TV-Service Aware Bridge (T-Bridge)

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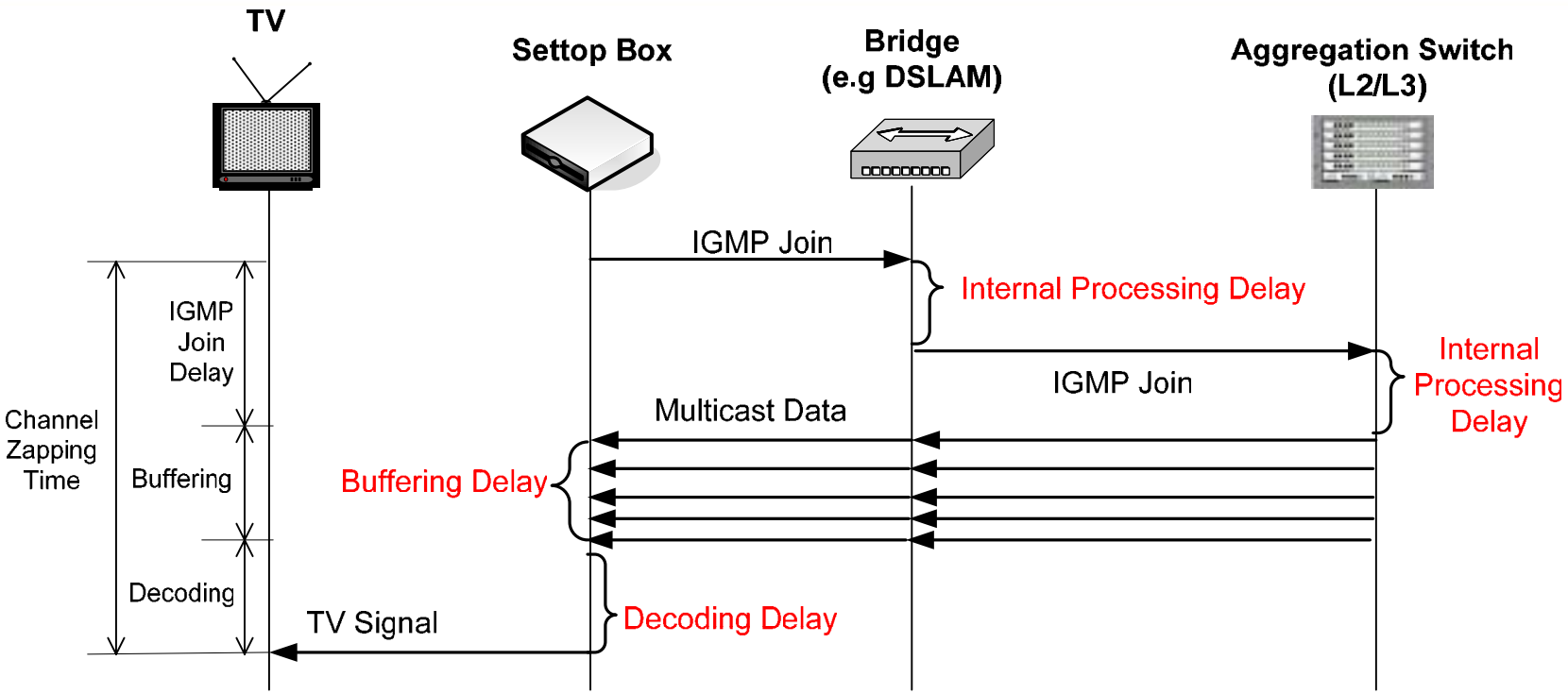
Issues in IP-TV Service

