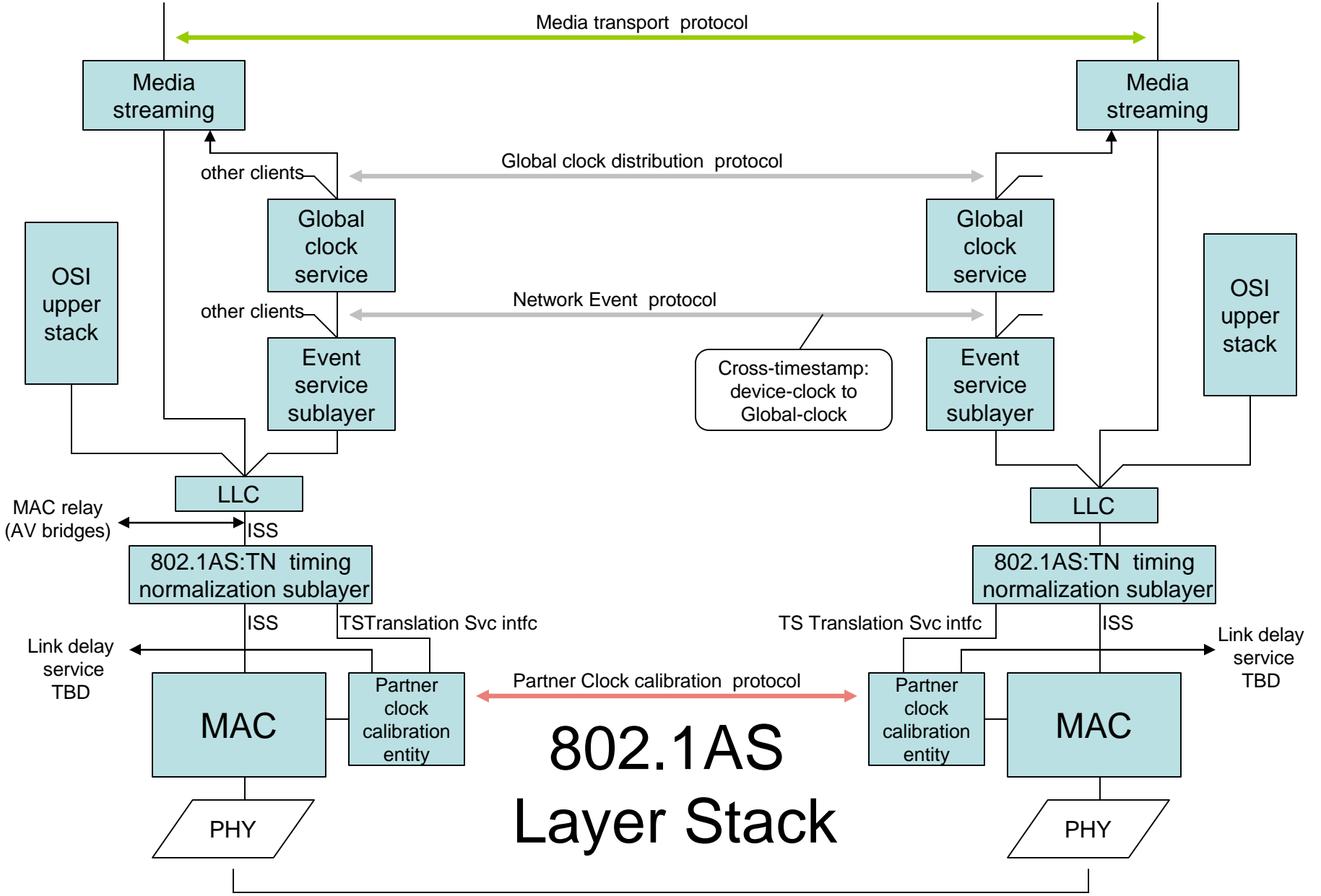


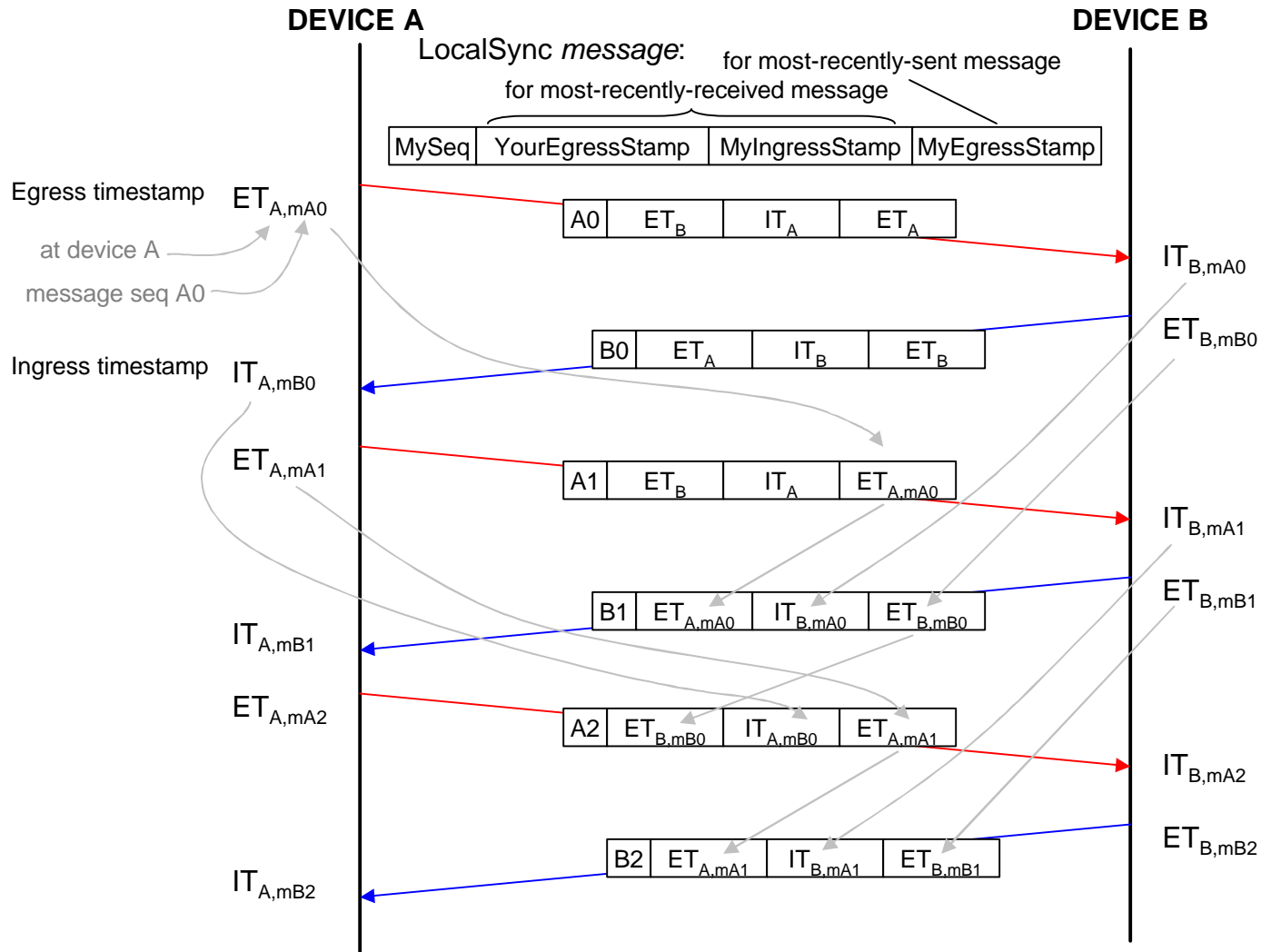
A peer-calibration architecture for global clock distribution

802.1AS Timing and Synchronization for Time-
Sensitive Applications in Bridged
Local Area Networks

