



IPTV: Multimedia Synchronisation

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IPTV: Headlines

- TV
- IPTV
- IPTV Multicast Protocols
- Multimedia Synchronisation
- TV&RSS Synchronisation
- TV&TV Synchronisation
- TV&Radio Synchronisation
- Future work

IPTV: TV systems

| | IPTV | Internet TV | Aerial TV | Satellite TV |
|-------------------------------|-------------|----------------------|------------------|---------------------|
| PC | | ✓ | | |
| Broadband | ✓ | ✓ | | |
| Set-Top Box Decoder | ✓ | | | ✓ |
| Satellite Dish Antenna | | | ✓ | ✓ |
| TV | ✓ | | ✓ | ✓ |
| Emission | Multicast | Unicast Multicast | Broadcast | Broadcast |

IPTV: Concepts

- **Internet TV:** Unicast/Multicast streaming TV (YouTube)
- **IPTV:** Multicast TV over IP Network that provides interactive service with end users
- **Triple Play:** Voice, video and data in the same service, Broadband connection
- **Quadruple Play:** Triple Play plus wireless
- **IMS:** IP Multimedia Services
- **Lean-Forward:** IMS on the PC
- **Lean-Back:** IMS on the TV

INTERNET TV / IPTV

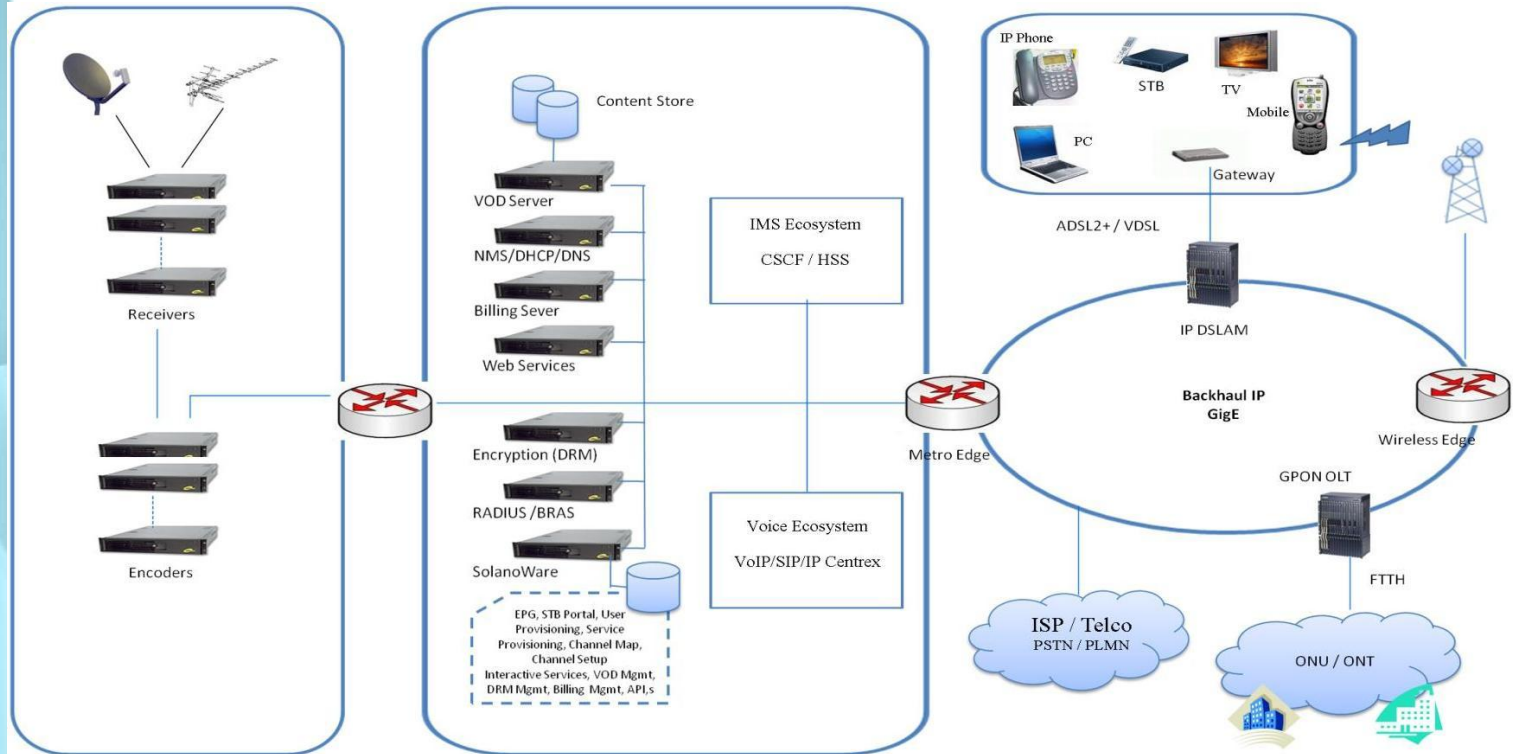
- Potentially supranational or worldwide
- PC oriented
- Depend on coding
- High level viewer involvement
- Best effort quality, QoS not guaranteed
- PC
- Unsafe
- Content usually unprotected
- Any users (generally unknown)
- Local (limited operator coverage)
- TV oriented (real-time)
- Real SDTV/HDTV
- Low level viewer involvement
- Controlled QoS, “broadcast” TV quality
- STB with a TV display
- Safe
- Media is protected
- Known customers, IP addresses and locations

