TV-Service Aware Bridge (T-Bridge)

2006. 5.

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Issues in IP-TV Service

• Many market analysts say IP-TV service will show sharp increase over next decade.

• Over 90% of IP-TV streams will be delivered via Ethernet.

• For IP-TV service, Bridges need capability of..
  • Fast channel zapping (currently 2~4 sec, with blackout)
  • Authentication (Prevent unauthorized channel access)
  • Protection (From DoS attack, Multicast attack.. )
  • Reliable service availability

• Are Bridges good enough for IP-TV service ?
  • GMRP is not widely deployed.
  • GMRP and IGMP Snooping are not fast enough.
  • VLAN is unsatisfactory for service separation/protection.
  • Group forwarding behavior is not suitable for commercial service
Channel Zapping Latency

Channel Zapping Time

TV Signal

TV

Settop Box

Bridge (e.g. DSLAM)

Aggregation Switch (L2/L3)

IGMP Join Delay (<1Sec) + Buffering Delay (1~2Sec) + Encoding Delay (<1Sec) = Blackout Screen Period (2~4Sec)

We may reduce IGMP Join Delay + Buffering Delay latency.
Problem with IGMP

- IGMP Snooping is SLOW
  - Some vendors implement IGMP in dataplane hardware
- Snooping Switch is vulnerable to DoS attack
- It gives burden to CPU
  - More than hundreds of join signals may arrive
Several TVs and PCs may exist in a house
- Bandwidth requirement may different by terminal type
• A user may watch several channels at the same time
• IGMP signal tends to arrive in burst pattern
  → e.g. during commercial advertisement time
• Lots of IGMPs may overwhelm snooping switch
  → IGMP join aggregation doesn’t help much
A Suggestion: Dynamic GA Learning

- A data frame of **Group Addressed SA** is used for dynamic join
  - DA indicates multicast stream source (Unicast/Broadcast)

- By default, only the **Input Ports** of **Registered Group Address** are learned.
  - Otherwise, frames of unknown group address are dropped
  - MAC spoofing using unknown group address is prevented

- Optionally, **Unknown Group Address** may also be dynamically learned
Difference with GMRP/IGMP

- GMRP & IGMP messages are processed in control plane
  - Explicit control message is used

- GA Learning is performed in dataplane at wire speed
  - Bridges learn group state from member traffic
  - No explicit control message is necessary
  - Performance is similar to H/W implemented IGMP but, ...
Modification to Filtering Database

1. **Learning Port Map** indicates learning permission.
2. **Forwarding Port Map** indicates current group forwarding state.
3. When learning is enabled, **Ageing Timer per Port for each Entry** is used for implicit leave operation.
4. Timer for join aggregation, etc. may additionally be used, if necessary
Fast Join & Slow, Implicit Leave

- Channel termination by **Fast Ageing (Implicit Leave)**
  - Receivers must periodically (1~2sec.) transmit Keep Alive Message to refresh **Ageing Timer**.
  - No explicit leave message is necessary for channel switching → unused channel will be aged out in 5 sec.
  - BW may be wasted during channel switching → Is it bad (?)
Issue in Buffering Delay

• Unless QoS is strictly guaranteed, jitter buffer is necessary

• TV Settop box fills jitter buffer for 1~2 sec. when new channel is requested
  → During buffering time, screen stops

• Buffering acceleration techniques
  - Pre-buffering of near channels / all channels
  - High-rate transmission for first several frames, etc.

• Bridges may buffer past frames
  - for 2 Mbps SD class movie : 500 Kbytes buffering/channel
  - for 4 Mbps HD class movie : 2 Mbytes buffering/channel
Fast Buffering by VoD Server

- In order to reduce buffering delay, VoD server transmits stream at high-rate at first. 
  \[\text{applicable only in VoD applications where session flows are independent to each receiver.}\]

- In multicast network, many receivers share common stream in common timeframe. 
  \[\text{New member should buffer stream from the time it joins stream}\]
Fast Buffering by Cascaded Bridges

- Bridges buffer multicast streams
- Join request triggers forwarding of buffered data in high-rate
  - Multicast forwarding state is configured after buffer transmission
- When requested stream doesn’t exist in downstream node, buffer request is passed to upstream node
Problem in VLAN Configuration

- Service Provider may configure tagged VLAN
  - for separation of data/TV flows, SD/HD flows, adult/child group, etc...

- Current bridges cannot prevent interruption from other users when they share VLAN group.
  - Harmful in some application
  - Some vendors implement proprietary unbalanced ingress filtering

- VLAN forwarding rule needs to be enhanced
A Suggestion: VLAN Forwarding Matrix

- VFM (VLAN Forwarding Matrix) only defines internal forwarding direction
  - No change in ingress/egress filtering rule
  - No impact to interoperability

- Prevents user-to-user direct communication
  - Useful in access network
  - There can be 4k VFMs per Bridge

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Summary and Requirements

A T-Bridge should,

- Support efficient multicasting
- Minimize channel switching latency
- Minimize group join/leave overhead
- Help minimizing buffering latency at user terminal
- Be able to prevent reverse multicast flow from user
- Provide effective means for filtering unauthorized channel access from user
- Provide reliable service availability

These requires new bridge standard for IP-TV service

Industry need is clear and present