- 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

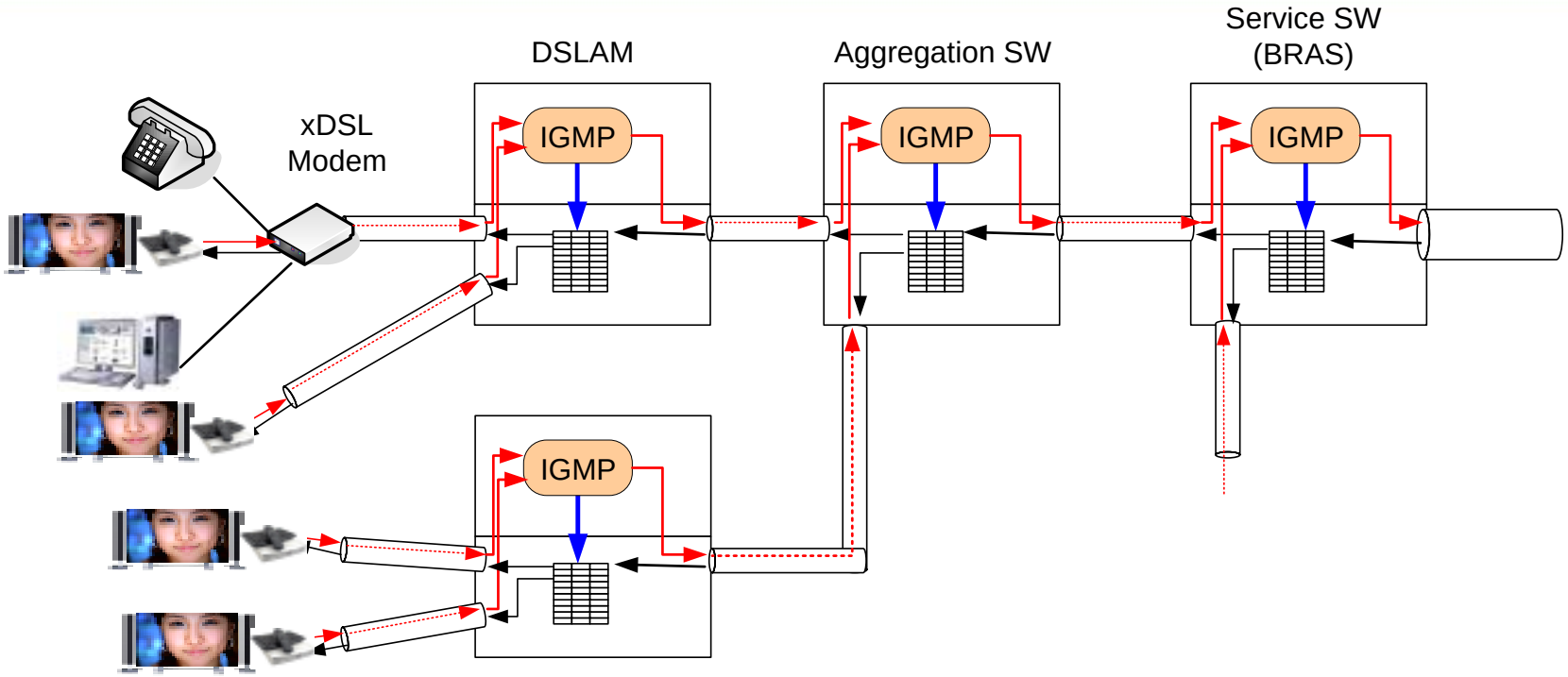
Channel Zapping Latency



① IGMP Join Delay (<1Sec) + ② Buffering Delay (1~2Sec) +
③ Encoding Delay (<1Sec) = Blackout Screen Period (2~4Sec)

