Media Clocks during Grandmaster changeover

802.1AS Precision Timing & Synchronization
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Residential AVB environment

- Unmanaged, but dynamic
  - Intermittent connection to public internet
  - Power on/off of AV and computer devices
  - Intermittent wireless device presence
- MUST operate standalone (no connection to standard time reference)
- SHOULD lock to standard time reference when available (1588-style clock selection)
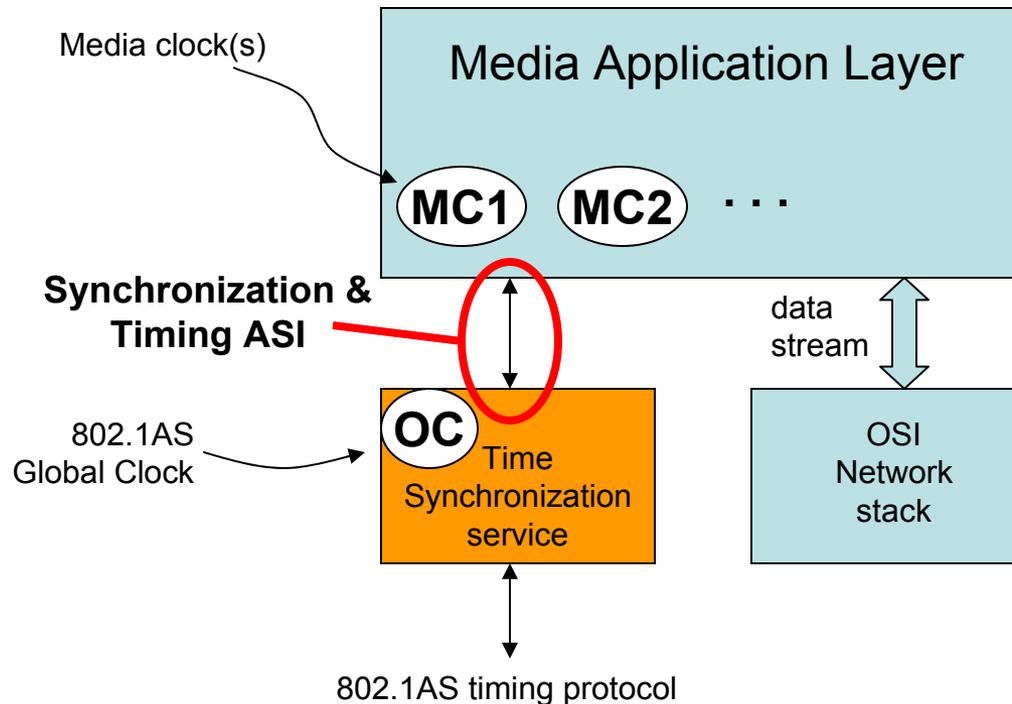
Grandmaster time changeover challenge

