
802.1as Time synchronization

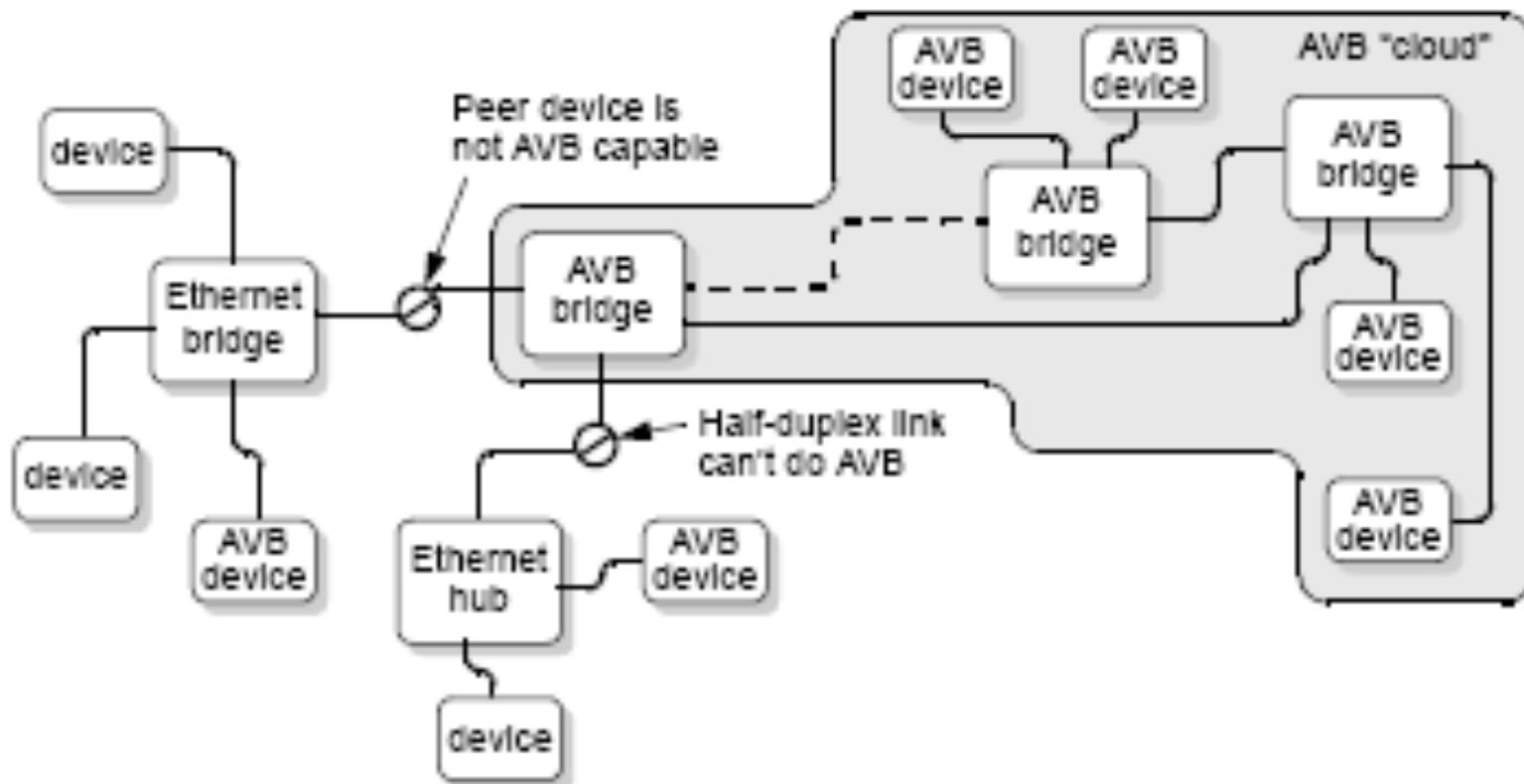
(a simplistic approach)