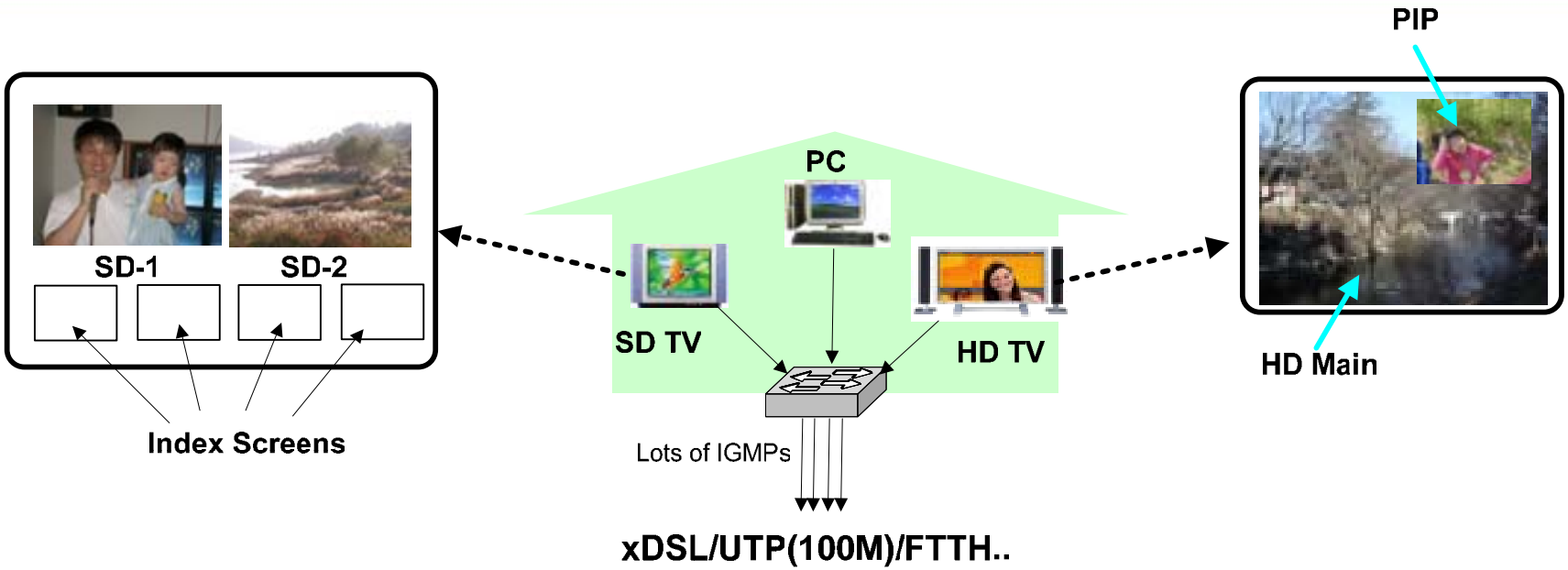
We may reduce ①+② latency

Problem with IGMP



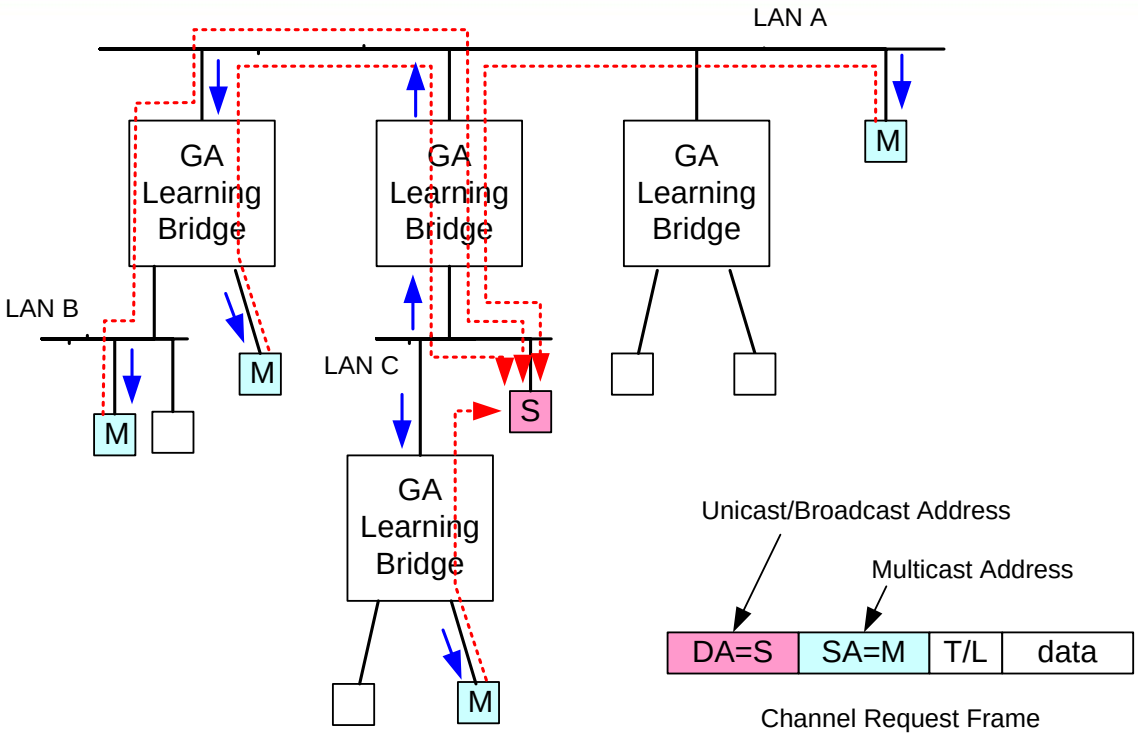
- IGMP Snooping is SLOW
  - Some vendors implement IGMP in dataplane hardware
- Snooping Switch is vulnerable to DoS attack
- It gives burden to CPU
  - More than hundreds of join signals may arrive

Signaling Overhead in Multi-vision TV



