ALANTEC™

Intelligent Switching Hubs

Some VLAN Styles

John Wakerly, CTO
2115 O'Nel Drive
San Jose, CA 95131
1-800-ALANTEC
wakerly@alantec.com

Virtual LANs (VLANs)

What are VLANs?

- A way of handling physical and logical LAN connections independently
- Doug Comer says (*Internetworking with TCP/IP, 1988*):
  - "We want the user to view the Internet as a single, virtual network to which all machines connect despite their physical connection."
  - "Application programs (can) use the Internet as if it were a single, real hardware network."
  - "Only software needs to change when new physical connections appear or old ones disappear."
  - "The internet will allow two machines to communicate even if the communication path between them passes across a network to which neither connects directly. *Such cooperation is only possible when computers agree on a set of universal identifiers and a set of procedures for moving data to its final destination.*"

VLAN Styles

Layer-2

- Bridge groups (broadcast domains)
- MAC-address lists
- Require layer-3 devices to connect VLANs

Layer-2/3 (multilayer)

- Layer-3 network number = VLAN identifier
- Layer-3 connections provided by external router; or
- A single bridge/router device provides layer-2 and layer-3 connections as required

VLAN Styles in Layer-2 Switches

Depend only on layer-2 information

- Require layer-3 devices (routers) to provide communication between VLANs

Several types

- Bridge groups (broadcast domains)
- MAC-address lists
- Protocol-type groups
- Encapsulating styles

Different switch designs

- Single vs. multiple MAC addresses per segment
- ASIC vs. CPU-based
- Centralized vs. distributed bridge table

Bridge Groups

Creates multiple "virtual bridges" or broadcast domains

- Each physical segment is assigned to a bridge group
- Packets are forwarded only within a bridge group
- Bridge groups may overlap [Alantec MultiLAN Switch, 1990]

Questions/problems:

- Duplicate MAC addresses in different bridge groups
- Only works well in a single switch (lose VLAN association when traffic is co-mingled on interswitch backbone)

MAC-Address Based

VLAN membership is implied by source MAC address

- Packets are forwarded only to segments that have at least one device belonging to the same VLAN as the source
- MAC-layer "type" field may also be used with source address to handle multiprotocol devices

Questions/problems:

- How to create MAC-address lists
- Sharing MAC-address lists across multiple switches

Protocol-Type Groups

VLAN membership is implied by MAC-layer "type" field

- Within a switch, selected protocol types are configured to be forwardable only on selected segments
- Useful for non-routable protocols (e.g., LAT, NetBIOS)
- Most useful when combined with another VLAN style (e.g., layer-3)

Questions/problems:

- By itself, cannot further subdivide VLAN for one protocol
- Ethernet type II vs. 802.3/SNAP

Layer-2 Encapsulating

Operation:

- Within a switch, VLAN membership is implied by segment, source MAC address, or type, as in previous slides
- On backbones between switches, packet is wrapped with another header containing a VLAN identifier

802.10 proposal

Questions/problems:

- How to manage VLAN identifiers
- Which encapsulation to use
  - Why not a layer-3 encapsulation?
- Performance / MTU size / fragmentation

Layer-3 (Net/Subnet Number)

Layer-3 network or subnet number = VLAN identifier

- Within a switch, bridge packets with the same network number; route packets with different network numbers
- Ditto between switches
- Routing may be handled by the switch itself (multilayer bridge/router) or by an external router

Questions/problems:

- Doesn't handle non-routable protocols
- Requires protocol-specific packet-header processing
- Some broadcasts difficult to parse
- Difficult to do in hardware if you don't believe that CPUs are hardware

ATM

VLAN = Emulated LAN

- LANE 0.4 (FORE): One emulated LAN
- LANE 1.0: Multiple emulated LANs

All of the VLAN styles on previous slides can run on a single ATM emulated LAN which is used as an "interswitch backbone" segment

- Which leaves open a mind-boggling possibility for the future: multiple VLANs over multiple ELANs

MPOA

- Enough said!

Spanning Tree Questions

Single spanning tree per internetwork or one per VLAN?

- Complexity
- Spanning-tree traffic and computation time
- Correct network operation

Must all packets follow a spanning tree?

- Load balancing
- Redundancy
- Convergence time

ALANTEC PowerHub VLAN Capabilities

Characteristics

- CPU-based, software-centric switch
- Bridging or routing (IP, IPX, AppleTalk, DECnet)
- Shared-memory switch fabric
- All forwarding algorithms run on CPUs
- All tables stored in conventional RAM
- Modular system
  - Additional CPUs and switch fabrics distributed to high-speed modules (FDDI, Fast Ethernet, ATM)

ALANTEC PowerHub Layer-2 VLANs

Currently only one style of layer-2 VLAN implemented

- Bridge groups
- Bridge groups may overlap
- Single, global instance of Spanning Tree

ALANTEC PowerHub Layer-3 VLANs

Used for IP, IPX, AppleTalk

- Any network or subnet number may be assigned to any number of physical segments
  - Segments may have same or different media types (Ethernet 10 or 100, FDDI, ATM emulated LAN)
  - Very useful to customers who want to increase Layer-3 network (VLAN) bandwidth without creating new Layer-3 networks and addresses
- A physical segment may have any number of network or subnet numbers from multiple protocols assigned to it
  - Needed to create backbone segments
  - All traffic is co-mingled on the backbone
  - Backbone traffic is received at destination hubs and sorted out according to layer-3 network numbers and bridged as required.

ALANTEC PowerHub Layer-3 VLANs

How does it work?

- Each switch port operates in "promiscuous mode"
- One Spanning Tree for bridged traffic
- Unicast packets are forwarded according to bridging rules
  - Possibly subject to network/subnet boundaries
- Broadcast packets (ARP, network broadcasts, etc.) are handled in a protocol-specific way, subject to network/subnet boundaries
- A pair devices on the same network/subnet will find each other via the conventional ARP mechanism
- A pair of devices on different networks/subnets will learn that the PowerHub is their router
  - For routed packets, PowerHub updates src and dst MAC addresses, decrements TTL, updates checksum, etc.

ALANTEC™

Intelligent Switching Hubs

IEEE 802.1 Meeting : October 11–13, 1995 : John Wakerly : Some VLAN Styles