FabricPath Frame Encapsulation

Endnode ID (5:0)	U/L	I/G	Endnode ID (7:6)	RSVD	OOO/DL	Switch ID	Sub Switch ID	LID (Port ID)		Etype 0x8903	Ftag	TTL
6 bits	1	1	2 bits	1	1	12 bits	8 bits	16 bits		16 bits	10 bits	6 bits

Outer DA	Outer SA	FP Tag	DMAC	SMAC	802.1Q	Etype	Payload	CRC (New)
6 bytes	6 bytes	4 bytes						

Cisco FabricPath Frame

DMAC	SMAC	802.1Q	Etype	Payload	CRC
6 bytes	6 bytes	4 bytes	2 bytes	46~9000 bytes	4 bytes

Classical Ethernet Frame
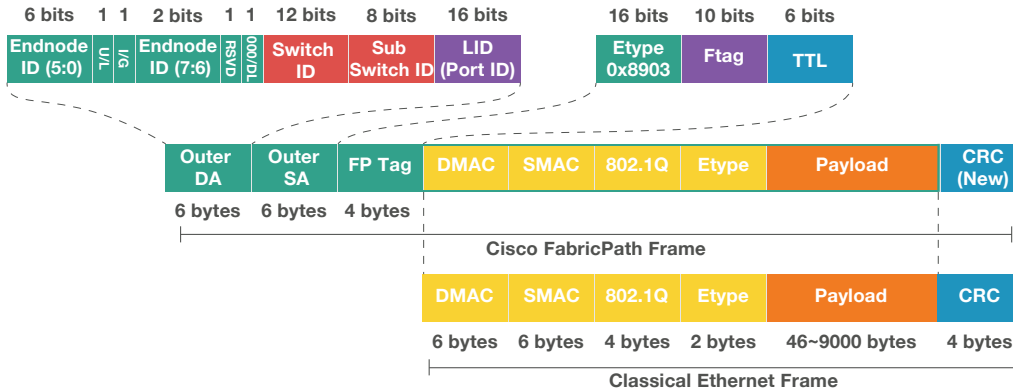
Switch ID: 12 bit switch ID uniquely identifies every switch in the FabricPath domain

Sub-Switch ID: Identifies vPC+ port-channel interface associated to vPC+ switch pair

LID: exact port which the frame is sourced/destined; avoid MAC learning for core ports

Ftag: identifying topology/distribution tree (multicast,broadcast & unknown unicast)

EType & TTL: 0x8903 identifies fabricpath frame & TTL is frame hop limit (default : 32)

Wireshark Display Filter

Eth.type 0x8903

cfp.d_hmac Destination HMAC

cfp.d_hmac_mc MC Destination

cfp.eid End Node ID

cfp.ftag FTAG

cfp.ig I/G bit

cfp.lid Source LID

cfp.ooodl OOO/DL Bit

cfp.s_hmac Source HMAC

cfp.sswid sub-switch-id

cfp.swid switch-id

cfp.ttl TTL

cfp.ul U/L bit

Layer 2 Multi Pathing

	Standard	Frame Routing (ECMP,TTL, RPF)	A/A FHRP Anycast HSRP vPC+	Multiple Topology & Conversational Learning	STP domain interaction	Inter-switch links
TRILL	RFC 5556,6325	Yes	No	No	Integrated	P2P or Shared
Fabric Path	Cisco	Yes	Yes	Yes	Isolated	P2P only

Terminology

Classical Ethernet (CE) Regular ethernet with flooding & STP

**Leaf Switch** Connect CE domain to FP domain; Ports in CE & FP

Spine Switch FP backbone switch with all ports in FP domain only

**CE Edge Port** Send/receive ethernet frames, stp & mac learning

FP Core Ports Send/receive FP frame, no stp & mac learning

Conversational MAC Address Learning core switches generally do not learn any MAC addresses at all;
Edge switch only learn the MAC of remote hosts when there are two way communications between remote hosts and local hosts. Provide Layer 2 scaling & Optimization of control plane

Conversational Learning
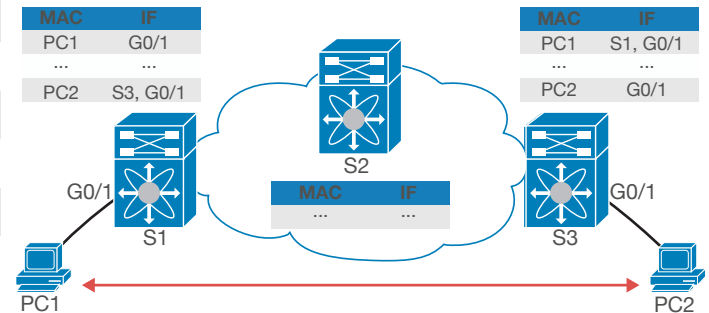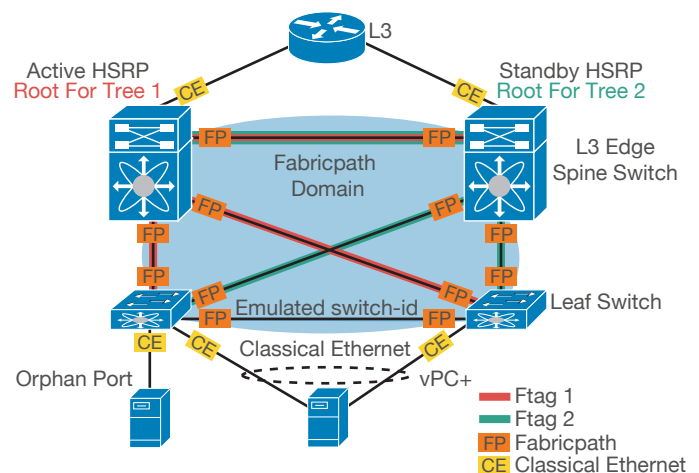
Fabricpath Configuration

```
# Install and enable feature (require license)
install feature-set fabricpath
feature-set fabricpath

# Set the switch ID (should be unique number)
fabricpath switch-id 10

# turn the port on and convert the vlan to FP
interface ethernet 1/1 - 4
   switchport mode fabricpath
vlan 10
   mode fabricpath
```

