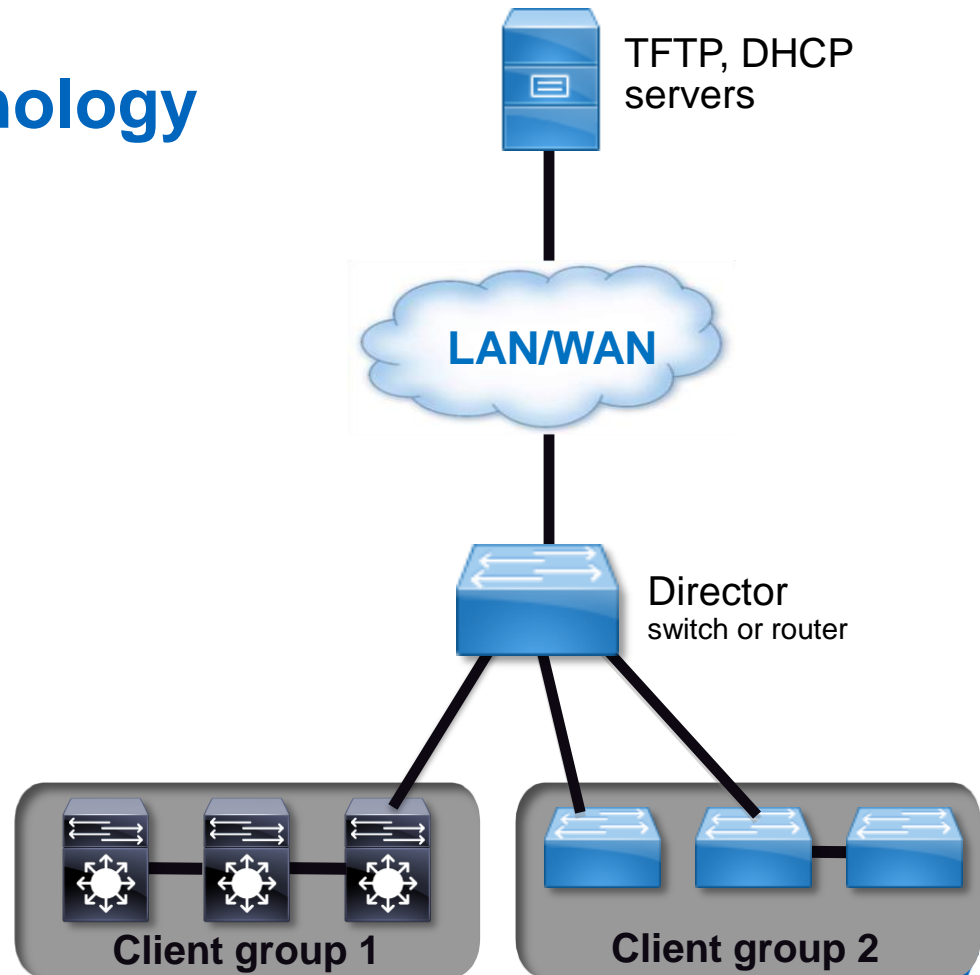
Collection of Clients (same image and config)

Director

Manages client image and configuration

DHCP and TFTP Servers

Centrally located and shared across network



Smart Install – How It Works

1.

Director discovers client via CDP

2.

New switch issues DHCP discover

3.

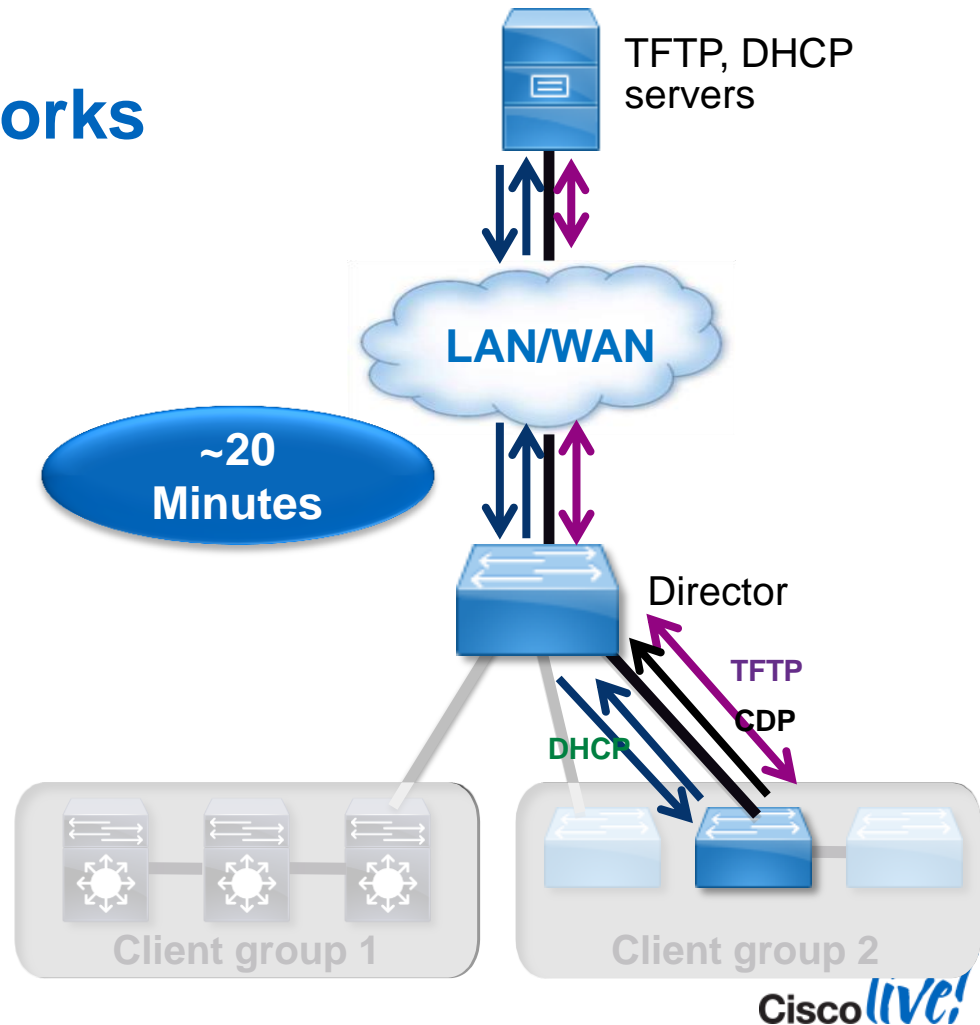
Director adds options to DHCP offer

4.

Client retrieves image, config via TFTP

5.

Client reboots with new configuration and image



Smart Install Supported Platforms

Smart Install Directors



Catalyst 6500

Sup 2T (SW Ver 15.1.1-SY)

Catalyst 4500

Sup 8, Sup 7 and Sup 6
(SW Ver 3.4.0SG 15.1.2-SG)

Catalyst 3K

3850 (SW Ver 3.2.0SE)

3650f (sw ver 3.x.x?)

3750, 3750G, 3750v2, 3750E,
3560, 3560v2, 3560E, 3560G
3750X, 3560X

Min Recommended: 12.2.(58)SE2



ISR Branch Router

G1: 1841, 2801, 2811, 2821, 2851, 3825, 3845

G2: 1921, 1941, 2901, 2911, 2921, 2951, 3925, 3945,
3925E, 3945E, NM-16-ESW

Min release : 15.1.(3)T1



Smart Install Clients

Catalyst 3K

3850

3750, 3750v2, 3750E, 3750G, 3750X,
3560, 3560v2 3560E, 3560G, 3560X



Catalyst 2K

2960, 2960S, 2960G, 2960SF,
2960-X, 2960-XR



Catalyst 2K/3K Compact

2960C, 3560C



Additional platforms will be supported in future releases

Common Deployment Scenarios

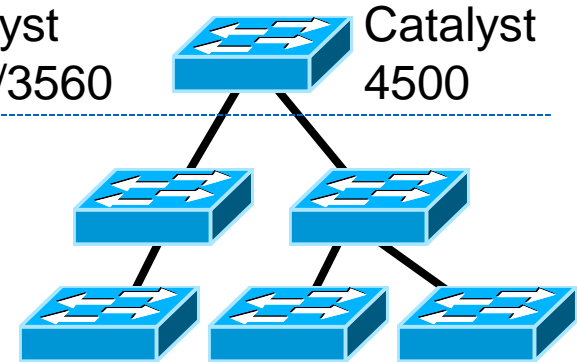
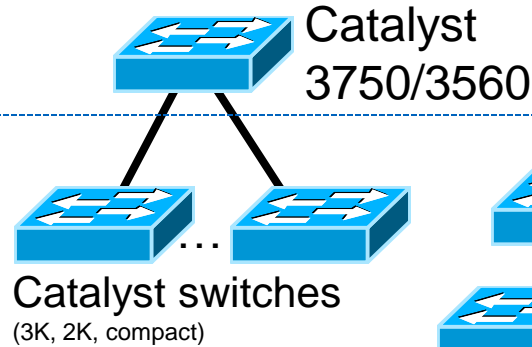
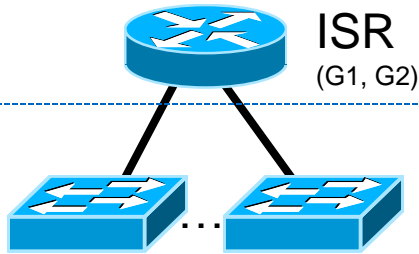
Branch (ISR)

Branch (3K)

Small Campus

Director

Clients



Retail
Hospitality

Sales Offices
Schools

L2 campus
with 4K core

Also: central staging before deployment to sites

Example Smart Install Director Configuration

```
!  
ip dhcp remember  
!  
interface Loopback0  
ip address 15.15.15.15 255.255.255.255  
!  
interface GigabitEthernet0/2  
ip address 1.1.1.1 255.255.255.0  
ip helper-address 15.15.15.15  
!  
tftp-server flash0:default_imglist.txt  
tftp-server flash0:seed_config.txt  
tftp-server flash0:config_2960G_1.txt  
tftp-server flash0:config_3750.txt  
tftp-server flash0:2960_sales_3.txt  
tftp-server client_cfg.txt  
tftp-server flash0:2960g-8-imagelist.txt  
tftp-server flash0:c3750-ipbasek9-tar.122-55.SE.tar  
tftp-server flash0:3750-imagelist.txt  
tftp-server flash0:c2960-lanbasek9-tar.122-55.SE.tar  
tftp-server flash0:2960-imagelist.txt  
!
```

Director
IP
DHCP
helper

TFTP
Server

```
vstack group custom 3750v2 mac  
image flash0:c3750-ipbasek9-tar.122-55.SE.tar  
config flash0:config_3750.txt  
match mac 0015.c6e8.6480  
!  
vstack group custom 2960 connectivity  
image flash0:c2960-lanbasek9-tar.122-55.SE.tar  
config flash0:2960_sales_3.txt  
match host 1.1.1.1 interface GigabitEthernet0/3  
!  
vstack group built-in 2960 8  
image flash0:c2960-lanbasek9-tar.122-55.SE.tar  
config flash0:config_2960_1.txt  
!  
vstack hostname-prefix springfield  
!  
vstack dhcp-localserver pool1  
address-pool 1.1.1.1 255.255.255.224  
file-server 1.1.1.1  
default-router 1.1.1.1  
!  
vstack director 15.15.15.15  
vstack basic  
!  
end
```

