Labelcast Protocol

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Motivations(1)

- IPTV is a new kind of video service on Internet
  - VOD, time shifted program, live video

- IPTV customers increasing dramatically

- Characteristics of IPTV Data distribution
  - Working at network edge
  - Need multicast service to support live video
  - Quality of experience is important

Motivations(2)

- Most popular data distribution Protocols used in Commercial IPTV platform
    - TS/UDP, IP multicast

- Platforms based on these protocols can work , but can not OAM easily
    - IP multicast is not well controlled
    - Failure is hard to be detected and located

- Why not define a new protocol for IPTV ?

What is the Labelcast protocol?

- A protocol especially designed for IPTV
  - Packets carry rich information supporting for quality monitoring

- Support multicast as well as unicast
  - Multicast tree, packet replicated in network

- A transport layer protocol
  - Not depend on IP layer technologies
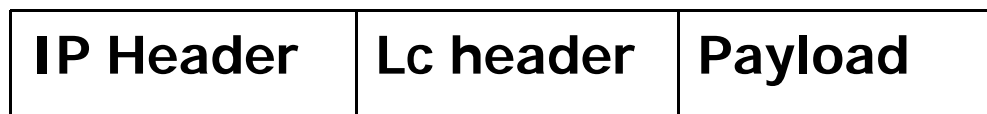 - Transparent to applications

Labelcast node type

- **Three node types in labelcast forwarding path**
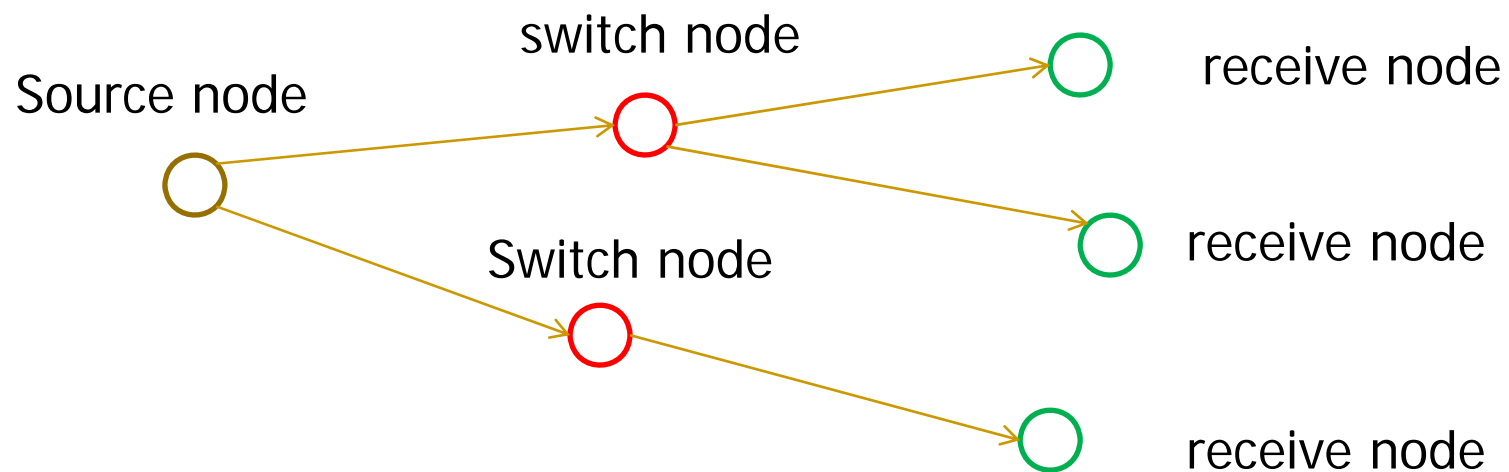
- **Forwarding state is managed by a Labelcast manager**

Labelcast packet structure

IP Header	Lc header	Payload

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|Ver|Pri|        Seq        |     BW    |         Aid           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|          Label            |              TS                   |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Figure 1: Head Format