J. Maisonneuve, M. Deschanel, J. Heiles, H. Liu, R. Sharpe, Y. Wu. “An overview of IPTV standards Development”, in: IEEE Transactions on Broadcasting vol.55, no3, June 2009 pp.315-328.

TV MEDIA CONTENT



SOLANOTECH HIGH LEVEL DIAGRAM



IPTV: Protocols

| | | |
|-------------------|------------------|-------------|
| Application Layer | VIDEO CODEC | AUDIO CODEC |
| | MPEG-2 MPEG-4 | |
| | RTP/RTCP | |

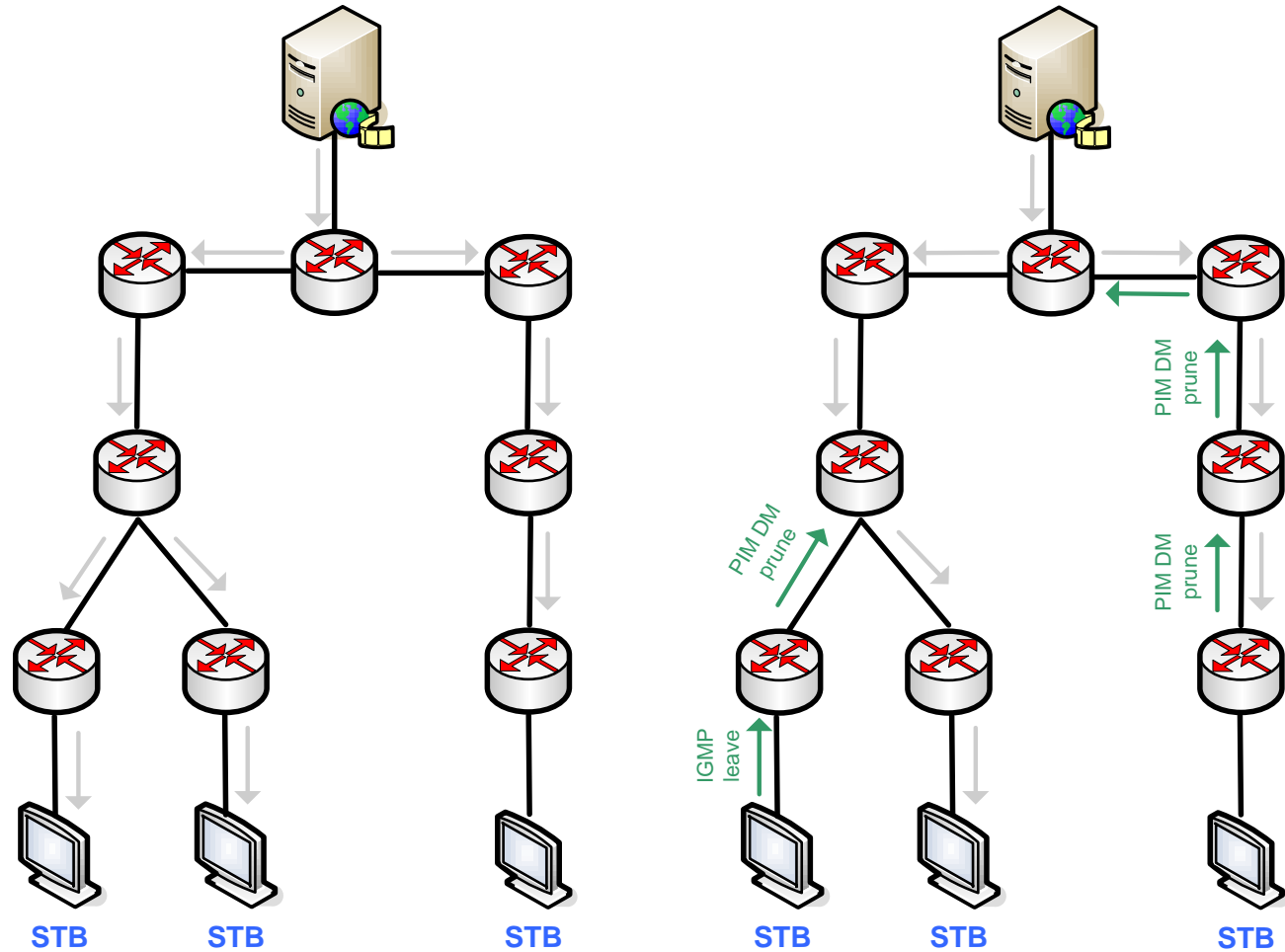
Sockets



| | |
|----------------|----------------------------------|
| TCP | UDP |
| IP | IP MULTICAST PIM-SM PIM-DM |
| Network Layer | IGMP MLD |
| Physical Layer | |