Client
groups

DHCP
server

Enable
Smart
Install

Smart Install Sample Configuration

```
vstack vlan 1
!
vstack group custom 2960c_compact_custom product-id
  image tftp://192.168.0.2/Nile/c2960c405-universalk9-tar.150-2.1.SE
  match WS-C2960CPD-8PT-L
!
vstack group built-in 2960g 8
  image tftp://192.168.0.2/Nile/c2960-lanbasek9-mz.150-2.SE
  config tftp://192.168.0.2/Nile/2960_seed_config_vtp.txt
!
vstack group built-in 2960s 48-2sfp
  image tftp://192.168.0.2/Nile/c2960s-universalk9-tar.150-2.SE
  config tftp://192.168.0.2/Nile/2960s_smi_client_config.txt
!
vstack group built-in 2960s 48-2sfp-poe
  image tftp://192.168.0.2/Nile/c2960s-universalk9-tar.150-2.SE
  config tftp://192.168.0.2/Nile/2960s_smi_client_config.txt
!
vstack hostname-prefix SMI_client
!
vstack dhcp-localserver SMI_MGMT_vlan1_pool
  address-pool 192.168.141.1 255.255.255.0
  file-server 192.168.0.2
  default-router 192.168.141.1
!
vstack director 192.168.141.1
vstack basic
vstack startup-vlan 1
no vstack backup
```

- Taken from 3750X SMI Director
- Multiple client groups
- External TFTP Server
- Vlan 1 is Vstack vlan
- Vstack backup is disabled
- Note: 2960S has multiple built-in groups for each model

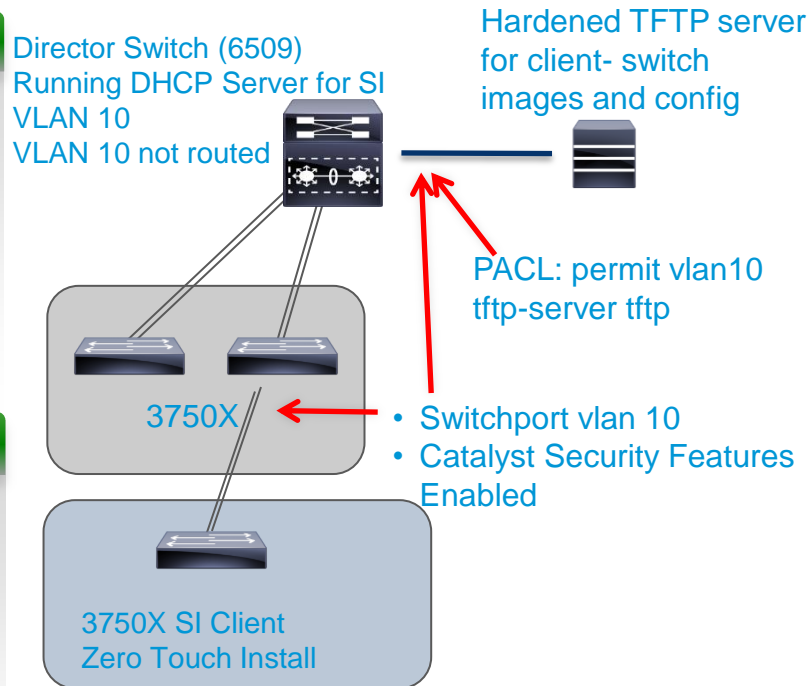
Smart Operations: Securing Smart Install

Segment Smart Install Functions

- Create and utilise dedicated VLAN/DHCP Scope only for Smart Install operation
- Configure SI DHCP scope on director switch
- Eliminate or severely restrict outside traffic into SI VLAN
- Enable Catalyst Security features on every switchport in the smart install VLAN
 - DHCP Snooping, DAI, IP SRC Guard, Port Security max macs

Segment Smart Install Functions

- Utilise Join Window on Director
 - Schedule a time-window for zero-touch image and config upgrades
 - Clients cannot download image/config outside the window
- Disable TFTP server switchport or TFTP Service outside of Join Window
- Configure PACL on TFTP server that only allows tftp from smart install vlan dhcp scope
- Prune SI VLAN from trunks when not in use



Smart Install – Best Practices

- External TFTP server for performance
 - Director as TFTP server is slow
- Use Director as TFTP server for limited clients
- For Single client type use defaults
 - Defaults for client image and client configuration
- Allow vlan 1 with interface configuration workaround
 - Config example coming in a few slides

Smart Install – Limitations

- **Clients** must reach director & DHCP server on VLAN 1
 - The Director must snoop on DHCP Discover between clients and the DHCP server
- **Scaling considerations:** Director manages 64 clients
 - Looking to improve over time
- **Director** – no redundancy for non-VSS platforms
 - Eg: HSRP environment
 - VSS with 6500 and 4500 do not have this limitation
- **Not all clients are “built-in”**
 - use custom product IDs
- CLI based – no GUI support
- Security – all configurations in the clear.

Smart Install Customer Checklist

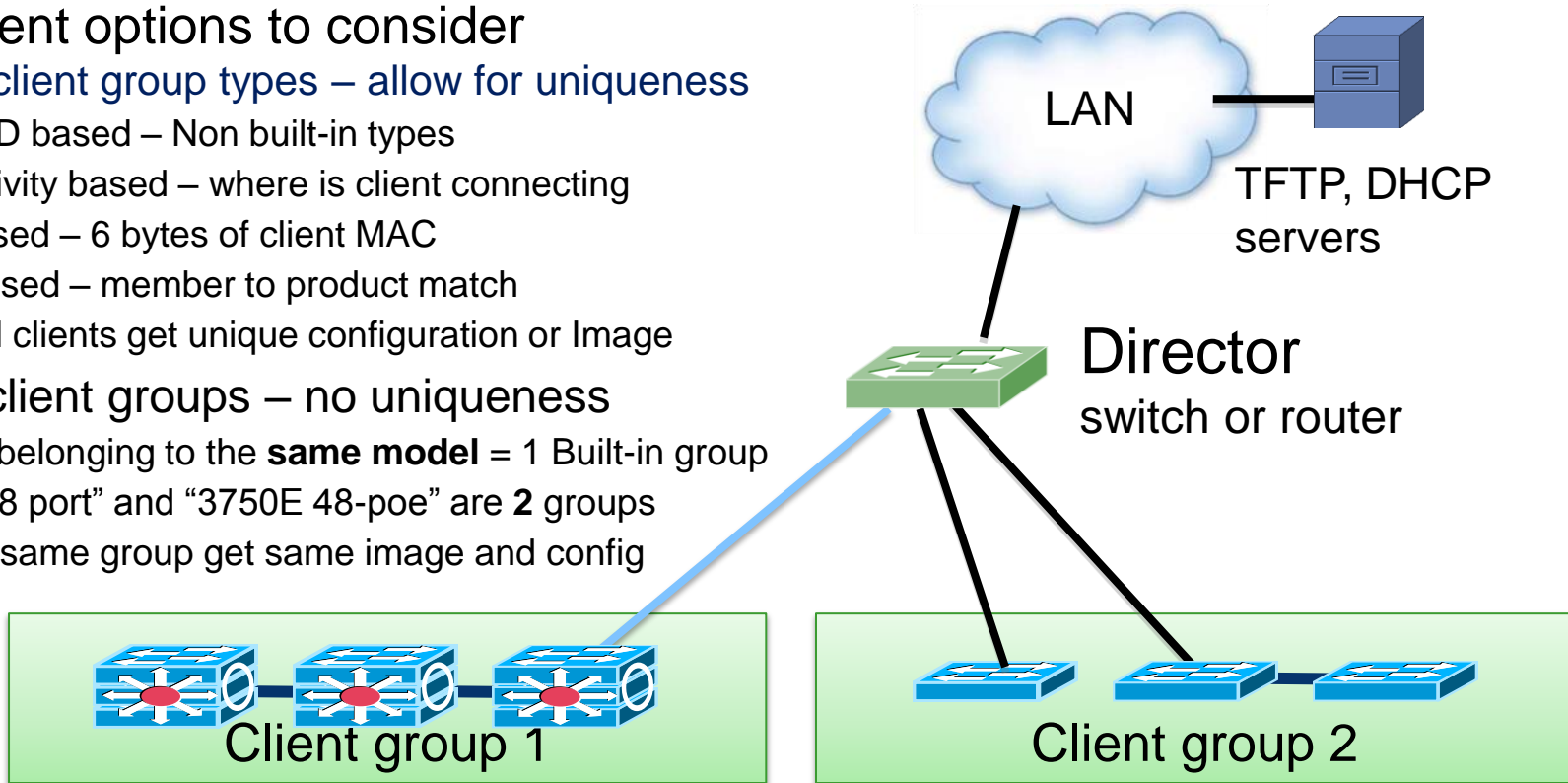
Deployment options to consider

- Client Groups
 - Built-in or custom
- DHCP Server location
 - Director as DHCP Server – less complex
 - Final IP Address of client – does it need to route outside of distribution topology?
- Director options – only 1 per client
 - ISR, 3750, 4500, 6500
 - Needs to see DHCP Discover from Client TFTP Server location
 - Central, per site, or on Director
- Backup configuration server
 - Defaults to Director
 - Needed?
- Security concerns
 - Configuration files not secure

Smart Install Customer Checklist – Client Groups

Deployment options to consider

- Custom client group types – allow for uniqueness
 - Product ID based – Non built-in types
 - Connectivity based – where is client connecting
 - MAC based – 6 bytes of client MAC
 - Stack based – member to product match
 - Individual clients get unique configuration or Image
- Built-in client groups – no uniqueness
 - Switches belonging to the **same model** = 1 Built-in group
 - “3750E 48 port” and “3750E 48-poe” are 2 groups
 - Clients in same group get same image and config



Smart Install Checklist – DHCP Server Options

DHCP Deployment options to consider

- Smart Install Clients require Dynamic IP Address assignment for Day 0.
- Downloaded config can apply permanent/static IP.
 - Implies unique Configurations for each client
 - Use custom group for this
- DHCP Server location
 - Director as DHCP Server – less complex
 - Centralised DHCP – easier to manage IP Addresses for network of clients
 - Modifying DHCP Server for client Network Devices?

Final subnet to manage Client IP Address?

Dynamic IP Address temporary?

Does Dynamic IP Address of Clients matter?

how are clients tracked Day 1?