- "normal" operation includes changeover of grandmaster during streaming media operation
- "normal" operation includes changeover from standalone to TAI-referenced source
  - This involves a step change in timescale, typically milliseconds to seconds
  - Step change could be years (changeover from standalone "power-on epoch" to TAI time)
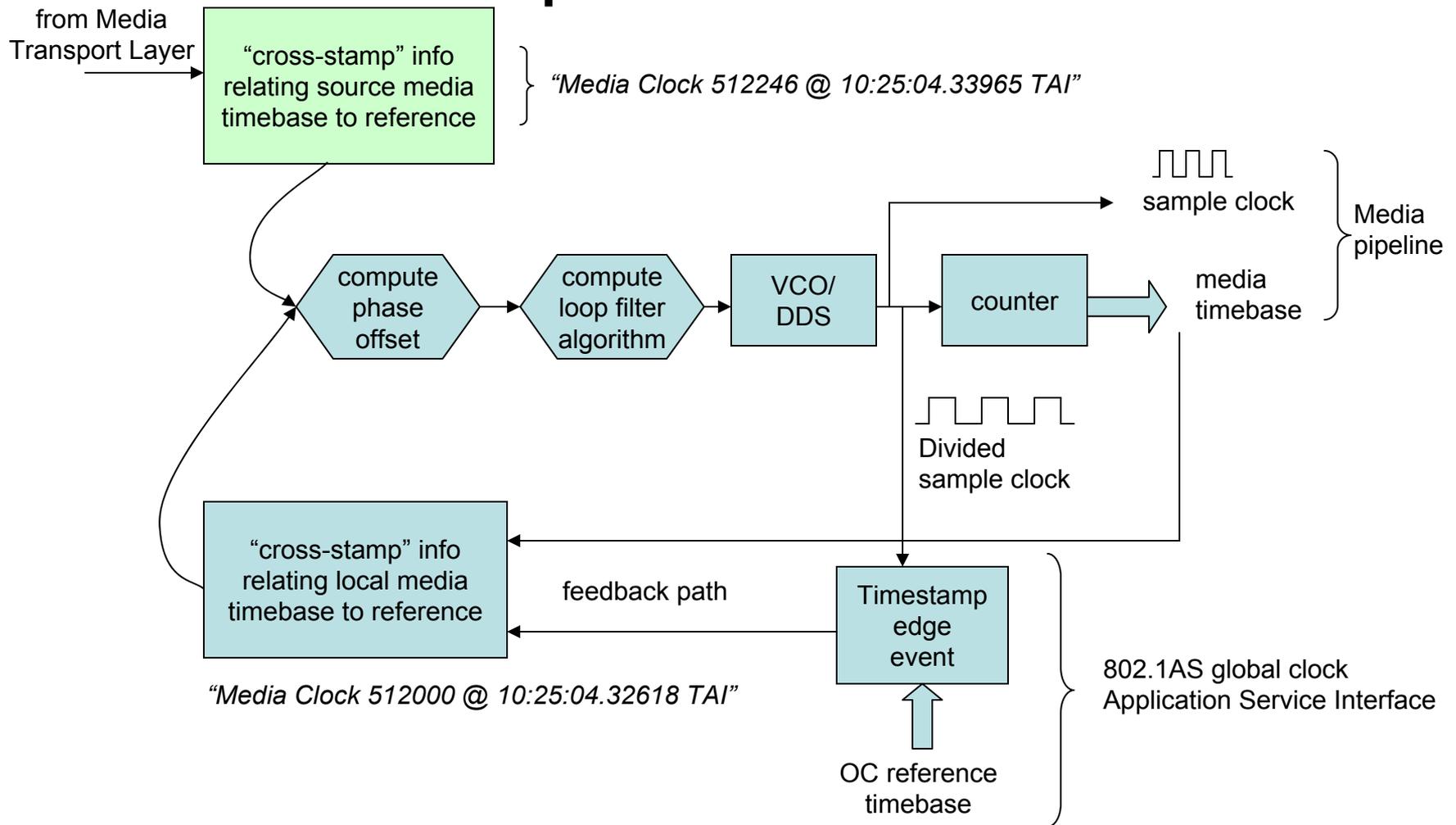- Goal: maintain media stream QoS during changeover

Yes, it can be done

Media clocks are distinct from
802.1AS Global Time clocks

- AVB media transport uses Global Time to *transfer* source Media Clock to receiver Media Clock
- For this function we only require that Global Time be *equal* at source and receiver, we don't care about its epoch
- During grandmaster changeover, there is a transient (due to propagation of new grandmaster selection and settling of Global Time clock algorithms) during which "equal time at source and receiver" is not guaranteed
- Solution: Media Clock can "freewheel" during changeover transient

802.1AS Global Clock Application Service Interface (ASI)

example Media Clock implementation

from Media Transport Layer

"cross-stamp" info relating source media timebase to reference

"Media Clock 512246 @ 10:25:04.33965 TAI"

compute phase offset

compute loop filter algorithm

VCO/ DDS

counter

sample clock

media timebase

Media pipeline

Divided sample clock

"cross-stamp" info relating local media timebase to reference

feedback path

Timestamp edge event

"Media Clock 512000 @ 10:25:04.32618 TAI"