- **PIM-SM** (Protocol Independent Multicast-Sparse Mode)
- **PIM-DM** (Protocol Independent Multicast-Dense Mode)
- **IGMP** (Internet Group Management)
- **MLD** (Multicast Listener Discovery)

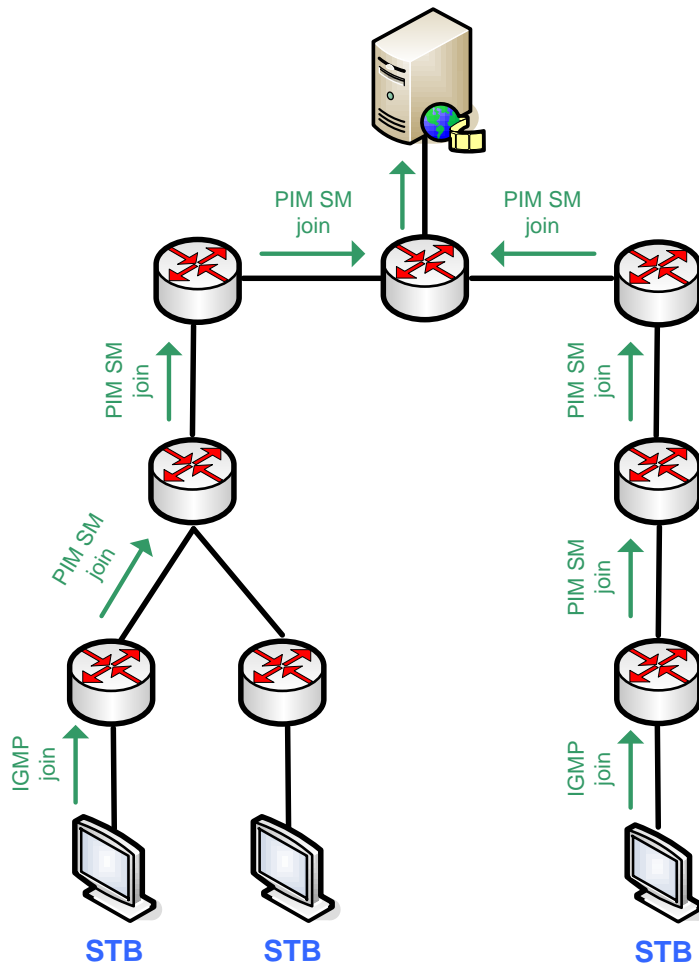
Multicast: PIM-DM/ IGMP



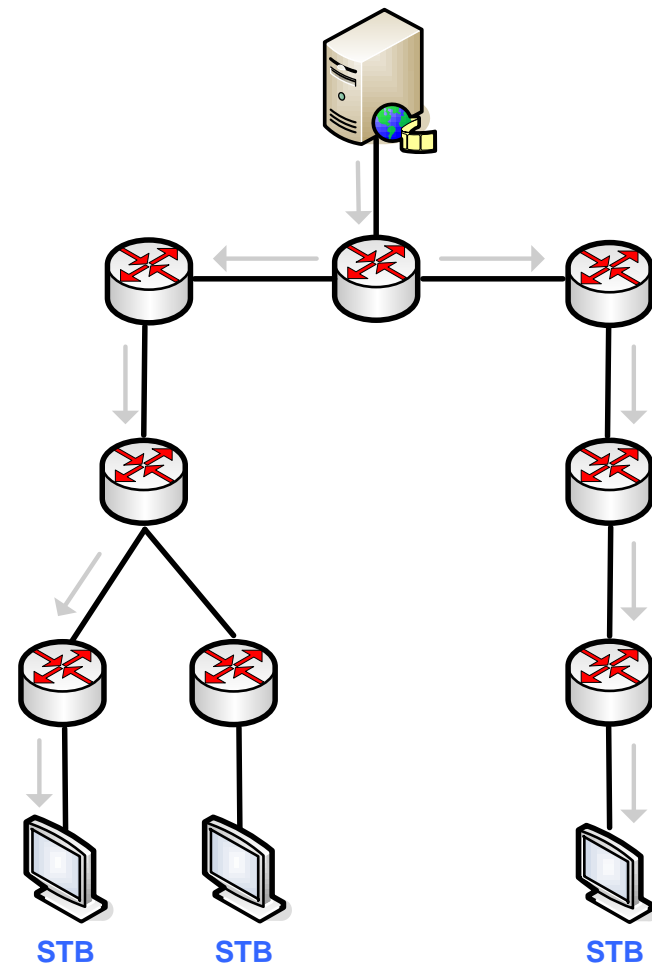
PIM-DM Stage Flood

PIM-DM Stage Prune

Multicast: PIM-SM/ IGMP

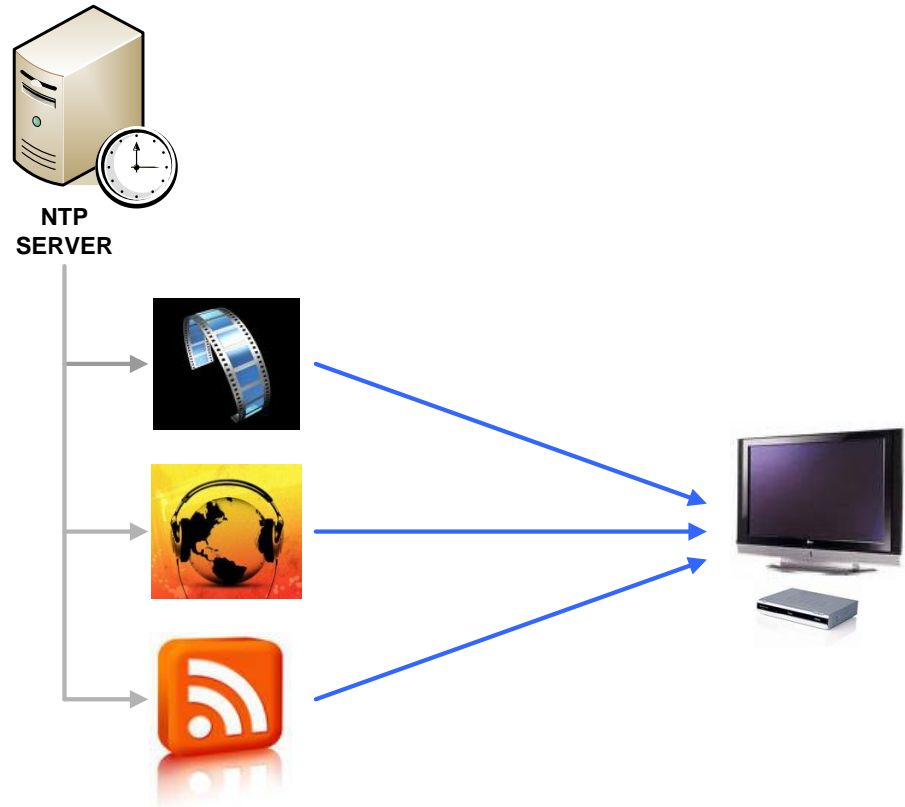


PIM-SM: Hosts joining a Multicast Group



PIM-SM: TV Multicast Streaming