SMI: Status of Clients

SMI# show vstack status

SmartInstall: ENABLED

Status: Device_type Health_status Join-window_status Upgrade_status

Device_type: S - Smart install N - Non smart install P - Pending

Health_status: A - Active I - Inactive

Join-window_Status: a - Allowed h - On-hold d - Denied

Image Upgrade: i - in progress I - done X - failed

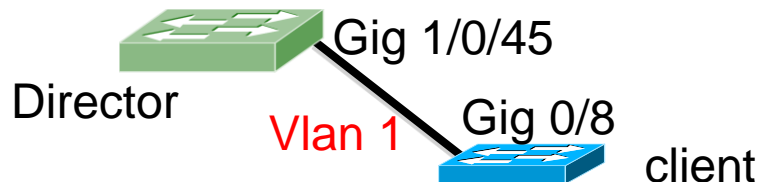
Config Upgrade: c - in progress C - done x - failed

Client Status Keys
Pass / Fail / in progress

Director Database:

DevNo	MAC Address	Product-ID	IP_addr	Hostname	Status
0	0027.0d3b.cc80	WS-C3750X-48P	192.168.141.1	SMI	Director
1	40f4.ec52.1700	WS-C2960CG-8TC-L	192.168.141.3	SMI_client	S A I C a
2	0026.52f0.d400	WS-C2960G-8TC-L	0.0.0.0	Switch	S A a
3	0022.bdd3.b080	WS-C2960S-48TD-L	192.168.141.4	SMI_client	S A I C a
4	0017.0e9a.9300	WS-C2960-48TT-L	172.28.104.28	RACK-8_TOR	S A a
5	d4a0.2a85.1f00	WS-C2960CPD-8PT-L	192.168.141.2	SMI_client	S A a

Director to Client Interface Configuration (1)



On Initial Client boot

Interface: Access Mode using Vlan 1

Interface config on the director side:

```
interface GigabitEthernet 1/0/45
description To_C2960G_client
switchport trunk encapsulation dot1q

switchport access vlan 1
switchport trunk native vlan 999

switchport mode dynamic auto
switchport trunk allowed vlan 1,10-
100,200
end
```

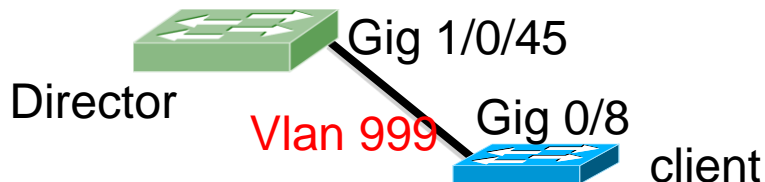
Interface config on client side before reload:

```
interface GigabitEthernet 0/8
switchport access vlan 1
switchport mode dynamic auto
```

The interface on the client side after reload:

```
interface GigabitEthernet 0/8
description To_SMI_director
switchport trunk native vlan 999
switchport access vlan 1
switch trunk allowed vlan 2-4094
switchport mode dynamic desirable
```

Director to Client Interface Configuration (2)



Interface config on the director side:

```
interface GigabitEthernet 1/0/45
description To_C2960G_client
switchport trunk encapsulation dot1q

switchport access vlan 1
switchport trunk native vlan 999

switchport mode dynamic auto
switchport trunk allowed vlan 1,10-100,200
end
```

After Client reload

Interface: Trunk mode negotiated 999

Interface config on client side before reload:

```
interface GigabitEthernet 0/8
switchport access vlan 1
switchport mode dynamic auto
```

The interface on the client side after reload:

```
interface GigabitEthernet 0/8
description To_SMI_director
switchport trunk native vlan 999
switchport access vlan 1
switch trunk allowed vlan 2-4094
switchport mode dynamic desirable
```

SMI Advanced Practices

- Vlans created by making them access vlans
 - Cannot be created using “normal” means
 - Vlans stored in “vlan.dat”, not the startup configuration file
- Work around for creating vlans, edit the startup configuration file

```
interface gi0/1
  switchport access vlan 999
  switchport access vlan 200
  switchport access vlan 11
  switchport access vlan 10
exit
```

!!! the above will create vlans 999, 200, 11, and 10. Leaving the interface in vlan 10 as the access vlan.

Smart Install Summary

Smart Install : Automates Device Deployment and Replacement

- Accelerated deployment, upgrades and replacement
- Use for staging in the lab, or installation in remote locations
- Requires a Catalyst 3K,4K, 6K or ISR as director in DHCP path
- Client uses VLAN 1

- To learn more (case studies, white papers, documentation):
<http://cisco.com/go/smartoperations>
- **DO NOT Touch the client Console!!!!!!!!!!**

Questions?

Up Next : Auto Smartports (ASP)



Agenda

- Context – Why Smart Operations?
- Smart Install
- Auto Smartports
 - What is it?
 - How Auto Smartports works
 - Builtin Devices and Macro
 - How to use Auto Smartports
 - Best practices
 - Connected Device Identification – Device Classifier
 - Questions???
- EEM

Today's Dynamic Business



Some notes are not possible to hear without powerful amplification

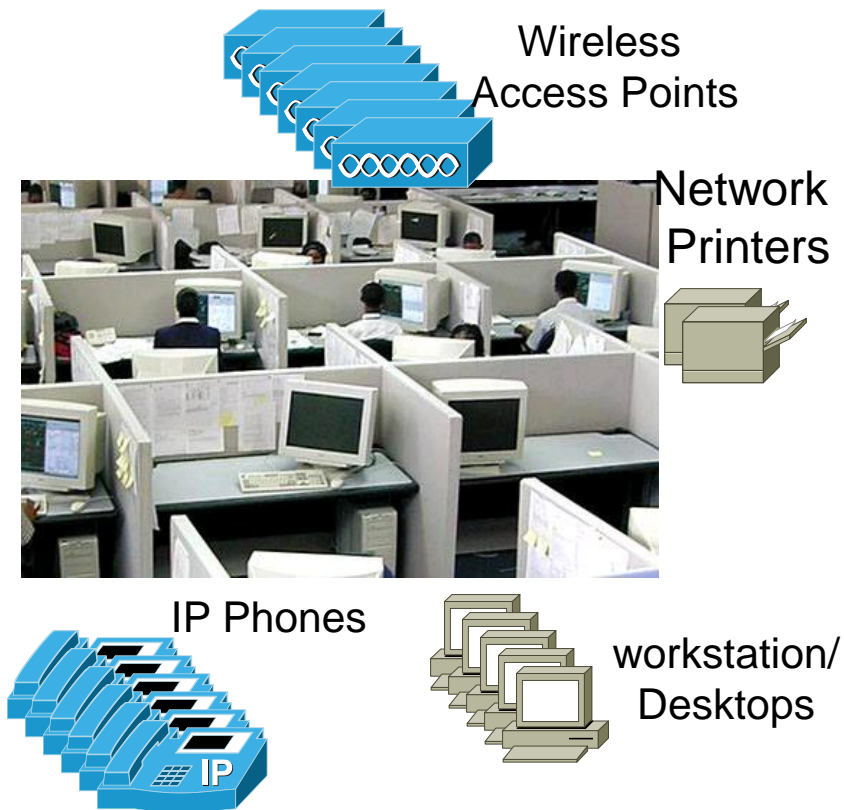
- Nothing is constant apart from change.
- We need power tools (like amplifiers) for Network Engineers to keep up with pace of change.
- Auto Smartports can help “amplify” our configuration effort through automation.

Auto Smartports – What It Is

Auto Smartports: Dynamically Configures Ports Based on the Device Detected

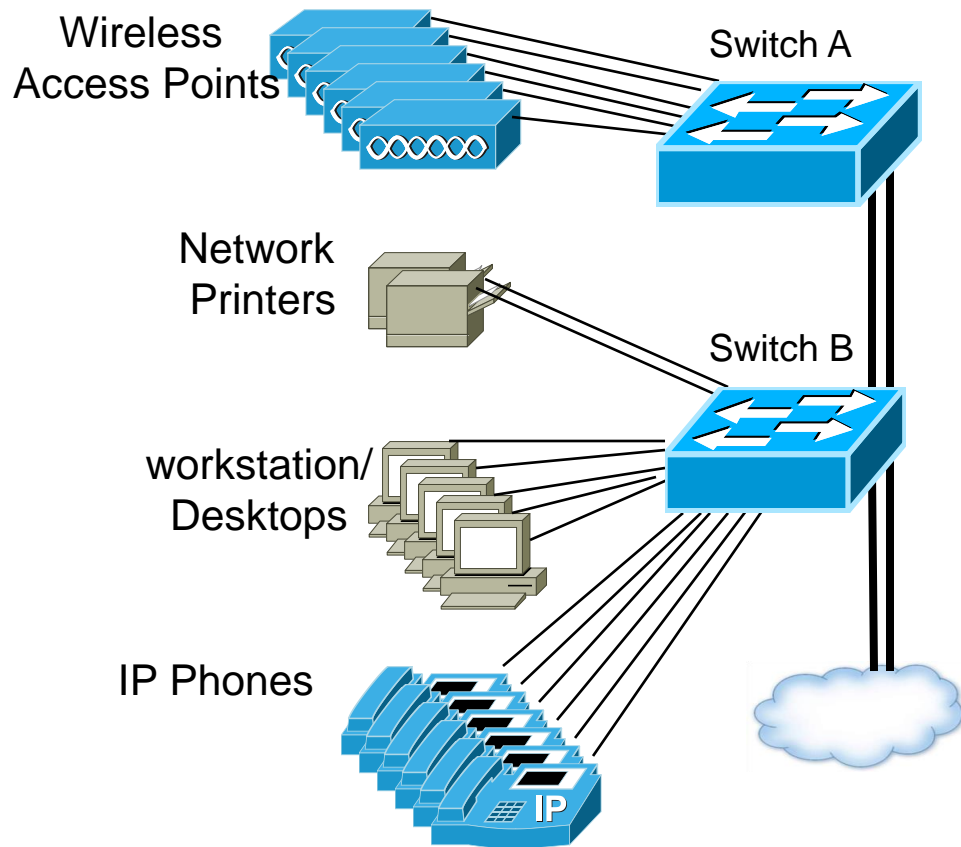
Problems?	Solutions
Manual configuration of every port - Devices move	Configuration moves with device
Wasted Ports – pre-configured dedicated interfaces and no device	Interfaces in ready state waiting for a device to attach. - More efficient use of valuable ports
Unsure how to mix multiple features together	Cisco Best Practices for mixing interface level configurations
Not knowing what is connected -Which interface has the printer?	Device classification. - What is attached on every interface

Auto Smartports – Use Case (1)