OC reference timebase

802.1AS global clock Application Service Interface
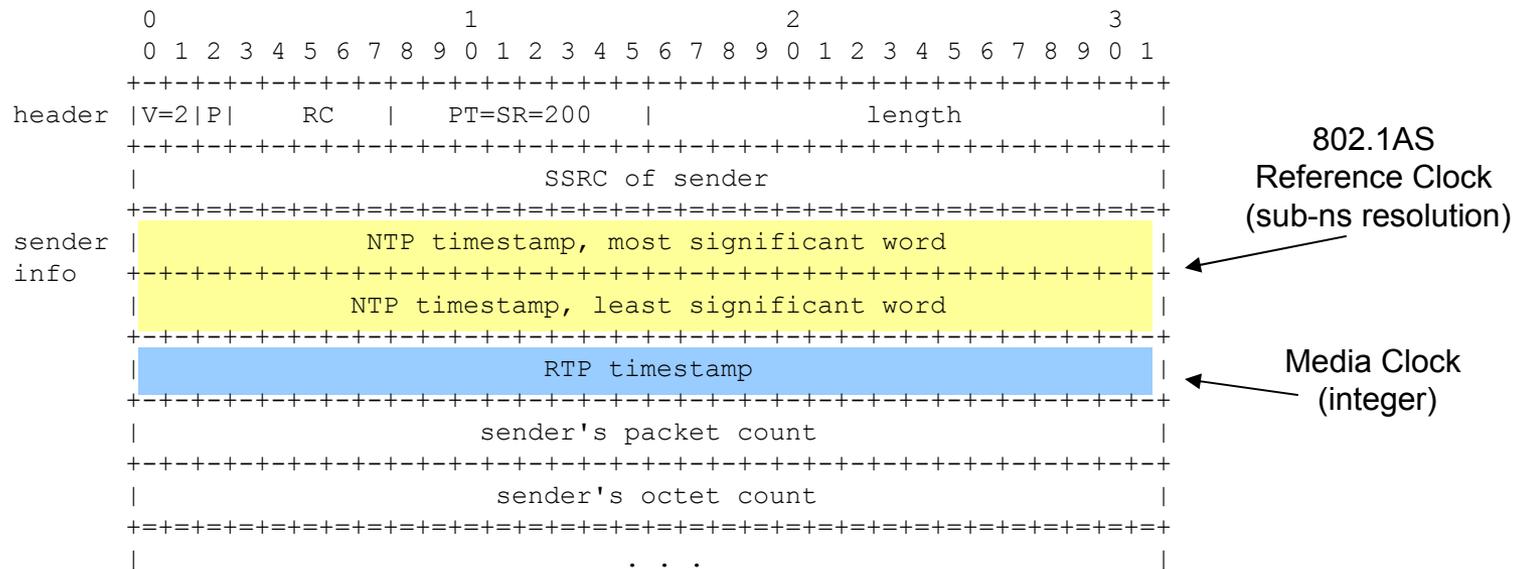
Media Cross-stamp in L3

```
RFC 3550                        RTP                          July 2003

6.4.1 SR: Sender Report RTCP Packet

        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
       +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
header |V=2|P|    RC   |   PT=SR=200   |             length            |
       +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
       |                         SSRC of sender                        |
       +=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+
sender |              NTP timestamp, most significant word             |
info   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
       |             NTP timestamp, least significant word             |
       +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
       |                         RTP timestamp                         |
       +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
       |                     sender's packet count                     |
       +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
       |                      sender's octet count                     |
       +=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+
       |                              . . .                            |
```

802.1AS
Reference Clock
(sub-ns resolution)

Media Clock
(integer)

Equivalent functionality expected from 61883 AVBTP, details TBD

Changeover transient

- 802.1AS Slave Clock can detect transient, based on change of Grandmaster ID
- Slave Clock can indicate this condition to media application layer
- Two proposals:
  - Slave Clock decides duration of transient and reports "valid/invalid" status (Jan 2007)
  - Slave Clock reports time since GM transition, application layer decides duration of transient (preferred in this presentation)

Modified ASI primitives

C. Harrison proposal

9.2.2.2.2 Semantics of the service primitive
The semantics of the primitive are as follows:
OC_TIMESTAMP.indication (

timestamp_value;	// Snapshot of Global Time at OC_EVENT.request instant
stabilization_time;	// Elapsed time since most recent GM changeover
overrun;	// Status of interface

)

D.V. James proposal

7.4.3.2 Semantics of the service primitive
The semantics of the primitives are as follows:
slaveSync {

frameCount,	// Identifies the previous slavePoke invocation
grandTime,	// Grand-master synchronized snapshot
stabilizationTime,	// Elapsed time since most recent GM changeover.

}

Media clock behavior

Recommended (not normative) behavior

Effect of receipt by "media clock slave" type client

Upon receipt of the {OC_TIMESTAMP.indication | slaveSync} primitive, the client application should update its media clock timebase (except as noted below) so as to maintain it in synchronization with its peer media clock source timebase. This update process should involve adequate temporal filtering to maintain the media clock timebase within the dynamic performance parameters, including jitter and wander, required by the application.

As an exception to the above, if the {*stabilization_time* | *stabilizationTime*} field of the primitive is less than the *stabilization_delay* parameter of the application, the client should treat the timestamp information in the primitive as unreliable and its media clock timebase should *not* be updated. A default *stabilization_delay* value of 0.5 seconds is recommended.