IPTV: Multimedia Synchronisation



IPTV: User Interactivity



IPTV

Imagenio Standard:
Around 40 TV Channels

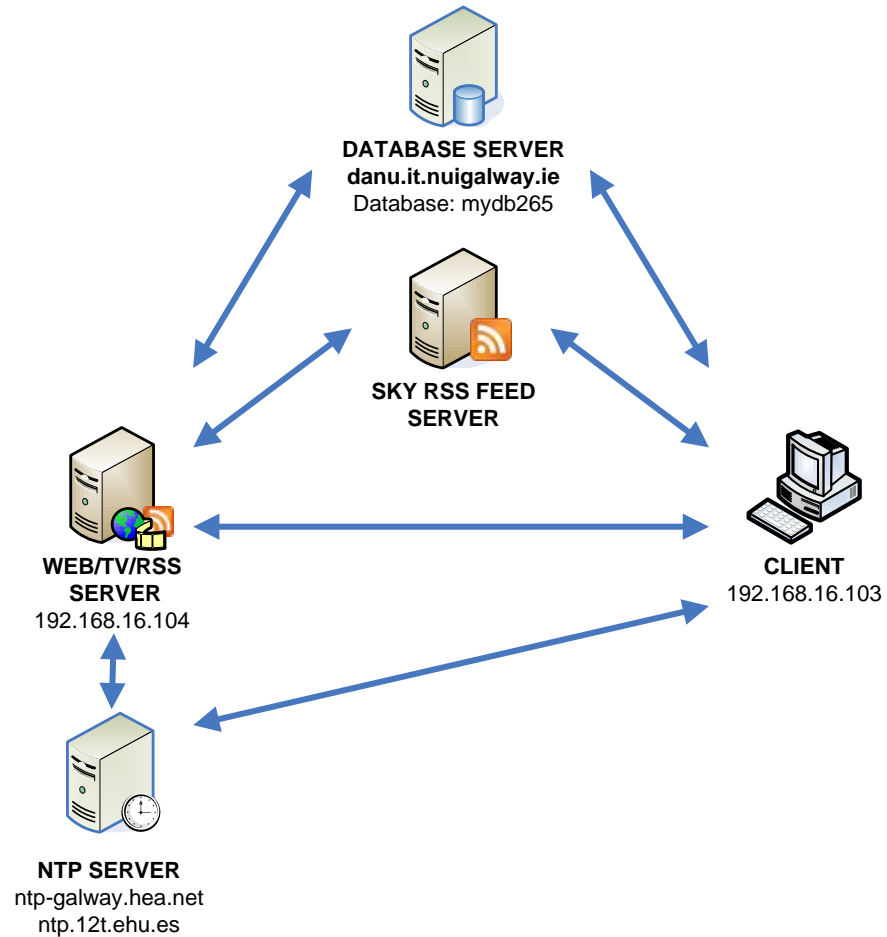
Imagenio Family:
Around 70 TV Channels



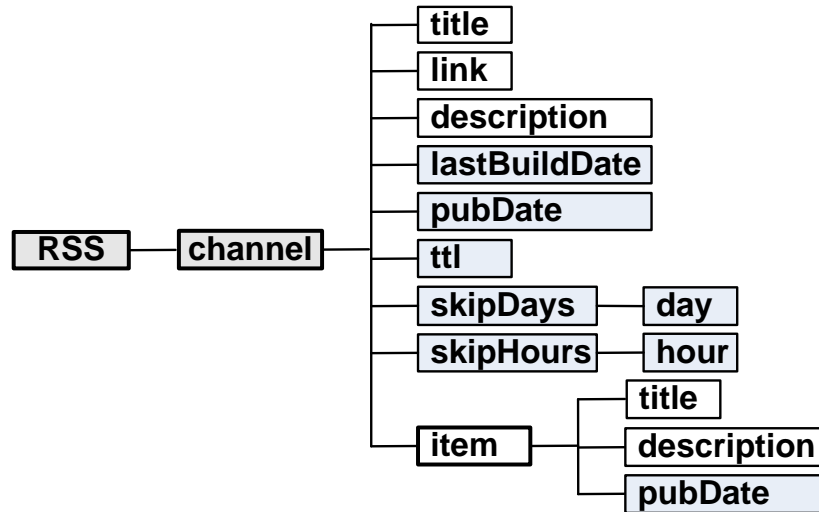
INTERNET RADIO

Ireland:
156 Internet Radio Stations

TV&RSS: High Level Diagram

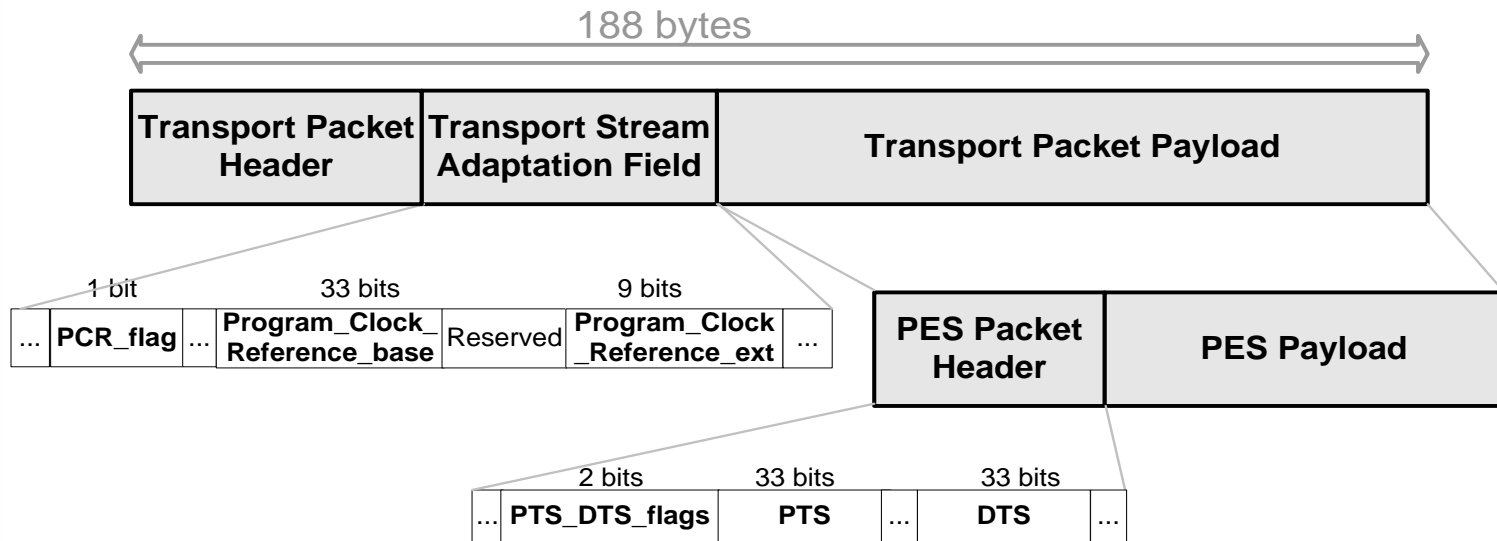


RSS 2.0 Timestamps



```
<?xml version="1.0" encoding="UTF-8"?>
<rss version="2.0">
<channel>