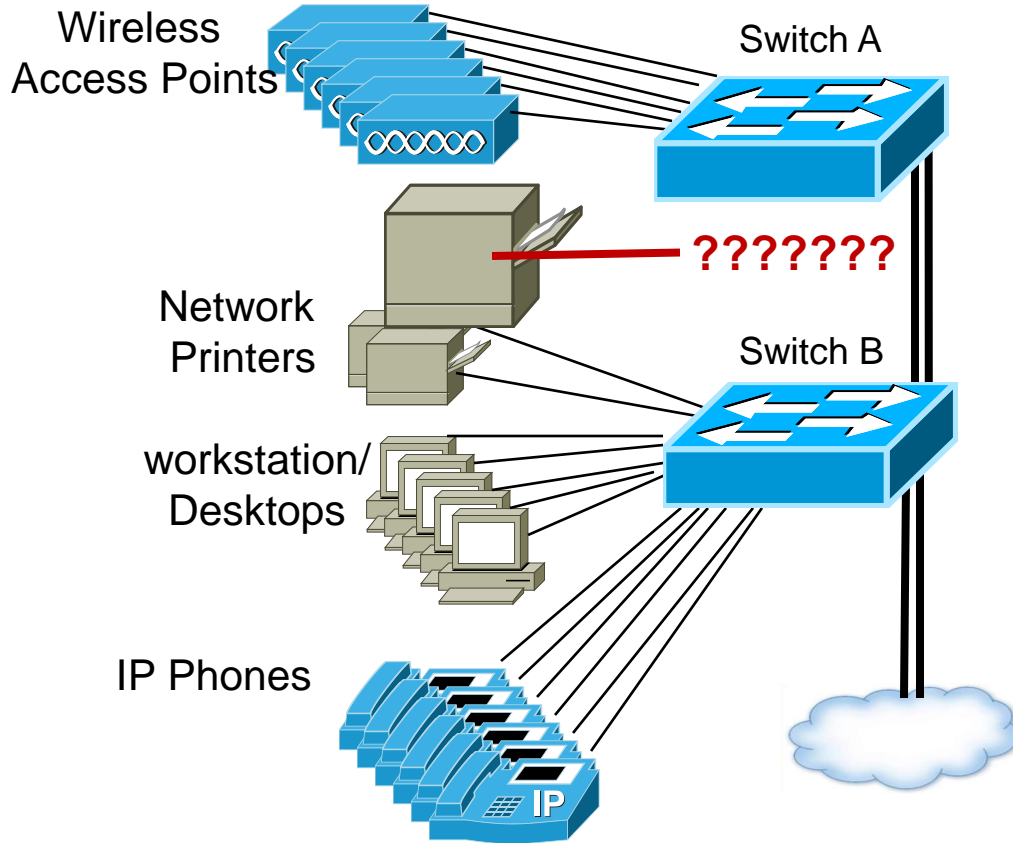
- Typical cube farm, multiple networked end devices
 - Access Point
 - Network Printers
 - IP Phones
 - Workstations/Desktops
- All networked devices connect to access layer switch(s) in IDF
- Everyone has a system/process in place to manage this.

Auto Smartports – Deployment Example(2)



- Today
 - Interface configuration is static
 - Devices bound to specific interfaces because of config
 - Access Points connect to switch A
 - Everything else connects to Switch B
 - Available ports in Switch A
- Be careful which cables connect to which switch interfaces!

Auto Smartports – Add a Printer (3)



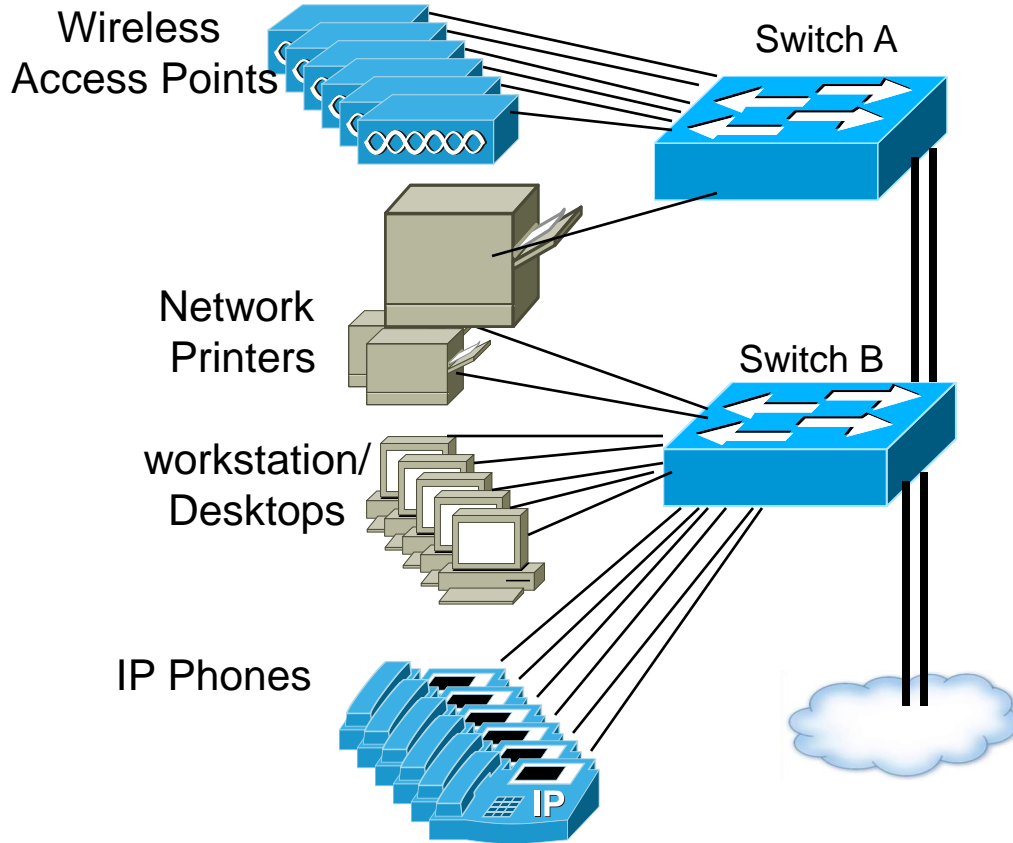
Problems:

- Cannot connect additional Printer to Switch B
 - No available interfaces on Switch B.
- Adding to Switch A creates special case
- Requires network Admin to resolve



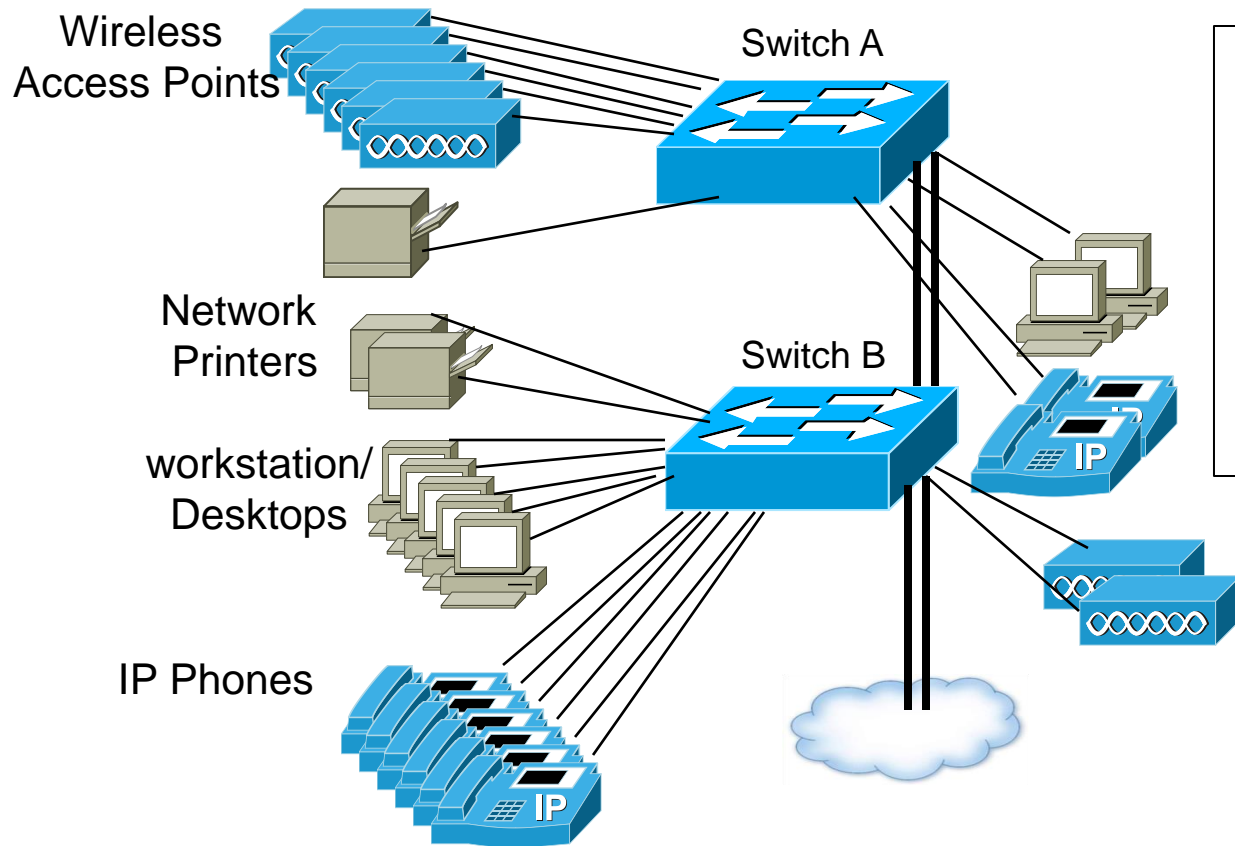
Where's the printer???

Auto Smartports – Using ASP(4)



- With Auto Smartports, No hard binding between device and Interface
- Devices connect anywhere
- IOS applies the configuration dynamically
- Configuration matches with type of device. (consistency 😊)
Things should work!

Auto Smartports – Devices Distributed(5)



- Over time, devices balance on switches in IDF
- Balance Access Points across physical switches

Auto Smartports – How it Works

1. ASP snoops incoming packets for
 - Source MAC Address
 - CDP – Cisco Discovery Protocol
 - LLDP – Link Layer Discovery Protocol
 - DHCP Discover from end device
2. Uses Above to classify Device Type
3. Device Type triggers the macro to an interface
 - Macro = set of interface level CLI commands.
 - Built-in Macro's for well known devices

Auto Smart Ports – Example How It Works Cont.

Order of events for IP Phone attachment, and configuration applied



- Attach Phone
- Power up via POE
- CDP/LLDP Exchange
- Get Voice VLAN Config
- Register with CUCM

- Phone is Attached
- Provide PoE as requested
- CDP/LLDP Exchange
- Classifies Device as IP Phone
- Apply Macro

Contents of Macro:

- Voice and Data VLAN plus QoS
- Cisco best practice for security

Auto Smart Ports – Timing

Time for IP Phone to power on and configure

```
May 4 01:55:05.645: %ILPOWER-7-DETECT: Interface Gi1/0/11: Power Device detected: IEEE PD (Stack-1)
May 4 01:55:06.836: %LINK-3-UPDOWN: Interface GigabitEthernet1/0/11, changed state to down
May 4 01:55:06.710: %ILPOWER-5-POWER_GRANTED: Interface Gi1/0/11: Power granted (Stack-1)
May 4 01:55:13.371: %LINK-3-UPDOWN: Interface GigabitEthernet1/0/11, changed state to up
May 4 01:55:14.377: %LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet1/0/11, changed state to up
May 4 01:55:29.536: %AUTOSMARTPORT-5-INSERT: Device Cisco-IP-Phone detected on interface GigabitEthernet1/0/11,
executed CISCO_PHONE_EVENT
```

PoE Device Detect:	0 – starts the process
Power granted:	1 second
Interface up:	7.7 seconds
Protocol up:	8.7 seconds
ASP configures interface:	23.8 seconds

Auto Smart Ports – Built-in Device Macros

Built in Devices with Macros

```
Switch# show macro auto device ?
```

```
access-point      Display auto configuration information for the autonomous
                  access point
ip-camera         Display auto configuration information for the video
                  surveillance camera
lightweight-ap    Display auto configuration information for the light weight
                  access point
media-player      Display auto configuration information for the digital media
                  player
phone             Display auto configuration information for the phone device
router            Display auto configuration information for the router device
switch           Display auto configuration information for the switch device
```