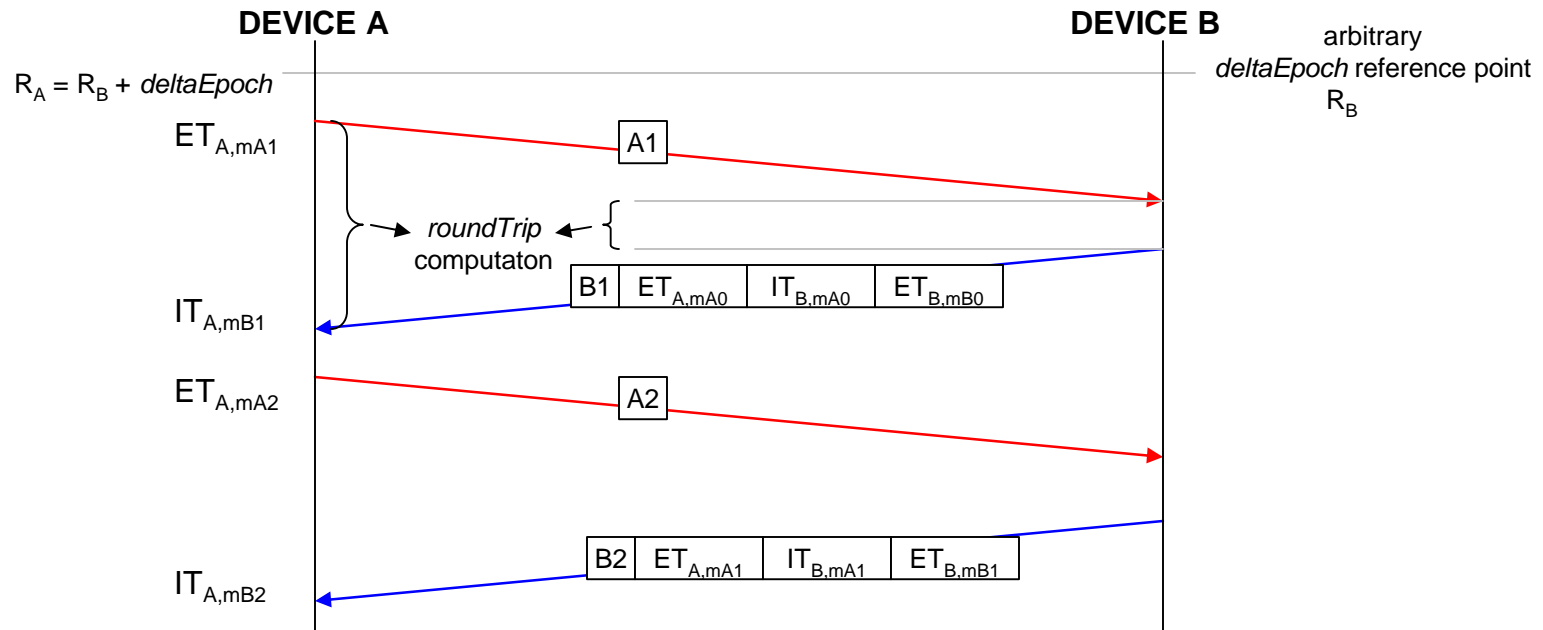
Chuck Harrison
19 February 2007



Partner clock calibration protocol: exchange of LocalSync frames



Partner clock calibration protocol: algorithm (view at device A)



Rate computation

$$\text{yourRate} = \frac{ET_{A,mA0} - ET_{A,mA1}}{IT_{B,mA0} - IT_{B,mA1}}$$

Roundtrip delay computation

$$\text{roundTrip} = (ET_{B,mB1} - IT_{B,mA1}) \text{yourRate} + IT_{A,mB1} - ET_{A,mA1}$$