Fabricpath Design

CloudPacket.net

FabricPath Unicast - Control Plane

Routing table IS-IS learn switch IDs(SIDs) & build routing table

Multidestination trees IS-IS elects the switch as a root and build multidestination forwarding trees

FabricPath Unicast - Data Plane

MAC table Hardware perform MAC table lookup for destination fabricpath switch(unicast) or to identify multidestination frames

Switch table Hardware perform destination switch IDs(SID) lookup to forward unicast frames to other switches

Multidestination table Hardware selects multidestination tree to forward multidestination frames through fabricpath network

Unicast Forwarding

Unicast frame forwarding use mac address & switch id table base on switch role

FP Ingress Switch After reciving the CE frame ,switch will lookup for destination mac and find associated SID in mac address table, and use switch id table to find nexthop switch

FP Core Switch FP core lookup for destination SID in switch id table and find the next hop interface toward egress switch

FP Egress Switch Lookup for switch id table and forward the frame to CE base on local identifier ID (LID) in the outer destination address (ODA) on egress switch mac address table

FabricPath System Architecture & Debugging
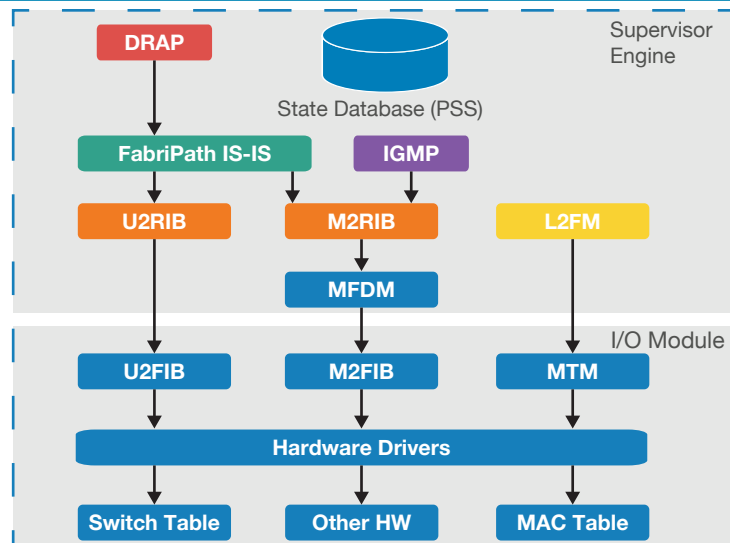

```
# Unicast Show command
Show fabricpath switch
Show fabricpath conflict [all | link | switch | transit]
Show fabricpath isis [switch | int | adj | data | route]
Show fabricpath route
Show mac address-table

# Multicast Show command
Show fabricpath isis [switch | tree |
        topology summary | database mgroup detail]
Show fabricpath mroute
Show l2 multicast trees
Show ip igmp snooping groups
```

FabricPath Multicast - Control Plane

IGMP snooping operate at edge switch and feed multicast forwarding database

FabricPath IS-IS learn multicast group membership from IGMP snooping on edge switch

FabricPath edge switch announces group interest using GM-LSPs, creating "pruned trees" for each group on MDT

FabricPath Multicast - Data Plane

Hardware selects which multidestination tree to use for each flow based on hash function; FTAG 1/2 for multicast

Once tree is selected, traffic constrained to pruned tree (FTAG) for that ip multicast group, base on mac table lookup

Multidestination Forwarding

1- Ingress fabricpath switch determines which tree to use; Tree/Ftag# 1 (Broadcast, Unknown Unicast & Multicast), Tree/Ftag# 2 (Multicast)

2a- For unknown unicast outer destination MAC set to "flood to fabric" multicast address(01:0F:FF:C1:01:C0)

2b- For multicast and broadcast the inner destination address (IDA) is copied to ODA of FP header

3- Other FP switch check tree ID chosen by ingress switch

4- Egress FP switch removes fabricpath header and floods in VLAN based on frame header(broadcast/unknown...)

FabricPath Control Plane Components

FabricPath IS-IS routing protocol that buiild FP control plane

Dynamic Resource Allocation Protocol (DRAP) IS-IS extention to ensure unique and consistent SID & FTAG value

IGMP Provide IGMP at edge switch to build multicast forwarding database

Unicast/Multicast Layer 2 RIB (U2RIB)/(M2RIB) best multicast/unicast layer 2 routing information

Layer 2 Forwarding Manager(L2FM) managing/control mac address table

Multicast Forwarding Distribution Manager (MFDM) Provide shim between platform-independent & platform-specific processes on I/O modules

Unicast/Multicast Layer 2 FIB (U2FIB)/(M2FIB) Managing hardware unicast/multicast routing table

Multicast Layer 2 FIB (M2FIB) Managing hardware multicast routing table

MAC Table Manager (MTM) Managing mac address table at hardware

Switch Table Contains Switch IDs and next-hop interface

MAC Address Table Contains local and remote mac entries

Other HW Other component; Table memories, HW Registers