Source IP: source node IP

Destination IP:

Multicast IP: multi-receivers

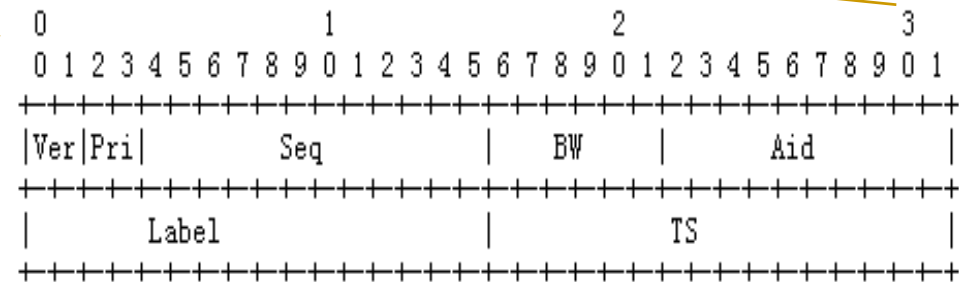Unicast IP: single receiver(VOD or time-shift program watcher)

Labelcast Header

field	Len	function
Ver	2b	protocol version
Pri	2b	packets priority, encoded by the payload types
Seq	12b	sequence of a packet in data flow
BW	8b	Bandwidth of the flow which equal to BW*128Kbps
Aid	8b	Identify different applications at the receiver
Label	16b	For packets forwarding use
TS	16b	Record packet arrive time in us

set by the source node, unchanged during forwarding

Changed hop by hop along the forwarding path

Checksum field and source port number are not used
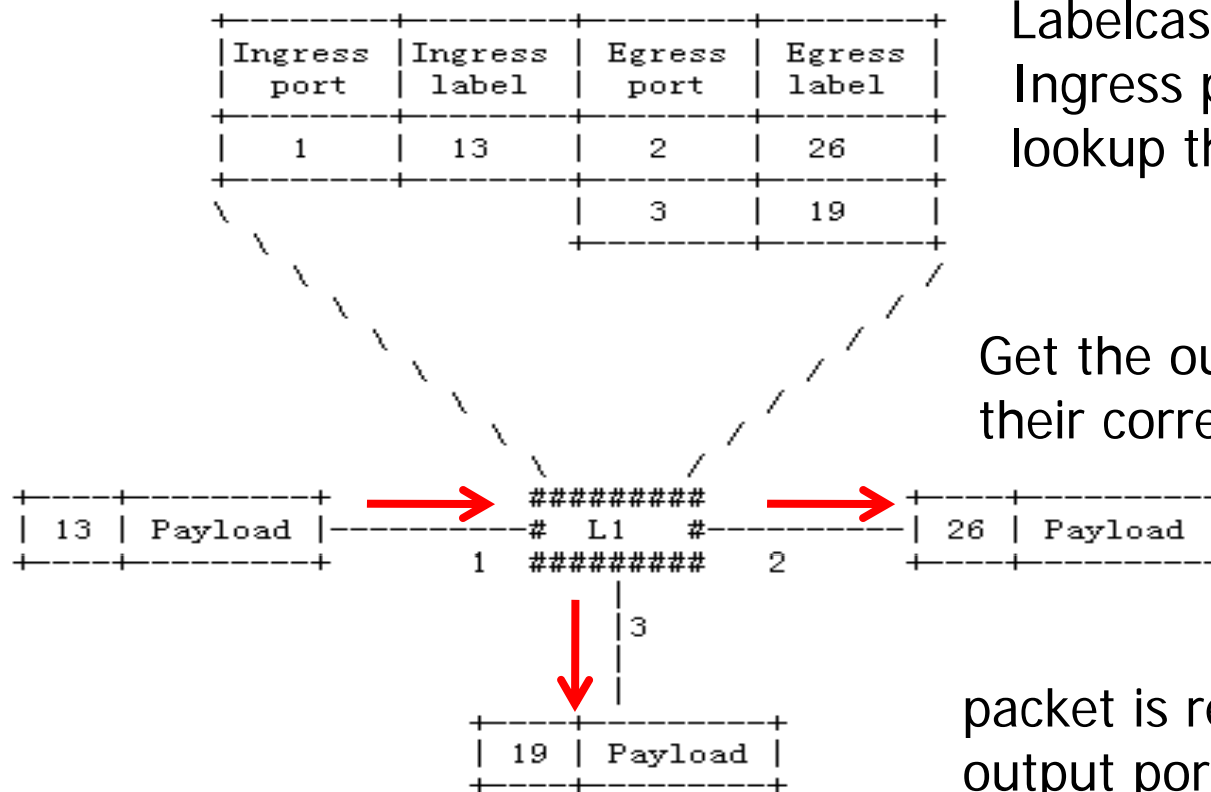
Label based forwarding

```
+---------+---------+---------+---------+
|Ingress  |Ingress  | Egress  | Egress  |
| port    | label   |  port   | label   |
+---------+---------+---------+---------+
|   1     |   13    |    2    |   26    |
+---------+---------+---------+---------+
  \        \        |    3    |   19    |
    \        \      +---------+---------+
      \        \                /
        \        \            /  /
          \        \        /  /
            \        \    /  /
              \       \  /  /
                \      /  /
                  \   /  /
+----+---------+     #########     +----+---------+
| 13 | Payload |------# L1   #-----| 26 | Payload |
+----+---------+    1#########  2  +----+---------+
                        |
                        |3
                        |
                  +----+---------+
                  | 19 | Payload |
                  +----+---------+

    Figure 2: Label Processing
```