Macro Contents – IP PHONE

Interface Configuration of CISCO_PHONE_AUTO_SMARTPORT

Cisco Best Practices for IP Phone

Switch# show run interface Gig 1/0/6

```
interface GigabitEthernet1/0/6
  switchport access vlan 10
  switchport mode access
  switchport block unicast
  switchport voice vlan 11
  switchport port-security maximum 3
  switchport port-security maximum 2 vlan access
  switchport port-security
  switchport port-security aging time 1
  switchport port-security violation restrict
  switchport port-security aging type inactivity
  load-interval 30
  srr-queue bandwidth share 10 10 60 20
  queue-set 2
  priority-queue out
  mls qos trust device cisco-phone
  mls qos trust cos
  macro description CISCO_PHONE_EVENT
  auto qos voip cisco-phone
```

... Continued

```
storm-control broadcast level pps 1k
storm-control multicast level pps 2k
storm-control action trap
spanning-tree portfast
spanning-tree bpduguard enable
service-policy input AutoQoS-Police-
  CiscoPhone
ip dhcp snooping limit rate 15
!
```

Auto Smart Ports – Macro Contents Sample

```
Switch# show shell functions CISCO_AP_AUTO_SMARTPORT
```

```
function CISCO_AP_AUTO_SMARTPORT () {  
  if [[ $LINKUP -eq YES ]]; then  
    conf t  
      interface $INTERFACE  
        macro description $TRIGGER  
        switchport trunk encapsulation dot1q  
        switchport trunk native vlan  
$NATIVE_VLAN  
        switchport trunk allowed vlan ALL  
        switchport mode trunk  
        switchport nonegotiate  
        auto qos voip trust  
        mls qos trust cos  
        exit  
    end  
  fi  
}
```

...Continued

```
if [[ $LINKUP -eq NO ]]; then  
  conf t  
    interface $INTERFACE  
      no macro description  
      no switchport nonegotiate  
      no switchport trunk native vlan  
$NATIVE_VLAN  
      no switchport trunk allowed vlan ALL  
      no auto qos voip trust  
      no mls qos trust cos  
      if [[ $AUTH_ENABLED -eq NO ]]; then  
        no switchport mode  
        no switchport trunk encapsulation  
      fi  
    exit  
  end  
fi
```

Macro definition includes anti-macro configuration as well



Auto Smart Ports- The Basics

- Built-in Macros have default vlan id.
 - Change vlan id for built-in macros

```
Switch(config)#macro auto execute CISCO_PHONE_EVENT builtin \  
    CISCO_PHONE_AUTO_SMARTPORT VOICE_VLAN=10 ACCESS_VLAN=3  
(repeat for all devices or builtin macros)
```

- Use LAST_RESORT MACRO for Unclassified Devices
 - Applied to interface that has no matches (eg: laptops)

```
Switch(config)#macro auto global control trigger last-resort  
Switch(config)#macro auto execute CISCO_LAST_RESORT_EVENT builtin \  
    CISCO_LAST_RESORT_SMARTPORT ACCESS_VLAN=data_vlan
```

- Optionally enable Auto Smart Ports for specific devices

```
Switch(config)# macro auto global control device access-point phone mac-address
```

- Enable Auto Smart Ports – Last step

```
Switch(config)# macro auto global processing
```

Auto Smart Ports – Advanced Features

- Exclude specific Ethernet Interfaces from Auto Smart Ports

```
Switch(config)# interface Gi3/1/1  
Switch(config-if)# no macro auto processing
```

- Make Macros “sticky”
 - stick to interface regardless of port operational state, disabled by default

```
Switch(config)# macro auto sticky
```

- Use vlan names instead of numbers for Macro parameter substitution

```
macro auto device phone ACCESS_VLAN=data_vlan VOICE_VLAN=voice_vlan
```

- Access the shell (needed in newer IOS Releases)

```
Switch# term shell
```


Auto Smart Ports – What Macro has been Applied

```
Switch# show macro auto interface
```

```
Global Auto Smart Port Status
```

```
Auto Smart Ports Enabled
```

```
Fallback : CDP Disabled
```

Interface	Auto Smart Port	Fallback	Macro Description(s)
Vl1	TRUE	None	No Macro Applied
Vl10	TRUE	None	No Macro Applied
Fa0	TRUE	None	No Macro Applied
Gi1/0/1	TRUE	None	No Macro Applied
Gi1/0/2	TRUE	None	CISCO_WIRELESS_AP_EVENT
Gi1/0/3	TRUE	None	No Macro Applied
Gi1/0/4	TRUE	None	CISCO_LAST_RESORT_EVENT
Gi1/0/5	TRUE	None	HP_printer_OUI macro
Gi1/0/6	TRUE	None	CISCO_CUSTOM_EVENT
Gi1/0/7	TRUE	None	CISCO_PHONE_EVENT

```
.  
. .  
. .
```



laptop

Auto Smart Ports – Custom Device Recognition

- Custom Macro (eg: MAC OUI) for devices without built-in Macro (last_resort)

```
Switch(config)# macro auto mac-address-group Xerox_printer_OUI  
  oui list 0000AA  
  exit
```

```
Switch(config)# macro auto execute Xerox_printer_OUI {  
  if [[ $LINKUP -eq YES ]]  
  then conf t  
    interface $INTERFACE  
    <snip>  
  fi  
  if [[ $LINKUP -eq NO ]]  
  then conf t  
    interface $INTERFACE  
    <snip>  
  fi  
}
```

Auto Smart Port – Best Practices

- Change the Vlan IDs in the Macros that will be used.
- EtherChannels can be tricky, don't use with Auto Smart Ports
- Devices that do not move, don't use with Auto Smart Ports
 - Routers and Switches don't change interfaces
 - Built-in MACRO for routers and switches rarely match customer configuration

```
Switch(config)# interface GigabitEthernet 1/1/2
Switch(config-if)# description Uplink to core
Switch(config-if)# !!! Disable auto smart processing on the interface
Switch(config-if)# no macro auto processing
```

- Complete configuration before globally enabling Auto Smart Ports

Device Classifier

- Identifies Directly Attached Devices
- Uses CDP/LLDP, DHCP, and MAC OUI to analyse device types
- Enabled by Default
 - 15.0.1SE (C3750, C3560, C2960) Summer 2011
 - 3.3.0SG (4500E Sup7) & 15.1.1SG (4500E Sup6)

```
Switch> show macro auto monitor device
```

```
Summary:
```

MAC_Address	Port_Id	Profile Name	Device Name
0019.553f.bf40	Gi1/0/1	Cisco-Device	CISCO SYSTEMS
0019.553f.bf01	Gi1/0/1	Cisco-Switch	cisco WS-C3560-8PC
0012.0198.8e86	Gi3/0/1	Cisco-Switch	cisco WS-C3750-48TS
001a.80e1.7a4e	Gi1/0/4	Un-Classified Device	MSFT 5.0
0012.80ad.71fe	Gi1/0/2	Cisco-AIR-AP-1130	cisco AIR-AP1131AG-N-K9
0001.e601.3499	Gi1/0/5	HP-JetDirect-Printer	Hewlett-Packard JetDirect
000f.20c6.843c	Gi1/0/9	HP-Device	HEWLETT-PACKARD COMPANY
04fe.7f69.38ee	Gi1/0/7	Cisco-IP-Phone-7975	Cisco Systems, Inc. IP Phone CP-7975G

laptop

Fixing Unclassified Devices – Trigger Device Name

- Device is not classified properly
- Even though device should be classified.

```
Switch# sho macro auto monitor device detail
DC default profile file version supported = 1
```

Detail:

MAC_Address	Port_Id	Cert	Parent	Proto	ProfileType	Profile Name	Device_Name
f0f7.55ae.b500	Gi1/0/22	0	0	C D M	Unknown	Un-Classified Device	cisco AIR-CAP3602I-N-K9

Fixing Unclassified Devices – Trigger Device Name (2)

- Get full CDP name

3 spaces after name
Caused classify to fail

```
Switch#show cdp neighbor detail
-----
Device ID: APf0f7.5519.944e
Entry address(es):
Platform: cisco AIR-CAP3502E-A-K9 , Capabilities: Trans-Bridge
Interface: GigabitEthernet2/0/4, Port ID (outgoing port): GigabitEthernet0
Holdtime : 139 sec
```

- Create trigger for Device 'CISCO_AP', match on reported CDP name
 - After 'device' key word, enter exactly as it appears above
 - "XXX" is for the spaces after the name. You must add those

```
Switch#configure term
Switch(config)#
macro auto trigger CISCO_AP
  device cisco AIR-CAP3502E-A-K9XXX
  exit
Switch(config)# macro auto execute CISCO_AP builtin CISCO_AP_AUTO_SMARTPORT
```

Auto Smart Ports Use Case

- Requirement:
 - Automatically configure IP Cameras and Access points
- Strategy
 - ASP only for uncommon devices (IP Camera and Access Points)
 - Default for IP Phone with Desktop
- Override built-in macro for IP Camera, and Access Points

Auto Smart Ports Use Case - Configuration

```
!-----  
! Default Interface Config  
!-----  
!  
spanning-tree portfast default  
spanning-tree portfast bpduguard default  
!  
interface range GigabitEthernet1/0/1-48  
  switchport access vlan 100  
  switchport mode access  
  switchport voice vlan 400  
  no logging event link-status  
  srr-queue bandwidth share 1 65 10 25  
  srr-queue bandwidth shape 20 0 0 0  
  priority-queue out  
  service-policy input POLICE-MARK-DSCP  
!
```

```
!-----  
! Override built-in LWAP Macro  
!-----  
!  
macro auto execute CISCO_WIRELESS_LIGHTWEIGHT_AP_EVENT {  
  if [[ $LINKUP -eq YES ]]; then  
    conf t  
      interface $INTERFACE  
        macro description $TRIGGER  
        logging event link-status  
        switchport access vlan 300  
        no switchport voice vlan 400  
        no service-policy input POLICE-MARK-DSCP  
        mls qos trust dscp  
      exit  
    end  
  fi  
  if [[ $LINKUP -eq NO ]]; then  
    conf t  
      interface $INTERFACE  
        no macro description $TRIGGER  
        switchport access vlan 100  
        switchport voice vlan 400  
        no mls qos trust dscp  
        service-policy input POLICE-MARK-DSCP  
        no logging event link-status  
      exit  
    end  
  fi  
}
```


Auto Smart Ports Use Case – Configuration (2)

```
!-----  
! Override built-in DMP Macro  
!-----  
!  
macro auto mac-address-group DMP_EVENT  
  oui list 000180  
macro auto execute DMP_EVENT {  
  if [[ $LINKUP -eq YES ]]; then  
    conf t  
      interface $INTERFACE  
        macro description $TRIGGER  
        switchport access vlan 250  
        no switchport voice vlan 400  
        logging event link-status  
      exit  
    end  
  fi  
  if [[ $LINKUP -eq NO ]]; then  
    conf t  
      interface $INTERFACE  
        no macro description $TRIGGER  
        switchport access vlan 100  
        switchport voice vlan 400  
        no logging event link-status  
      exit  
    end  
  fi  
}
```