<lastBuildDate>Tue, 2 Feb 2006 06:15:48 GMT</lastBuildDate>
<pubDate>Tue, 11 Feb 2006 06:15:48 GMT</pubDate>
...
<item>
  <pubDate>Thu, 11 Feb 2010 06:15:48 GMT</pubDate>
  ...
</item>
  <item>
    <pubDate>Thu, 11 Feb 2010 06:15:48 GMT</pubDate>
    ...
  </item>
</channel>
</rss>
```

MPEG-2 TS Timestamps



Timestamps TV&RSS

MPEG-2 Timestamps

Bits Frequency Location

| | Bits | Frequency | Location |
|--|---------|-----------|------------------|
| PCR (Program Control Reference) | 42 bits | 27MHz | Adaptation Field |
| PTS (Presentation Timestamp) | 33 bits | 90 KHz | PES |
| DTS (Decoding Timestamp) | 33 bits | 90 KHz | PES |

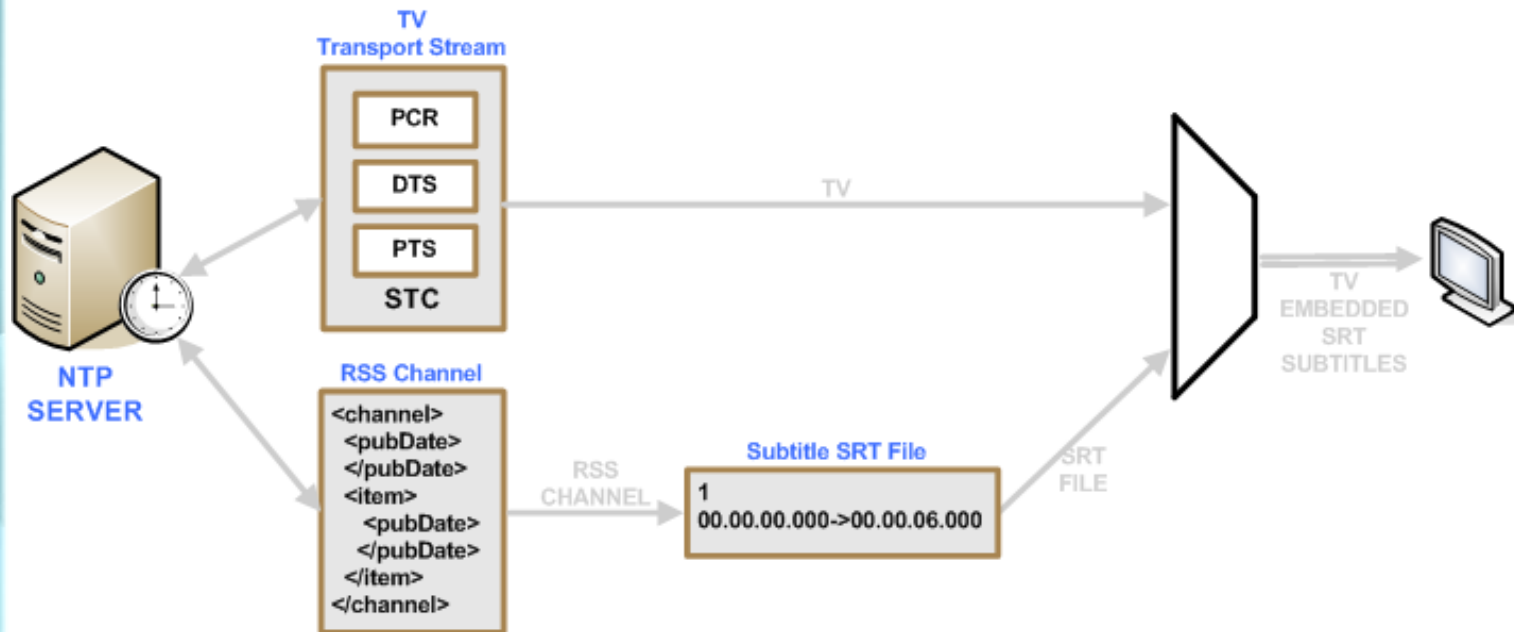
RSS 2.0 Timestamps

Time Data RFC822

Location

| | Time Data RFC822 | Location |
|--------------------------|-----------------------------------|----------|
| PubDate (Channel) | Sun, 19 May 2008 16:00:00.000 GMT | Channel |
| PubDate (Item) | Sun, 19 May 2008 16:00:00.000 GMT | Item |