Labelcast switch node (L1) use Ingress port(1) and label(13) to lookup the forwarding table

Get the output port list and their corresponding new label.

packet is replicated and sent to output port 2 and 3, and label field will be replaced with new values.

Use of Bw

- Bw indicate bandwidth(Bw*128Kbps) of the flow
  - Bw=1, bandwidth=128Kbps,
  - Bw=2, bandwidth=256Kbps
  - ...
  - Bw=255, bandwidth=32Mbps
  - Bw=0, bandwidth is unknown
- Functions
  - Calculate total bandwidth consumed by streaming data
  - Pre-calculate mean packet arrive interval of a given flow
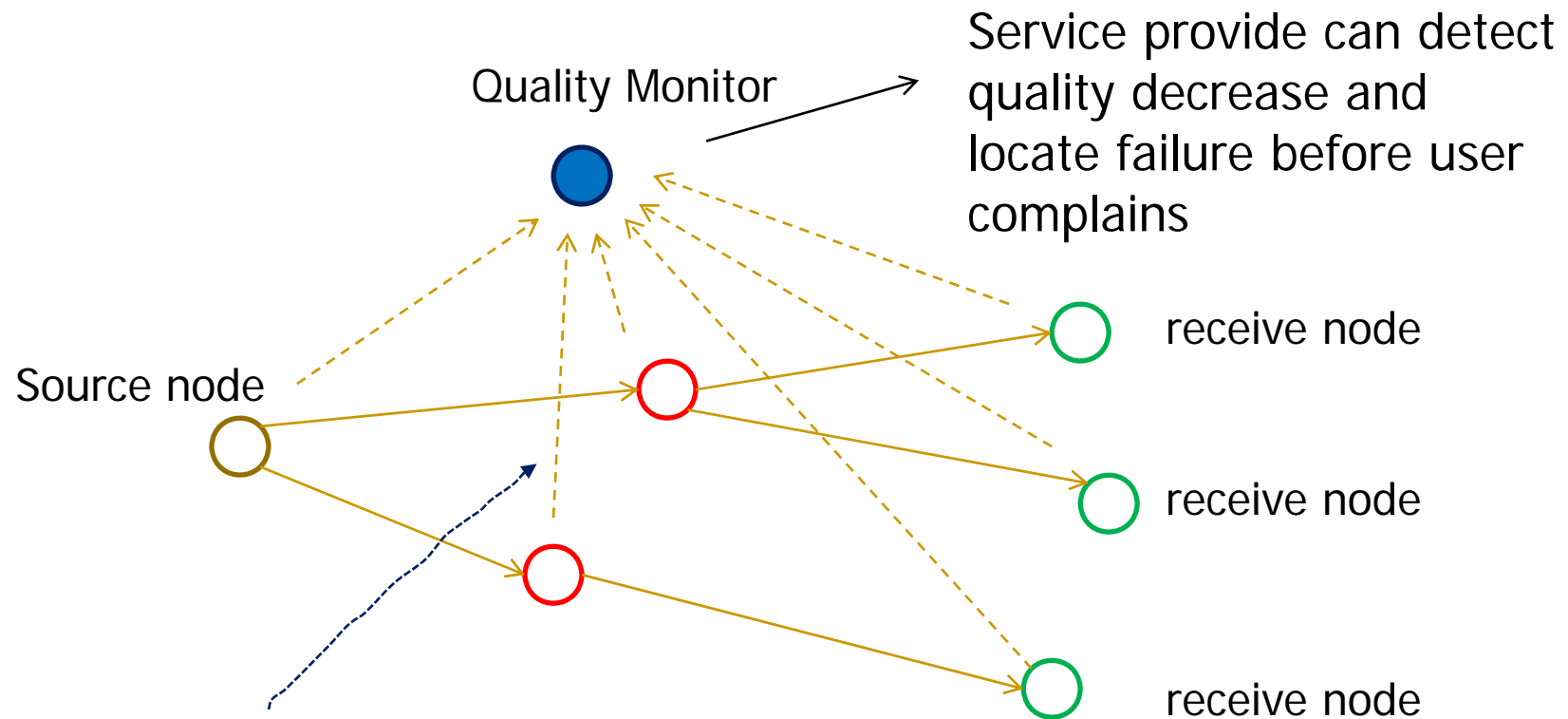   - Evaluate packet delay jitter, smooth the burst data in the network

TS[15:0]

- Used to calculate virtual delay(VD) between two neighbor labelcast nodes on the forwarding path
    - VD= packet arrive time(local) –Packet TS value

- Time synchronization is not required

- VD variations between successive packets can be used to evaluate delay jitter

Forwarding table management

- Forwarding tables on the data distribution path are managed by a centralized manager

- Several managers should be working in redundancy mode

- Communication protocol between Labelcast manager and switch node should be further studied and defined

Quality monitoring scenario

Labelcast packet has rich information to do quality monitoring

Service provide can detect quality decrease and locate failure before user complains