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```
!-----  
! Override built-in security Camera Macro  
!-----  
!  
macro auto mac-address-group SEC_CAM_EVENT  
  oui list 78843c  
macro auto execute SEC_CAM_EVENT {  
  if [[ $LINKUP -eq YES ]]; then  
    conf t  
      interface $INTERFACE  
        macro description $TRIGGER  
        switchport access vlan 500  
        no switchport voice vlan 400  
        logging event link-status  
      exit  
    end  
  fi  
  if [[ $LINKUP -eq NO ]]; then  
    conf t  
      interface $INTERFACE  
        no macro description $TRIGGER  
        switchport access vlan 100  
        switchport voice vlan 400  
        no logging event link-status  
      exit  
    end  
  fi  
}
```

Auto Smart Ports Use Case – Configuration (3)

```
!-----  
! Global and other ASP configuration  
!-----  
!-----  
! Disable macros on Uplink Interfaces  
!-----  
!  
interface range Te1/1/1-2  
  no macro auto processing  
!  
!-----  
! Auto SmartPort Global Config  
!-----  
!  
! Disable all auto macros except LWAP and anything that references a MAC Address  
macro auto global control device lightweight-ap mac-address  
!  
! Disable the last-resort trigger  
no macro auto global control trigger last-resort  
!  
! Enable auto-smartports globally  
macro auto global processing
```

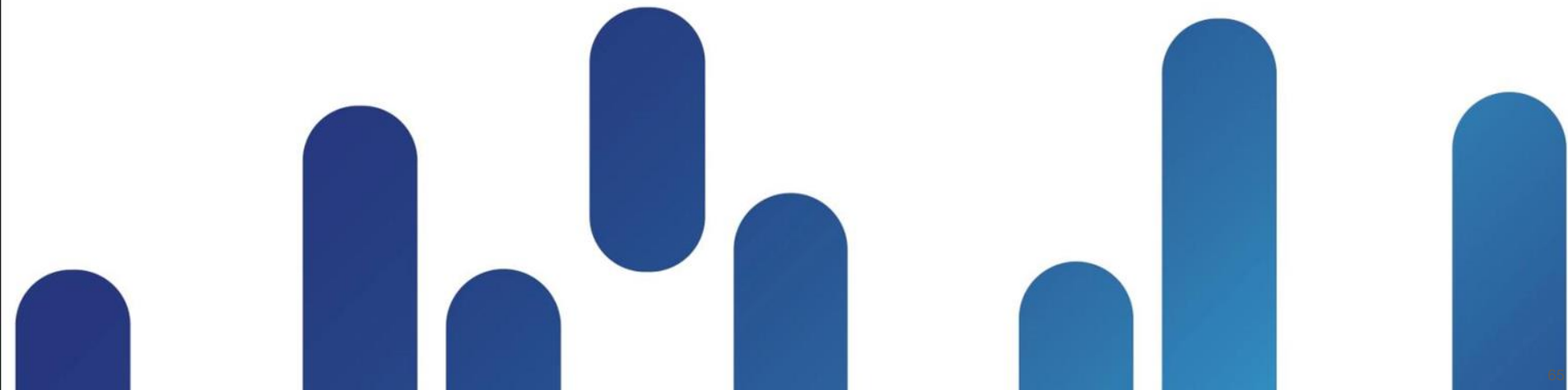
Auto Smart Ports – Summary

Main Concepts Of Auto Smart Ports

- “Auto Smartports: dynamically configures Ethernet ports based on the device type detected”
- ASP uses Device MAC, CDP/LLDP, DHCP options to detect device type
- Built-In Macros for known devices
 - Based on best practices
- Extendable for more devices

Questions?

Up Next : Embedded Event Management (EEM)



Agenda

- Context – Why Smart Operations?
- Smart Install
- Auto Smartports
- **EEM**
 - Feature overview
 - Basic concepts
 - Script format options
 - Use Cases
 - Applet solution
 - Tcl Policy Solution



What is Embedded Event Manager (EEM)?

- Flexible and Powerful tool within Cisco IOS Software
- Takes action on user enabled system events
- Events trigger the execution of user defined set of actions
 - User defined actions written in CLI or Tool Command Language (Tcl)
- Consistent behaviour across Catalyst switches and Cisco Routers
- EEM: Catalyst switches with IP Base feature set and above



Embedded Event Manager Benefits

- Automate operational activities done manually
- Change the behaviour of Catalyst Switch or Cisco Router
 - Customise switch or router behaviour
 - Automatically apply workarounds (aka Fix bugs)
 - Change configuration dynamically
- Notify network admin on event
 - Eg: Send email on temperature threshold crossing

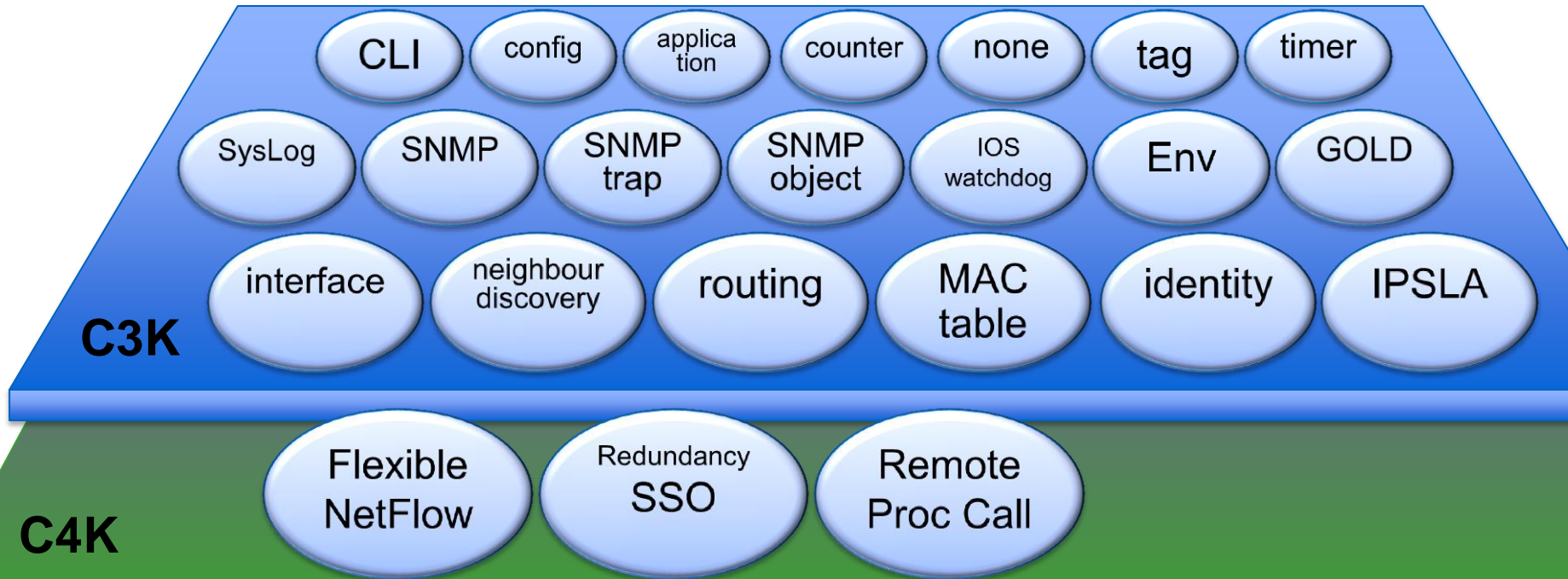
Why use Embedded Event Manager

Do You Read syslog msgs Regularly???

- EEM can read syslog msgs for you.
- EEM can perform actions for you
- You don't have to read syslogs!

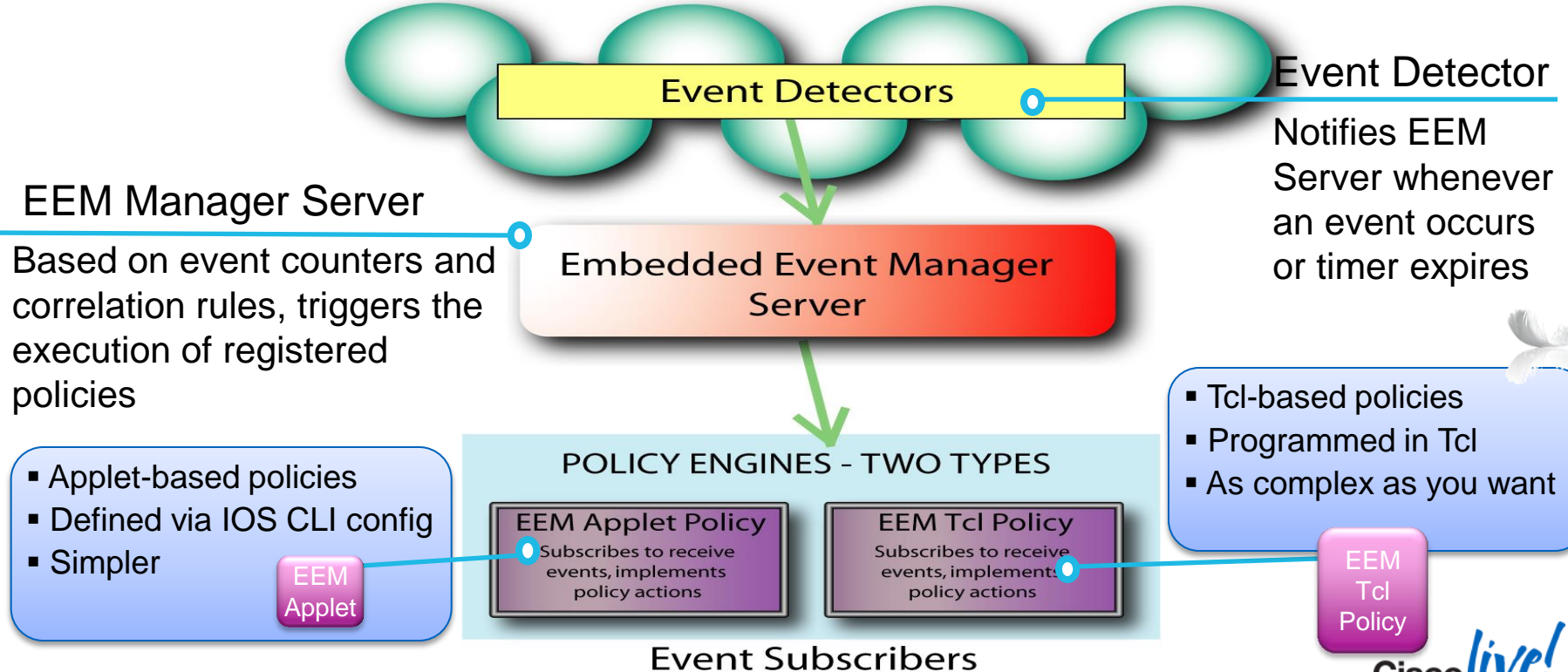
Embedded Event Manager

Event Detectors Supported



EEM Event Detectors and EEM Policies

All of this is internal to Cisco IOS



EEM –Native Vlan Mismatch Use Case(1)

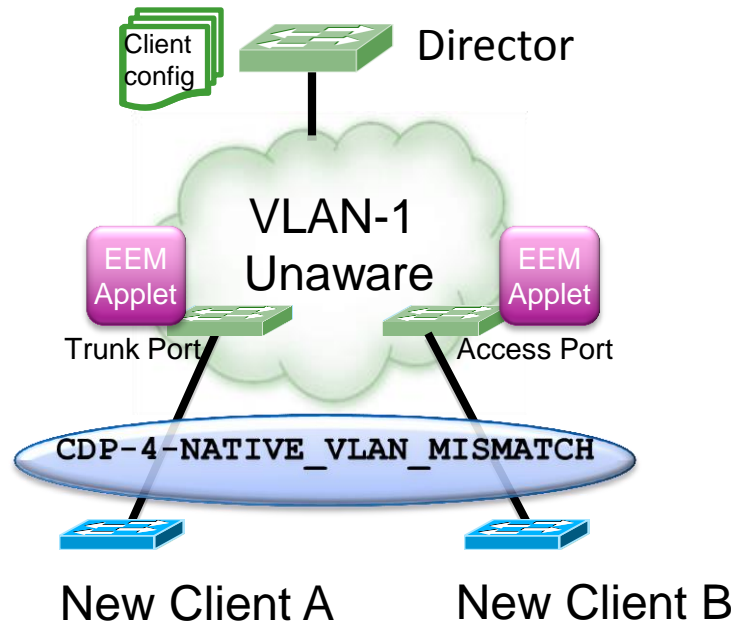
Smartinstall Limitation Workaround

- **Problem:** Native Vlan Mismatch blocks new client from SmartInstall
- **Solution:** EEM script changes Interface level configuration to match client
- EEM triggered by syslog msg
 - “CDP-4-NATIVE_VLAN_MISMATCH”
- EEM solution uses Applet Policy
 - As opposed to TCL Policy

EEM – Native Vlan Mismatch Use Case(2)

Potential Smartinstall Limitation Workaround

- Smart Install requires VLAN 1 continuity from Director to clients
- New client switches require VLAN 1
- CDP VLAN Mismatch SysLog event
 - EEM on Aggregation switch detects
 - EEM Applet temporarily enables VLAN 1 on that port
- Same applet re-establishes correct VLAN ID after new client Install



EEM SFP Removal

Interface Level SFP Configuration

- **Problem:** On SFP transceiver removal, IOS removes SFP interface level configuration
 - Desired behaviour is interface level configuration remains
 - Interface speed and duplex configuration is saved in “startup-config”
- **Solution:** Use EEM to detect SFP insertion, and reapply desired interface level SFP configuration
- EEM triggered by syslog msg
 - “%LINK-3-UPDOWN”
- EEM solution uses Tcl Policy
 - As opposed to an Applet

EEM SFP Removal

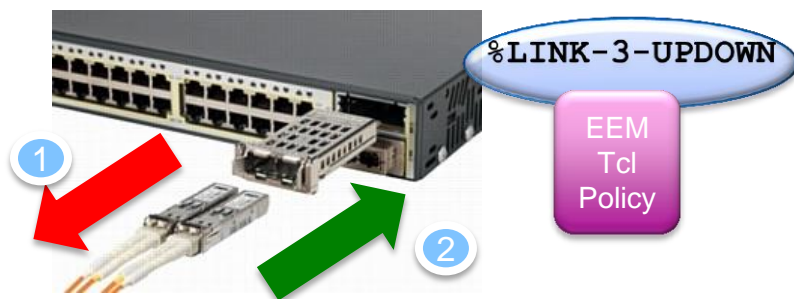
Interface Level SFP Configuration

- Speed and Duplex configurations lost on SFP removal
 - 1000 Base-T (copper) and 100 Base-FX SFPs have embedded PHYs
- ① ▪ Interface speed & duplex cleared SFP removal
- ② ▪ SFP insertion, speed & duplex configuration is not recovered

LinkUpApplyConfig.tcl can be downloaded at the following hyperlink:

<https://supportforums.cisco.com/docs/DOC-23267>

- LinkUpApplyConfig Tcl policy that monitors SFP link-up event



- Speed and duplex config automatically re-applied to SFP interface

EEM Tcl Policy

LinkUpApplyConfig Script Walkthrough: Body of Script

- Retrieve event details:
 - Check the event is related to a physical interface
- Compliance with environment variables
 - Check the event is related to a selected SFP (example only 100 BaseFX media type)
 - Retrieve interface startup-config commands that comply with desired commands (example only speed settings)
- Apply the selected startup-config commands to the interface
- Raise a SysLog event to track script completion

LinkUpApplyConfig.tcl can be downloaded at the following hyperlink:

<https://supportforums.cisco.com/docs/DOC-23267>

EEM with Flexible NetFlow

[REFERENCE]

Problem: CPU processing required to respond to packets with TTL values of one or less.

- (using TTL-exceeded packets)

Cannot forward a packet with a TTL value Less than one.

Results in a Denial of Service attack

- NetFlow Counters available for EEM
- E.g. look for packets with Time To Live (TTL) less than or equal to 1.
- EEM can also be configured to start a wireshark capture



Flexible NetFlow Configuration