Epoch difference computation

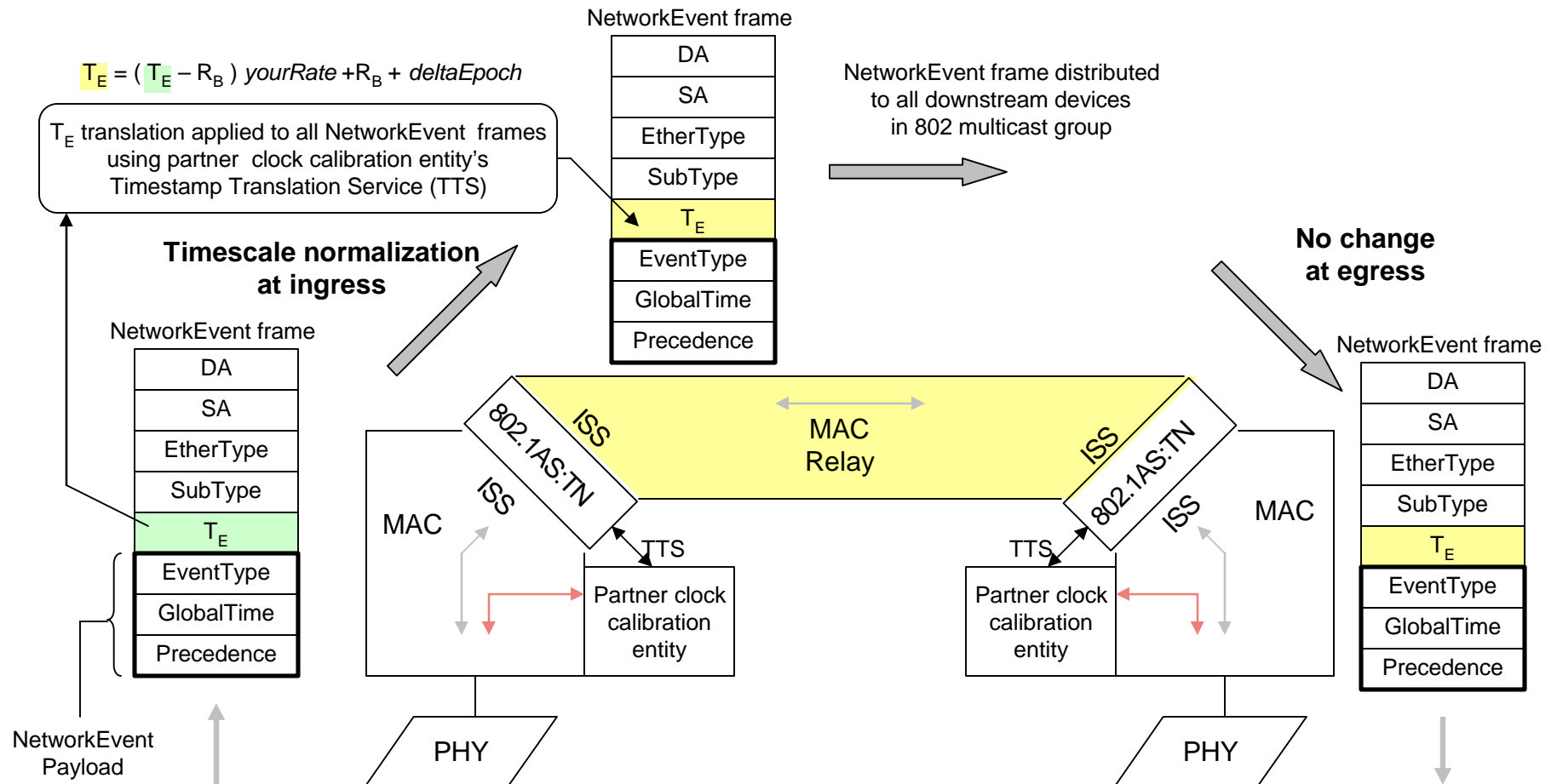
$$\text{deltaEpoch} = IT_{A,mB1} - \text{roundTrip} / 2 - ET_{B,mB1} * \text{yourRate} + R_B (\text{yourRate} - 1)$$

Timescale normalization (for Timestamp Translation Service)