Quality Monitor

Source node

receive node

receive node

receive node

RFC4445: Media Deliver Index, include Delay factor and Media Loss Rate

More discussions

- Push-based Multicast
  - Multicast tree is build depend on
    - Receiver location distribution and policies of service provider
- Out-of-Band Management Model
  - No flow control, no congest control, no session control
- New network measure resort
  - Streaming packets could be used as network measurement packets
    - Continous, rich fields etc.
    - the more users, the more quality feedback
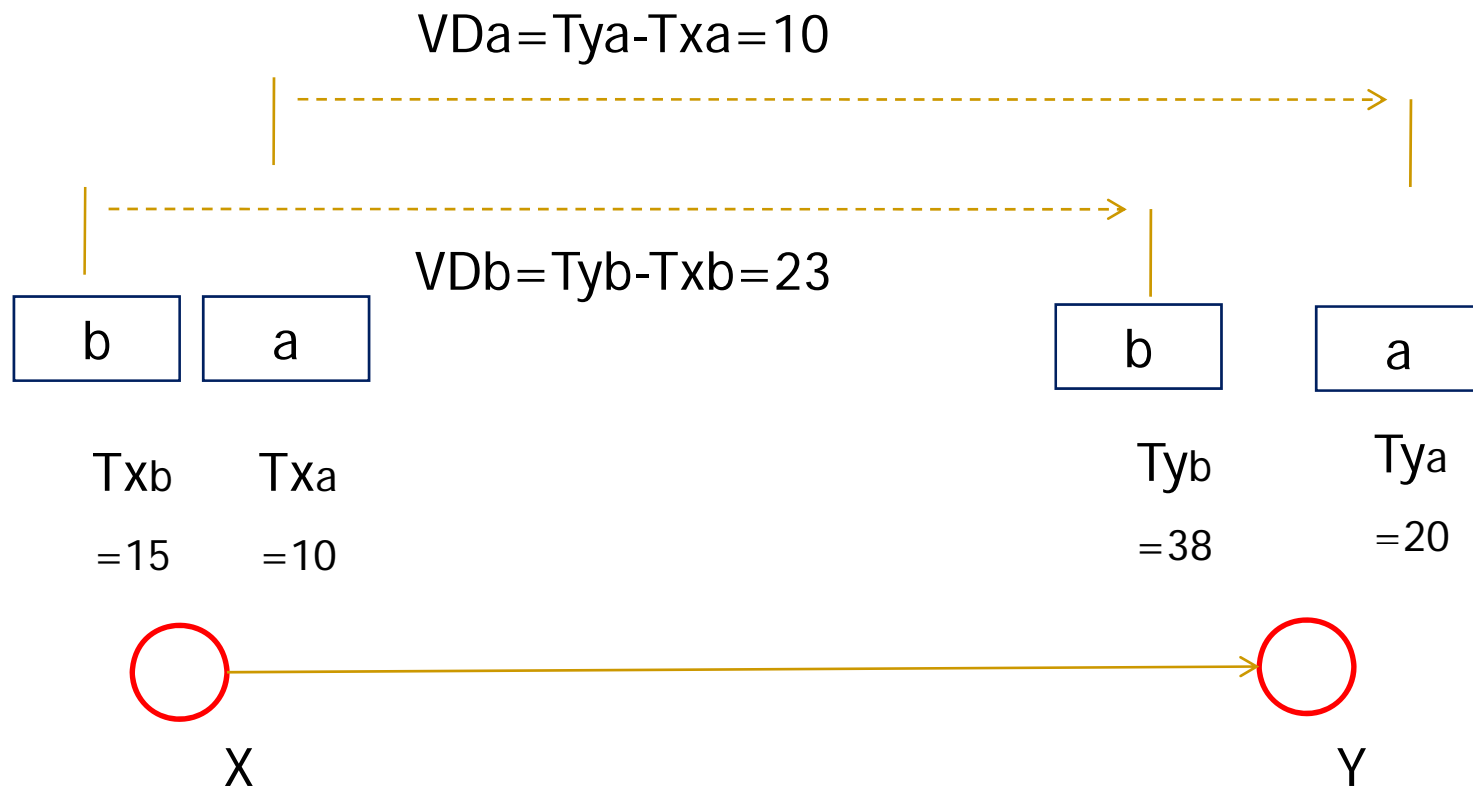
IANA and Security Considerations

- A protocol number should be assigned to Labelcast
  - we use number 253 for Labelcast experiment

- Security problem

Summary

- Labelcast just borrows some merits from existed protocols,
  - From RTP: Seq, TS, out of band control
  - From MPLS: label-based forwarding
  - From UDP: no feedback data transportation
- Labelcast is a supplement to current IP multicast infrastructure
- Labelcast is an enabled protocol for video-wared network in the future

Any questions?

Backup

$$VDa=Tya-Txa=10$$

$$VDb=Tyb-Txb=23$$

b	a

b	a

Txb   Txa

=15   =10

Tyb

=38

Tya

=20

X

Y

Example use of VD