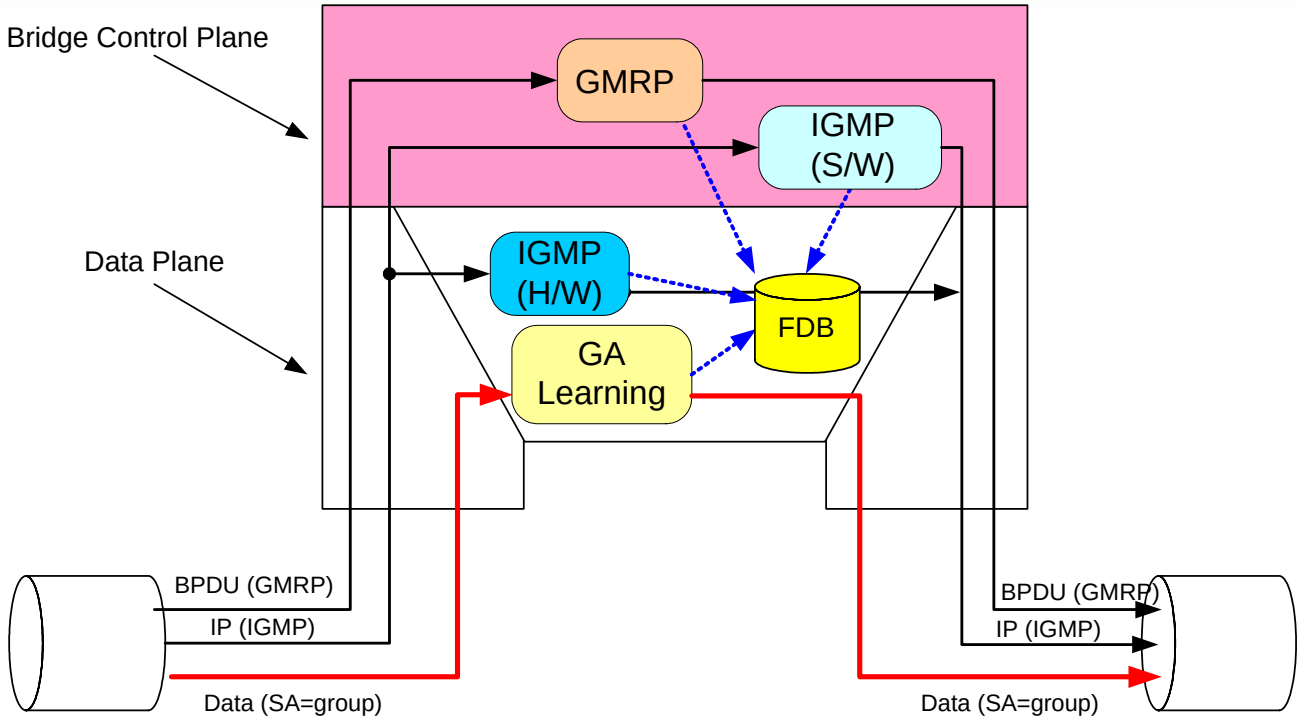
- Several TVs and PCs may exist in a house
  - Bandwidth requirement may different by terminal type
- A user may watch several channels at the same time
- IGMP signal tends to arrive in burst pattern
  → e.g. during commercial advertisement time
- Lots of IGMPs may overwhelm snooping switch
  → IGMP join aggregation doesn't help much

