IP Multicast Design Pitfalls

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PITFALLS

- Pitfalls Discussed in This Presentation
  - IGMP Protocol in ITS Networks
  - Layer 2 (L2) Switches with IGMP Snooping in ITS Networks

- Pitfalls
  1. Flash Port-Flooding
  2. Upstream Flooding
  3. CPU Overload

IGMP = Internet Group Management Protocol
WHY?

• Why Do These Pitfalls Exist?
  – ITS Network Topologies are Different Than Those Implemented on The Internet.

• Network Topology Types
  – Internet (No Pitfalls)
  – Typical ITS (Pitfalls)
  – Small ITS (Pitfalls)
MULTICAST IN INTERNET NETWORK

The Smiths

IGMP Snooping (Layer 2 Device)

IGMP (Layer 3 Device)

INTERNET

Layer 2 Switch Downstream from Gateway (L3 Device)

No Pitfalls

Multicast Source (Video)
TYPICAL ITS NETWORK

Layer 2 Switch
Upstream from Router

Pitfalls 1 & 2
Flash Port-Floding
Upstream Floding

Link Legend
- Trunk (L3)
- Subnet (L2)
SMALL ITS NETWORK

Layer 2 Switch Downstream from Source
Pitfalls 1, 2, 3
Flash Port-Flooding
Upstream Flooding
CPU Overload

Link Legend
- Trunk (L3)
- Subnet (L2)
HOW TO AVOID PITFALLS

• We need to understand:
  – How IGMP (Vr1 & Vr2) and L2 Switches with IGMP Snooping Operate in Internet Networks (No Pitfalls)
  – How IGMP and L2 Switches with IGMP Snooping Operate in Typical or Small ITS Networks (Pitfalls)
INTERNET NETWORK – IGMP OPERATION

IGMP Version 1

IGMP MESSAGES
- JOIN
- QUERY

Network Packets
- Unicast
- Multicast
INTERNET NETWORK – IGMP OPERATION

IGMP Version 2

Network Packets
- Unicast
- Multicast

IGMP MESSAGES
- JOIN
- QUERY
- LEAVE - Vr2
Components

- **ASIC** (Application Specific Integrated Circuit)
- **CPU** (Central Processing Unit)
I WANT MY MTV INTERNET NETWORK - L2 SWITCH WITH IGMP SNOOPING
TYPICAL OR SMALL ITS NETWORK
PITFALL 1

Flash Flooding of All Ports

Packet Legend

![Image of packet legend]

Network Packets

- Unicast
- Multicast
PITFALL 1 – SYMPTOMS & SOLUTION

• Symptom
  – Random Impairment of Non-Multicast Devices in a Subnet Containing Multicast Stream(s)

• Solution
  – Require Non-Multicast Devices to Withstand Multicast Streams.
  – Deploy L2 Switches That Minimize Multicast Flooding on All Ports
TYPICAL OR SMALL ITS NETWORK
PITFALL 2

Upstream Flooding

Multicast Types
⚠️ Video address No

Network Packets
● Unicast
▲ Multicast
PITFALL 2 – SYMPTOMS & SOLUTION

• Symptoms
  – Video Image Degradation.

• Solution
  – All Layer 2 Upper Links Need to Support Full Bandwidth
  – Add Routers at Links with Bandwidth Bottlenecks
TYPICAL OR SMALL ITS NETWORK
PITFALL 3

CPU Overload

Multicast Types

- Join
- Query

Network Packets

- Unicast
- Multicast
PITFALL 3 - SYMPTOMS & SOLUTION

• Symptoms
  – Video Streams OK, But L2 Switch CPU Functions (Telnet, SNMP, etc) Slow Down or Do Not Operate

• Solution
  – Use Routers at All TMCs to Connect Multicast Users
  – Limit the Number of Video Subscribers in L2 Sub-Nets that Contain Video Source
  – Test Layer 2 Switch CPU Capacity to Handle IGMP Messages
IP Multicast Deployment in Transportation

• Deployed for over a decade
• Many systems nationwide
• Reasons:
  – Equipment costs
  – Flexibility of video distribution
  – Redundancy
• Avoid pitfalls
  – Understanding of network technology
  – Testing: design, implementation, and products
  – Training
IP Multicast Pitfalls – The END

Questions????