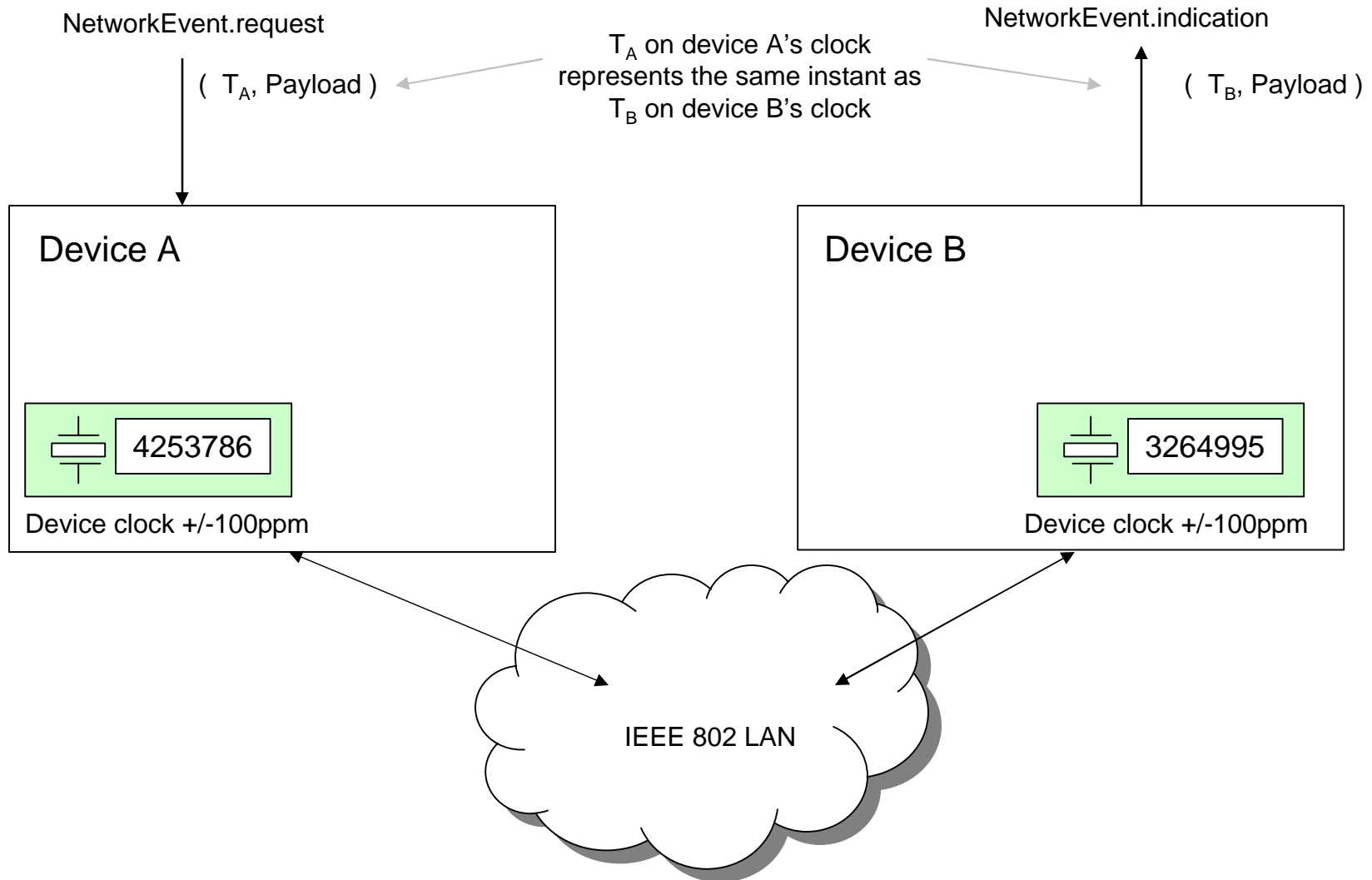
$$T_A = (T_B - R_B) \text{yourRate} + R_B + \text{deltaEpoch}$$