A Suggestion: Dynamic GA Learning



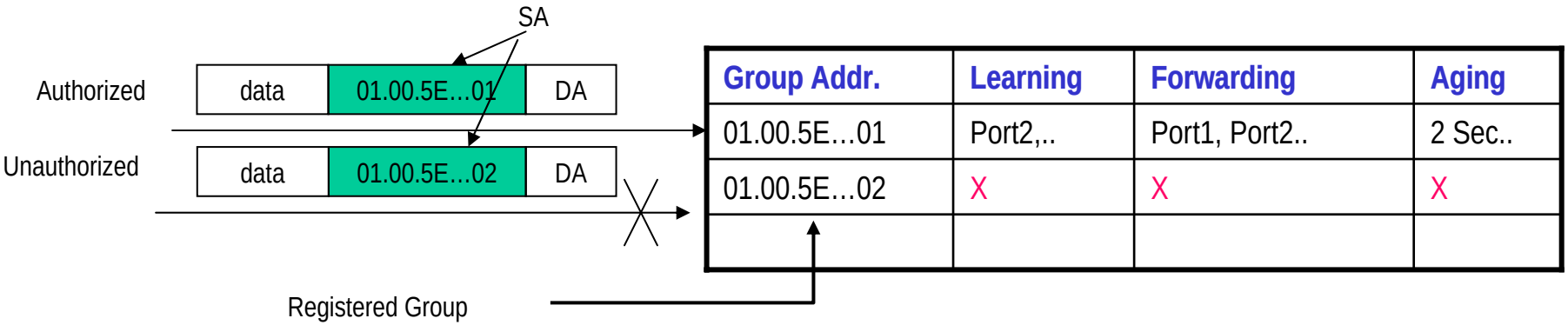
- A data frame of **Group Addressed SA** is used for dynamic join
  - DA indicates multicast stream source (Unicast/Broadcast)
- By default, only the **Input Ports** of **Registered Group Address** are learned.
  - Otherwise, frames of unknown group address are dropped
  - MAC spoofing using unknown 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, ...