```
flow record ttl
  match ipv4 ttl
  match ipv4 source address
  match ipv4 destination address
  collect counter bytes
  collect counter packets
  collect timestamp sys-uptime first
  collect timestamp sys-uptime last
flow monitor ttl
  record ttl
  cache timeout inactive 20
  cache timeout active 30
interface GigabitEthernet8/47
  switchport access vlan 50
  switchport mode access
  ip flow monitor ttl input
```

EEM Configuration

```
event manager applet ttl
  event nf monitor-name "ttl" event-type create event1 entry-
value "2" field ipv4 ttl entry-op lt

  action 1.0 syslog msg "TTL=1 frames from $_nf_source_address to
$_nf_dest_address detected."

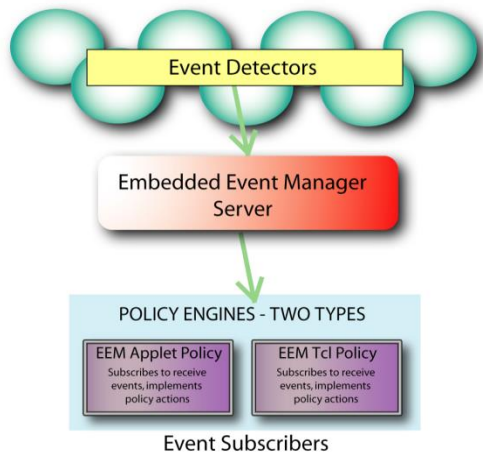
action 2.6 cli command "conf t"
action 2.7 cli command "int gi 2/2"
action 2.8 cli command "shut"
```


EEM with Flexible NetFlow - actions

REFERENCE

Example:

```
action 1.0 syslog msg "flow record with low TTL"
```



Reload the system

Run a pre-registered policy

Execute a CLI command

Modify a counter value

Force a software switchover

Foreach loop, if condition, else condition

Gets line of input from active tty

Set/Increment/decrement a variable

Obtain system specific info

Send an email

Publish an application specific event

Puts data to active tty

Regular expression match

Specify value for the SNMP get request

Send an SNMP trap

String commands

Log a syslog message

Read/set a tracking object

While loop

Wait for a specified amount of time

More customised requirement can be done through Tcl scripts

Embedded Event Manager

Applet vs. Tcl Policy



- EEM Applet
- Easier programming language
- Can be seen as part of the switch config and modified/tweaked online
- Limited regexp capabilities
- If goal is too complex can become cumbersome



- All Tcl built-in powerful functionalities
- Expandable with existing libraries
- Better for complex solutions

Cisco Beyond - Product Extension Community

EEM Scripting Community

- Open source: scripts, share, upload, download, learn by example
- Categories include: Ntwk mgmt., Diagnostics, Routing, QoS, High availability, User interface, Security etc.
- Comments, ratings, community managed forum

Cisco Systems: Embedded Event Manager (EEM) Scripting Community - Mozilla Firefox

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Embedded Event Manager (EEM) Scripting Community

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EEM is a flexible system designed to customize IOS

Automate tasks, perform minor enhancements and create workarounds. Develop and run scripts in your own environment, program your own custom address entries Tel and share your scripts with others by uploading them here. Download examples and useful scripts submitted by others for customization and use in your environment

2-View Usage Guidelines

What's New?

[Cisco IOS Service Diagnostics](#)
Automated and programmable isolation of common network problems

[Cisco IOS Diagnostic Tools for Commercial](#)
Easy-to-use tools for Small to Medium-sized Networks

Featured Script

[Cisco IOS Diagnostic Tools for Commercial - WAN Load Alarm](#)
Tel script sends an alert via syslog and email if the WAN link specified exceeds a specified load (wan_load_threshold) for more than a specified duration of time (wan_load_duration). This script takes samples of the rload/inload in the output of 'show interfaces' at specified intervals (wan_load_interval) to calculate the overall average of each over the specified duration (wan_load_duration)

Browse Scripts

Diagnostics - Scripts in this category pertain to the simplification and automation of network operations. Examples include diagnostics from any location, monitoring configuration changes on the router, proactively detecting and capturing common and transient errors, and in some cases, proactively recommended action to isolate the problem.

Network Management - Scripts in this category pertain to network and systems management. Examples include monitoring vital signs, checking for errors, and reacting to general fault conditions.

Capacity Planning - Includes data collection scripts used primarily to perform capacity planning and historical data analysis.

Routing - Scripts in this category pertain to routing protocol analysis, error detection, neighbor relationships, etc.

QoS - Scripts in this category relate to traffic analysis and classification.

High Availability - Includes scripts that seek to increased availability and involve dual route processors, NSF/SSO, and switchover actions.

User Interface - These scripts involve command simplification, user interfaces, multiple command output formatting and presentation.

Security - These scripts involve improving device and system security using automatic or periodic monitors, threat detection, and automated actions.

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Related Links

[Cisco IOS Embedded Event Manager Version 2.4 Expanded Capabilities and User Interface](#)

[Cisco IOS Service Diagnostics](#)

[Cisco IOS Service Diagnostics: Border Gateway Protocol Open Shortest Path First and Quality of Service Support](#)

[User Guide](#)

[Cisco IOS Diagnostic Tools for Commercial](#)

[The Benefits of Automation Using Limited-Event Manager Presentation](#)

[Cisco IOS EEM 2.1.3, Release 12.1U\(4\)49 Documentation](#)

[Cisco IOS EEM Home Page](#)

[Cisco IOS EEM Product Literature](#)

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<http://cisco.com/go/ciscobeyond>

Other EEM Support Resources

- EEM Cisco.com web site:
<http://www.cisco.com/go/eem>
- NetPro Forum
(<http://forum.cisco.com/eforum/servlet/NetProf?page=main>)
- Search the forum for EEM related discussions
- Post your question to get answer from EEM experts
- Email
askabouteem@cisco.com

The screenshot shows the Cisco NetPro Forum homepage. The browser title is "Cisco Systems: Networking Professionals Connection - Mozilla Firefox". The address bar shows the URL <http://forum.cisco.com/eforum/servlet/NetProf?page=main>. The page features a navigation menu with tabs for Solutions, Products & Services, Ordering, Support, Training & Events, and Partner Central. The main content area is titled "Networking Professionals Connection NetPro" and includes a "Join the Discussion" section with a description: "This is the gathering place for Networking Professionals to share questions, suggestions, and information about networking solutions, products, and technologies." Below this, there are several categorized links for discussion topics, including Network Infrastructure, Unified Communications and Video, Career Certifications, Wireless - Mobility, Service Providers, Data Center, and Idea Center. The right sidebar contains a "Forum Log in" section with fields for User Name and Password, a "Receive Newsletter" section, a "Cisco Wiki" section, and a "Member Product Reviews" section featuring a review for the Cisco Aironet 1300 Series Outdoor Access Point/Bridge.

Embedded Event Manager – Summary

- Built-in in IOS
- Dynamic problem solving
- Take action: Don't wait for next IOS release
- Manageable Learning Curve – Support and Examples online
- Different Scripting Options, for simple and complex scenarios
- Questions ???



Smart Operations Summary

- Smart Operations –tools available in IOS today
- Smart Install – automate the process of installing switches
- Auto Smartports – Device based automated configuratoin
- EEM –event based dynamic network configuration
- Questions?



Smart Operations: Automates the trivial and repetitive tasks

Where can you use more Automation?



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CISCO TM



Backup

vstack Commands

show vstack status – State of all managed Clients