IMPLEMENTATION: Subtitles



IMPLEMENTATION: Video Timing



Beginning video time 00:00:00,000
NTP: 15:16:00,000



Video time 00:00:10,666
NTP: 15:16:10,666



1
00:00:10,666-->00:00:16,666
<p>Mon, 14 Sep 2009 15:16:10,666 UTC</p>
<p>Kercher Judge Rejects Defence DNA Challenge</p>

SCREEN SHOT RESULT

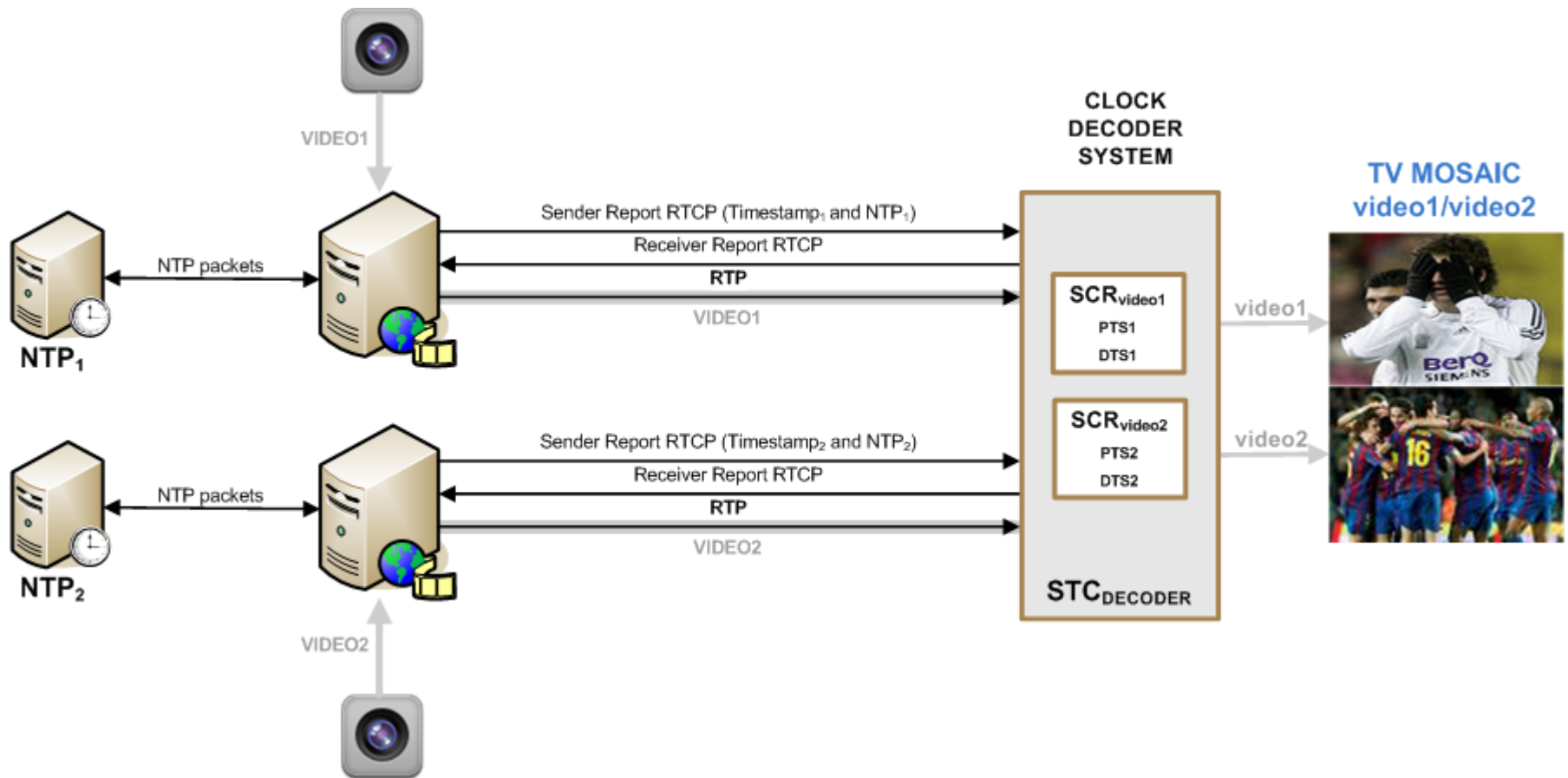


Wed, 16 Sep 2009 16:45:30 UTC
Rogue Bull Gores Runner To Death In Spain

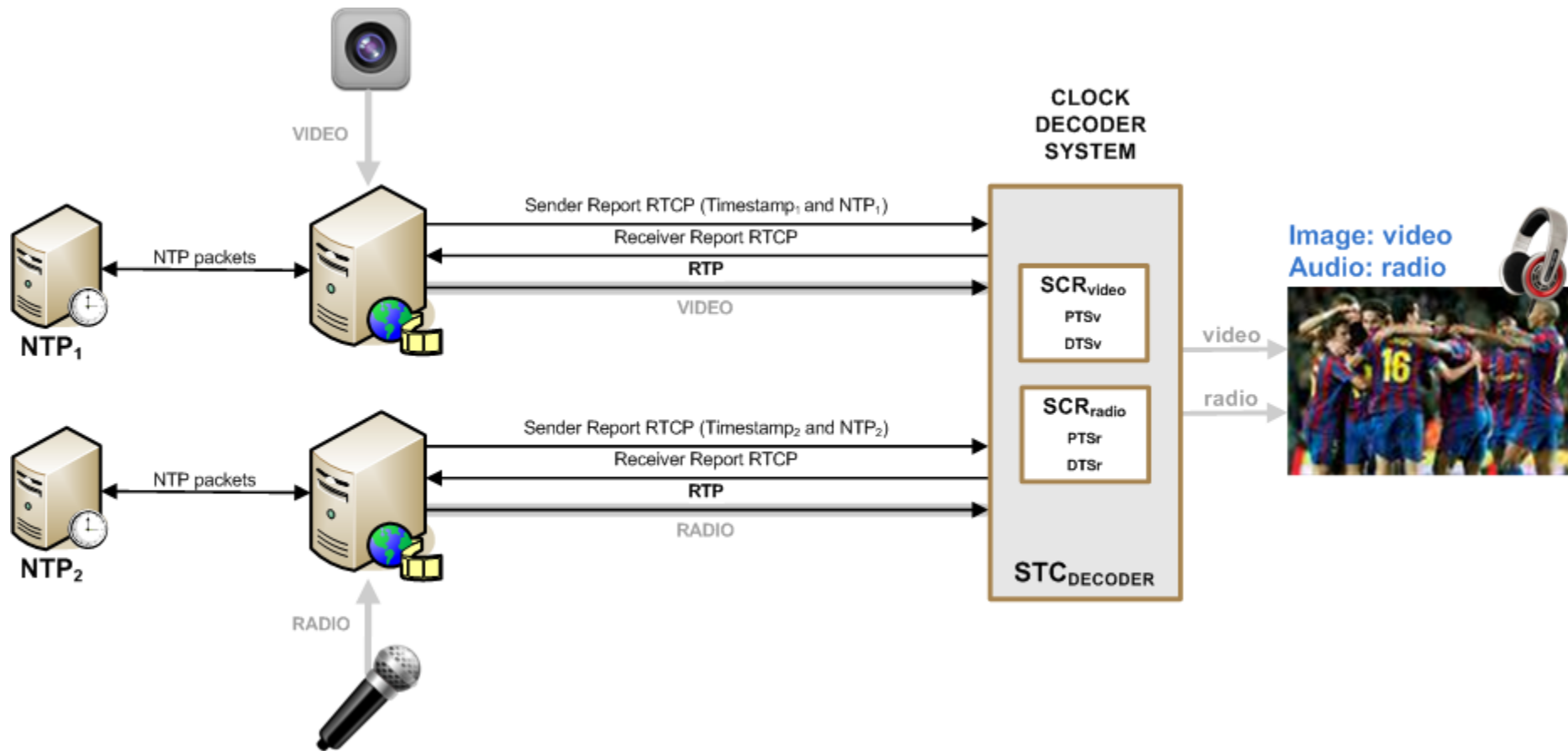
SCREEN SHOT RESULT



FUTURE WORK TV&TV



FUTURE WORK TV&Radio



TV&TV PROTOCOLS-TIMESTAMPS

RTP HEADER

| | | | | | | |
|--|---|---|----|---|----|-----------------|
| V | P | X | CC | M | PT | Sequence number |
| Timestamp (90KHz) 32 bits | | | | | | |
| Synchronisation source (SSRC identifier) | | | | | | |
| Contributing source (CSRC identifiers) | | | | | | |

RTCP HEADER

| | | | | |
|--|---|----|-----------|--------|
| V | P | RC | PT=RR=201 | length |
| SSRC of sender | | | | |
| NTP timestamp most significant word (32 bits) | | | | |
| NTP timestamp least significant word (32 bits) | | | | |
| RTP timestamp (90KHz) 32 bits | | | | |
| interarrival jitter (32 bits) | | | | |
| delay since last SR (32 bits) | | | | |

PES HEADER

| |
|---------------------|
| PTS (90KHz) 33 bits |
| DTS (90KHz) 33 bits |
| |
| |