New Filtering Database

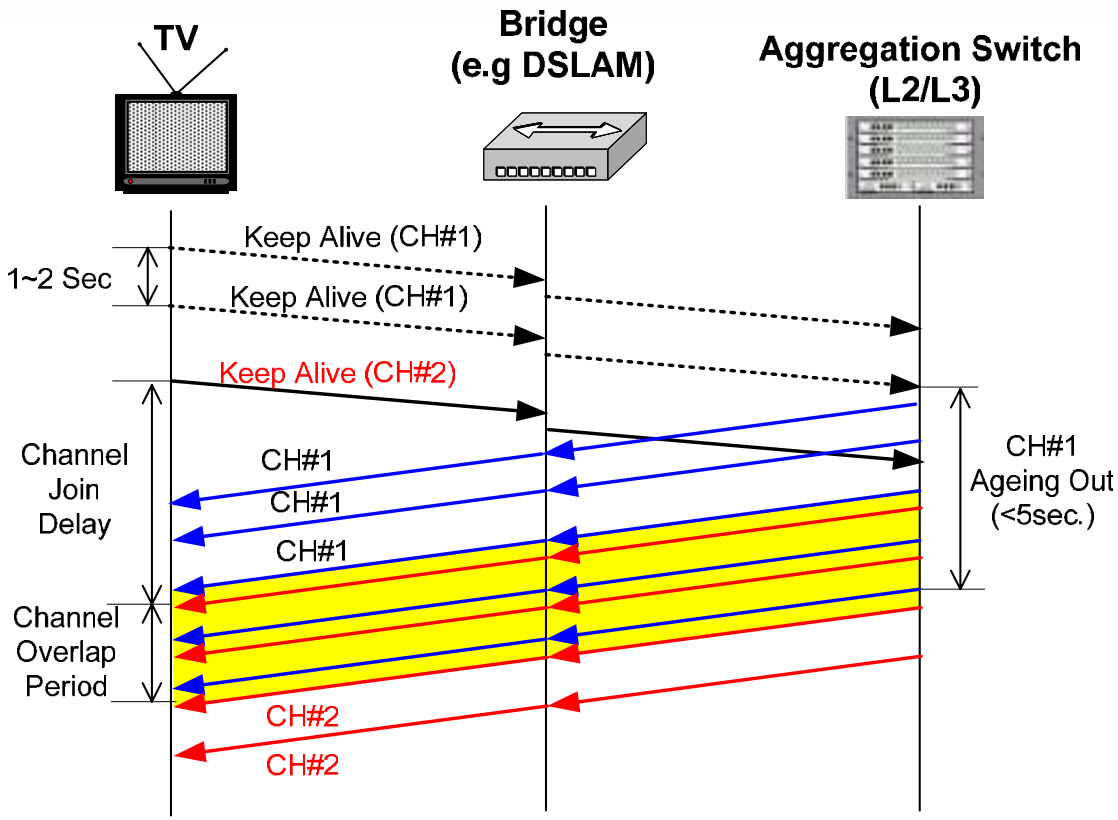


Group Addr.	Learning	Forwarding	Aging
01.00.5E…01	Port2,..	Port1, Port2..	2 Sec..
01.00.5E…02	X	X	X