parameters may be time-filtered to improve performance

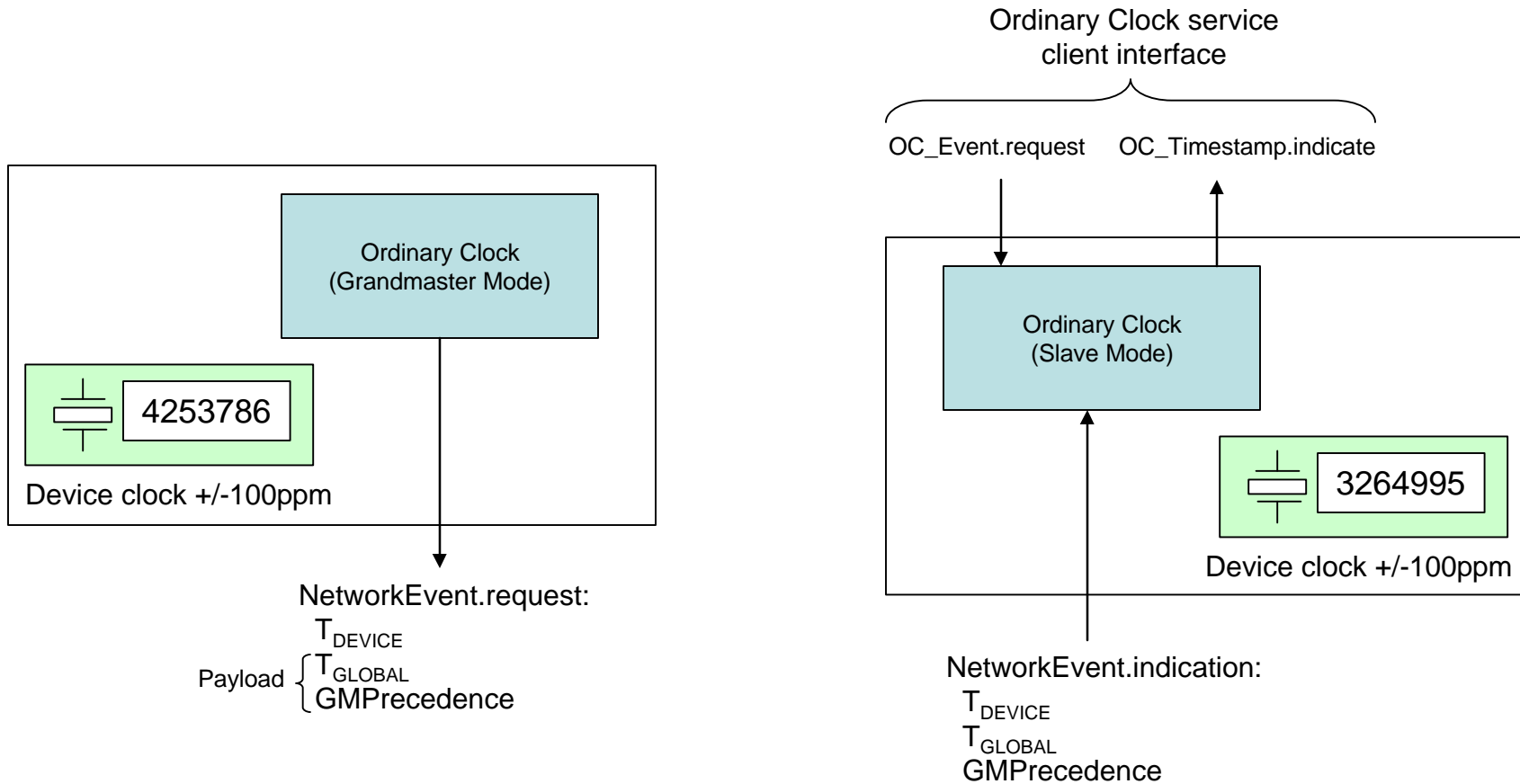
Forwarding of NetworkEvent protocol frames by 802.1AS bridge



Network Event Service (generic)



Global clock distribution using NetworkEvent service



Note: An Ordinary Clock receiving a message with a GMPrecedence field superior to its own operates in Slave Mode and emits no NetworkEvent service requests. An OC hearing no such messages operates in Grandmaster Mode, emits NetworkEvent requests, and also monitors all NetworkEvent service indications it receives.

Benefits of peer calibration architecture

- Scales well: no PLL- or syntonization- clock cascade
- Delivers low-jitter timestamps to Ordinary Clocks (due to peer calibration filtering)
- Minimal disruption under network topology change (peer clocks remain co-calibrated even when spanning tree is restructured)
- Useful interoperability interface at MAC Relay layer
- Useful generic service at Network Event layer: other applications can transparently deploy group synchronization functions independent of AVB global clock
- Leverages 802 Spanning Tree and multicast rather than implementing new BMC clock-hierarchy state machine
- Simple, robust, well-layered: you gotta love it!