```
2901_Director#
2901_Director#
2901_Director#
2901_Director#
2901_Director#
2901_Director#
2901_Director#
2901_Director#
2901_Director#
2901_Director#show vstack status
Device Status:  ACT - Active          INA - Inactive      PND - Pending Update
                  HLD - On-hold       DNY - Denied        NSI - Non Smart Install
Image Upgrade:   i - in progress      I - done            X - failed
Config Upgrade:  c - in progress      C - done            x - failed
Director Database:
DevNo  MAC Address          Product-ID          IP_addr            Hostname           Status
=====
0      0026.cb27.6f58       CISCO2901/K9       15.15.15.15       2901_Direc        Director
1      9c4e.207c.1800       WS-C2960G-8TC-L    1.1.1.3           2960G_temp        ACT I C
2      9c4e.2059.f680       WS-C2960G-8TC-L    1.1.1.2           2960_Sales        ACT I C
3      0015.c6e8.6480       WS-C3750G-16TD     1.1.1.4           C3750G            ACT I C
4      9c4e.2082.d280       WS-C2960G-8TC-L    1.1.1.5           Switch            ACT i C
2901_Director#
```

Connected 2:47:15

VT100

9600 8-N-1

SCROLL

CAPS

NUM

Capture

Print echo

Simple Smart Install Configuration Example on Catalyst Switch (1/2)

1) Enable Smart Install on the Director

```
Director# config terminal  
Director(config)# vstack director 10.0.0.33  
Director(config)# vstack basic
```

2) Configure the DHCP scope for Smart Install Client switches: (OPTIONAL)

```
Director(config)# vstack dhcp-localserver pool1  
Director(config-vstack-dhcp)# address-pool 10.0.1.0 255.255.255.0  
Director(config-vstack-dhcp)# default-router 10.0.0.33  
Director(config-vstack-dhcp)# file-server 10.0.0.33  
Director(config-vstack-dhcp)# exit  
Director(config)# ip dhcp remember  
Director(config)# end
```

Simple Smart Install Configuration Example on Catalyst Switch (2/2)

3) Configure the **default** image and configuration :

```
Director# config terminal  
Director(config)# vstack image flash:c2960-lanbase-tar.122-53SE.tar  
Director(config)# vstack configuration  
flash:2960lanbase_configuration.txt  
Director(config)# end
```

Power on the Brand new switch or
Do “**write erase**” on client switch and reload

!!! Do not touch console on client!!!!

Smart Install Config Example (1)

```
!!! Using Vlan 1. The Director layer 3 interface.
interface Vlan1
  ip address 10.20.244.254 255.255.255.0
  !
ip classless
ip route 0.0.0.0 0.0.0.0 10.20.244.1
ip http server
ip http secure-server
!
!!!! Match on Where the client connects into the Director Network
vstack group custom conn-stack1 connectivity
  image tftp://10.20.244.68/Imagelists/c3750e-universalk9-tar.122-58.SE1.tar
  config tftp://10.20.244.68/Imagelists/3750e-172-config.txt
  match host 10.20.244.254 interface GigabitEthernet1/0/2
  !
!!!!! Match on the Product ID (not built in)
vstack group custom IE-3000-4TC product-id
  image tftp://10.20.244.68/Imagelists/ies-ip-servicesk9-tar.122-58.0.66.SE1.tar
  config tftp://10.20.244.68/Imagelists/IE_config.txt
  match IE-3000-4TC
```

Match Statement

Match Statement

Sample(2)

```
!  
!!!! Built in group, no explicit match statement required  
vstack group built-in 2960 24poe  
  image tftp://172.20.244.68/Imagelists/c2960-lanbasek9-tar.122-58.SE1.tar  
  config tftp://172.20.244.68/Imagelists/2960-172config.txt  
!  
vstack group built-in 2960 24poe-lanlite  
  image tftp://172.20.244.68/Imagelists/c2960-lanlitek9-tar.122-58.SE1.tar  
  config tftp://172.20.244.68/Imagelists/2960-172config.txt  
!  
!!!! Director acting as DHCP Server for Clients  
!!!! Smart Install Director DHCP Server needs its own pool.  
vstack dhcp-localserver pool172  
  address-pool 172.20.244.0 255.255.255.0  
  file-server 172.20.244.68  
  default-router 172.20.244.254  
!  
!!!!!!! These next two enable SmartInstall called "vstack"  
vstack director 172.20.244.254  
vstack basic
```



Configure Vstack
DHCP Pool



Turn Vstack On!!!

Port Configuration Change Details

Current CVD recommendation

```
interface Port-channel101
description TO new client switches
switchport
switchport trunk encapsulation dot1q
switchport trunk native vlan 4001
switchport trunk allowed vlan 2-17,4093
switchport mode trunk
logging event link-status
logging event bundle-status
```



Change to..

```
interface Port-channel101
description TO new client switches
switchport
switchport trunk encapsulation dot1q
switchport access vlan 4093
!! VLAN 4093 is Smart Install VLAN !!
switchport trunk native vlan 4001
switchport trunk allowed vlan 2-17,4093
switchport mode trunk
```

- Configuration changes applicable to physical ports as well
- With new configuration, the client switch negotiates the mode to 'access' and gets IP on the access vlan
- Smart Install works as before without vlan 1 being enabled on the Director and other switches
- Tested in the SBA and UABU TME lab and it works as expected.

Auto Smart Port – Operational Change

From this

- Switch(config)# interface range Fa0/1 - 24
- description IP Phone Connection
- switchport access vlan 3
- switchport mode access
- switchport voice vlan 10
- switchport port-security maximum 3
- switchport port-security maximum 2 vlan access
- switchport port-security
- switchport port-security aging time 1
- switchport port-security violation restrict
- switchport port-security aging type inactivity
- load-interval 30
- auto qos voip cisco-phone
- storm-control broadcast level pps 1k
- storm-control multicast level pps 2k
- storm-control action trap
- spanning-tree portfast
- spanning-tree bpduguard enable
- ip dhcp snooping limit rate 15

To this

```
# macro auto global processing
#
# macro auto execute CISCO_PHONE_EVENT \
builtin CISCO_PHONE_AUTO_SMARTPORT \
ACCESS_VLAN=3 VOICE_VLAN=10
```

Auto Smart Ports – Built in Macros

- Built-in Macros
 - CISCO_AP_AUTO_SMARTPORT
 - CISCO_DMP_AUTO_SMARTPORT
 - CISCO_IP_CAMERA_AUTO_SMARTPORT
 - CISCO_LWAP_AUTO_SMARTPORT
 - CISCO_PHONE_AUTO_SMARTPORT
 - CISCO_ROUTER_AUTO_SMARTPORT
 - CISCO_SWITCH_AUTO_SMARTPORT
- Built-in Triggers
 - CISCO_DMP_EVENT
 - CISCO_IPVSC_EVENT
 - CISCO_PHONE_EVENT
 - CISCO_ROUTER_EVENT
 - CISCO_SWITCH_EVENT
 - CISCO_WIRELESS_AP_EVENT
 - CISCO_WIRELESS_LIGHTWEIGHT_AP_EVENT

Auto Smart Ports - Terms and Definitions

- **macro:**
 - Set of configuration commands referred as a single unit.
- **event:**
 - That which can cause an action where action here could be application of a macro on an interface. e.g.: CDP or LLDP based device detection.
- **trigger:**
 - Identifiers used to map the events to macros.
 - The trigger could be user-defined or built-in.
 - eg: Switch discovering a device through CDP is an event, which will result in a built-in CISCO_SWITCH_EVENT trigger.
 - Invoking this trigger results in execution of the mapped function or macro.
- **mapping:**
 - Refers to a linkage established between a trigger and a macro.
 - The mapping could be a built-in or user-defined.
- **OUI:** *Organisationally Unique Identifier* , which is the upper 3 bytes of the 6 byte mac-address.

Auto Smart Ports – MAC Based Macro

- Use MAC OUI for low intelligence devices (eg: printers, cameras, ...)

```
Switch(config)# macro auto mac-address-group Xerox_printer_OUI
oui list 0000AA
exit
```

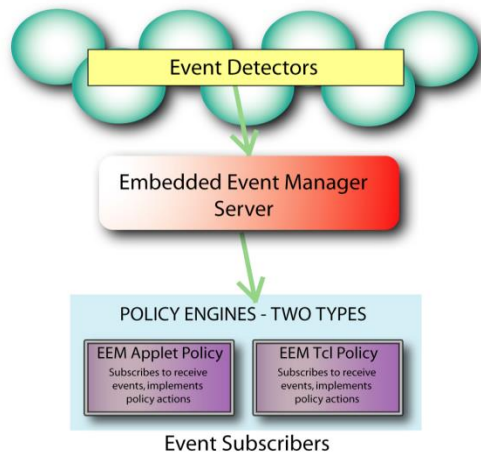
```
Switch(config)#macro auto execute Xerox_printer_OUI {
if [[ $LINKUP -eq YES ]]
then conf t
interface $INTERFACE
description HP_printer_OUI macro
switchport
switchport mode access
switchport access vlan data_vlan
spanning-tree portfast
exit
end
fi
if [[ $LINKUP -eq NO ]]
then conf t
interface $INTERFACE
switchport access vlan data_vlan
no spanning-tree portfast
no description
exit
end
fi
}
```

EEM with Flexible NetFlow

REFERENCE

Example:

```
Switch#event manager applet test
  event nf monitor-name "test" event-type update event1 entry-value "1000" field counter bytes
  rate-interval 15 entry-op gt event2 entry-value "192.168.1.1" field ipv4 destination address
  entry-op eq
```



IPv4	IPv6	Datalink
Destination IP addr	Destination IP addr	dot1q
DSCP	DSCP	Source MAC address
Precedence	Flow-label	Destination MAC address
Protocol	Hop-limit	Counter
Source IP address	Next-header	Bytes
ToS	Precedence	Packets
Total-length	Protocol	
TTL	Source IP address	
	Traffic-class	



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