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

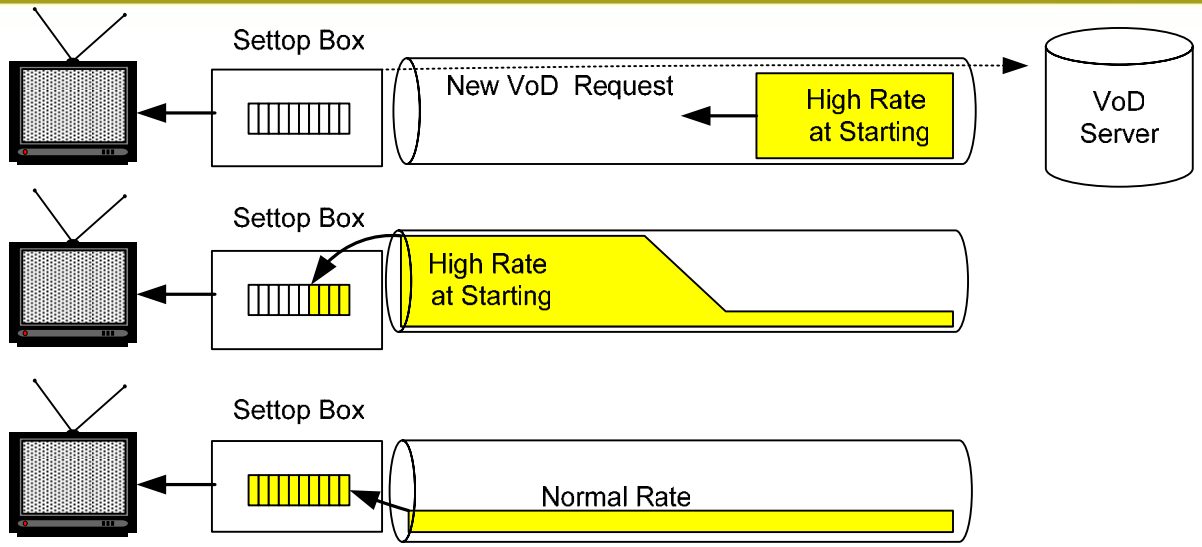


- Channel termination by **Fast Ageing (Implicit Leave)**
  - Receivers must periodically (1~2sec.) transmit Keep Alive Message to refresh **Ageing Timer**.
  - No explicit leave message is necessary for channel switching → unused channel will be aged out in 5 sec.
  - BW may be wasted during channel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

Issue in Buffering Delay

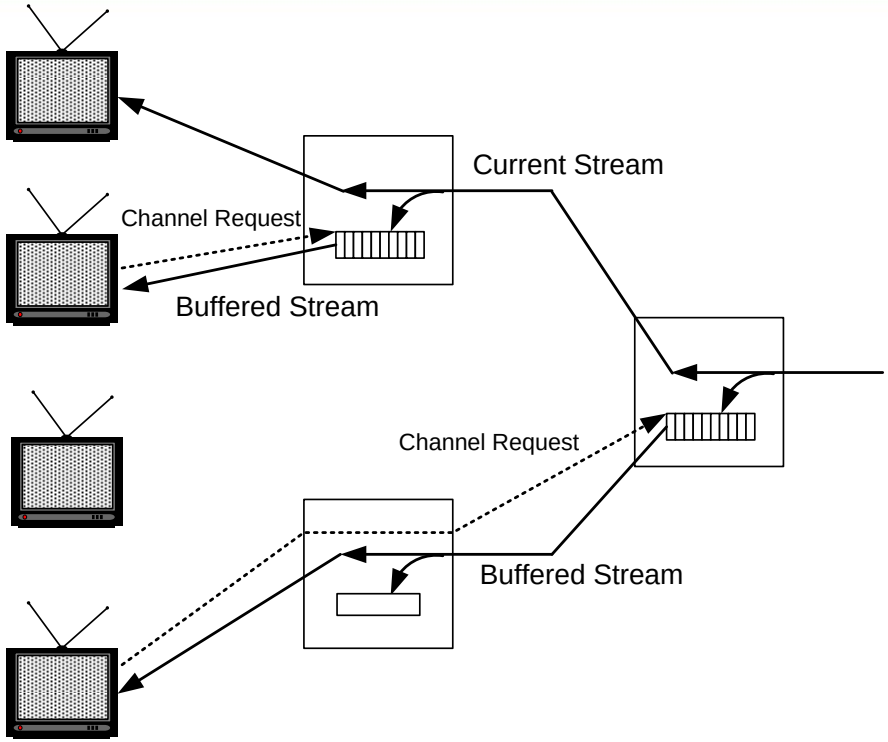
- Unless QoS is strictly guaranteed, jitter buffer is necessary
- TV Settop box fills jitter buffer for 1~2 sec. when new channel is requested
  → During buffering time, screen stops
- Buffering acceleration techniques
  - Pre-buffering of near channels / all channels
  - High-rate transmission for first 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



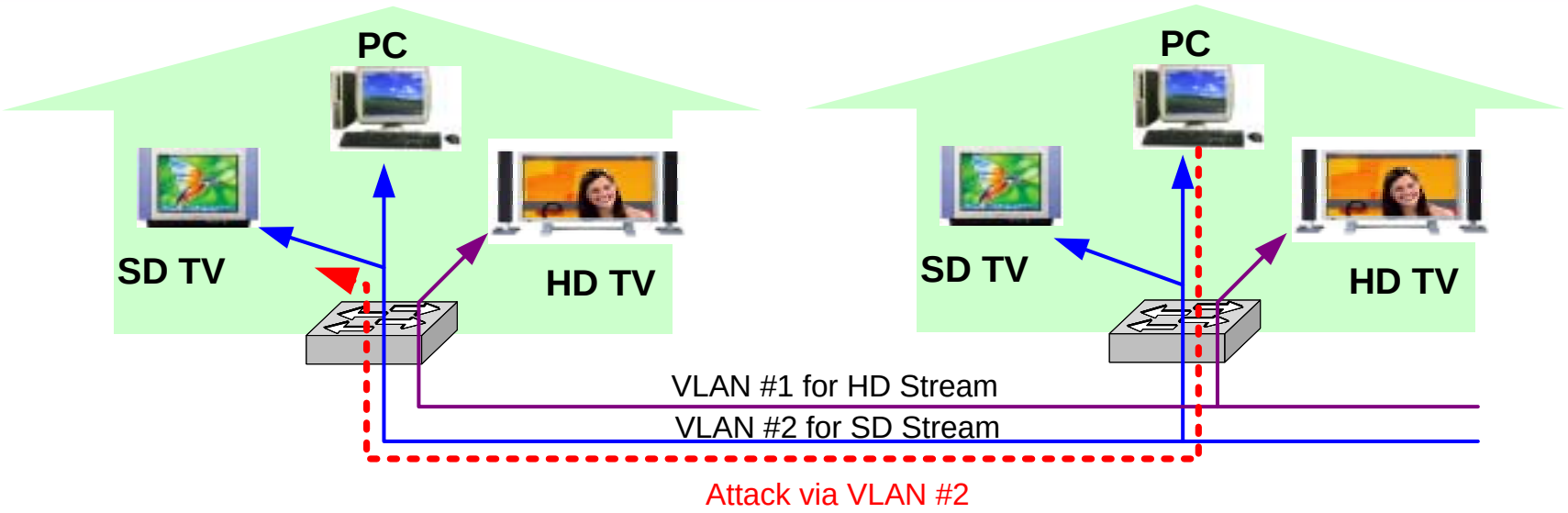
- In order to reduce buffering delay, VoD server transmits stream at high-rate at first.
  - → applicable only in VoD applications where session flows are independent to each receiver.
- In multicast network, many receivers share common stream in common timeframe.
  - → New member should buffer stream 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

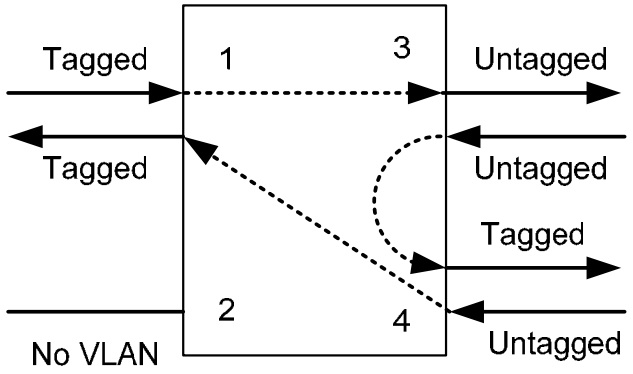


- Service Provider may configure tagged VLAN
  - → for separation of data/TV flows, SD/HD flows, adult/child group, etc…
- Current bridges can not prevent interruption from other users when they share VLAN group.
  - → Harmful in some application
  - → Some venders implement proprietary unbalanced ingress filtering
- VLAN forwarding rule needs to be enhanced

A Suggestion : VLAN Forwarding Matrix

Ingress	In \ Out	1	3	4
Tagged	1		Untag	0
Untagged	3	0		Tag
Untagged	4	Untag	0	

VFM for VLAN #n



VLAN #n Configuration

- 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

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