by David V James

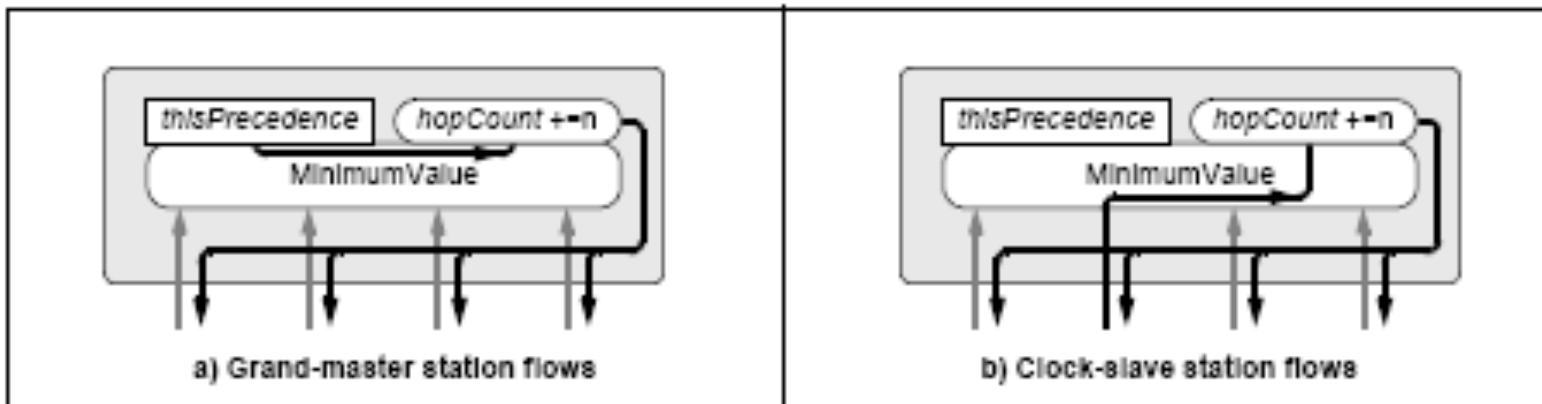
Features

- Simple
 - Single frame format
 - Single timeout (last of presence)
 - Single update rate (10 ms)
 - Single time format (scaled seconds)
- Accurate
 - Propagation-delay insensitive
 - Accurate cableDelay w/o grand-master syntonization
 - No gain peaking
- Familiar
 - Leverages 1588, changed only where simplifications needed
 - Common MAC-relay interface model

Assumed topologies

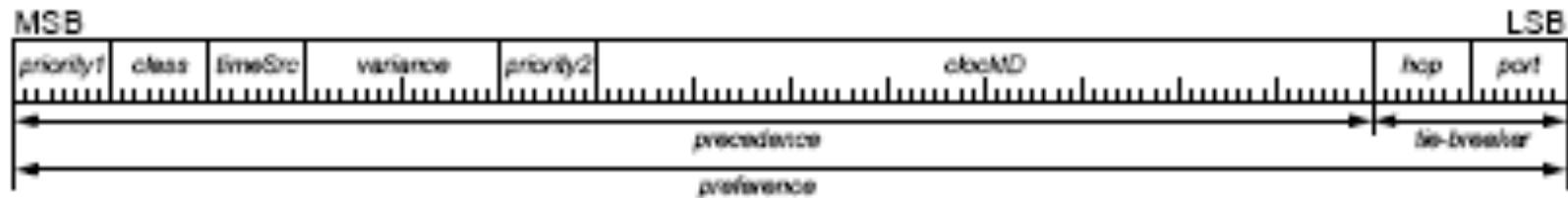


Rogue-frame aging

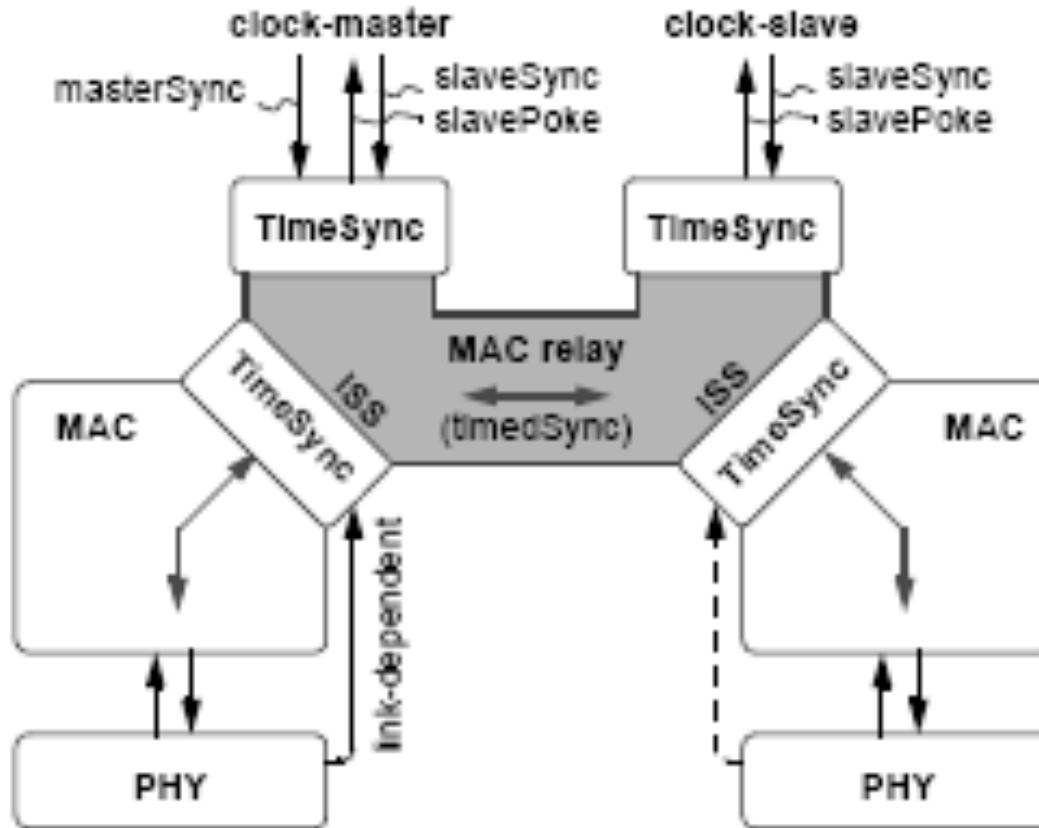


```
#define HOPS 255  
n = (frame.hopCount > hopCount) ? (HOPS - frame.hopCount) / 2 : 1;
```

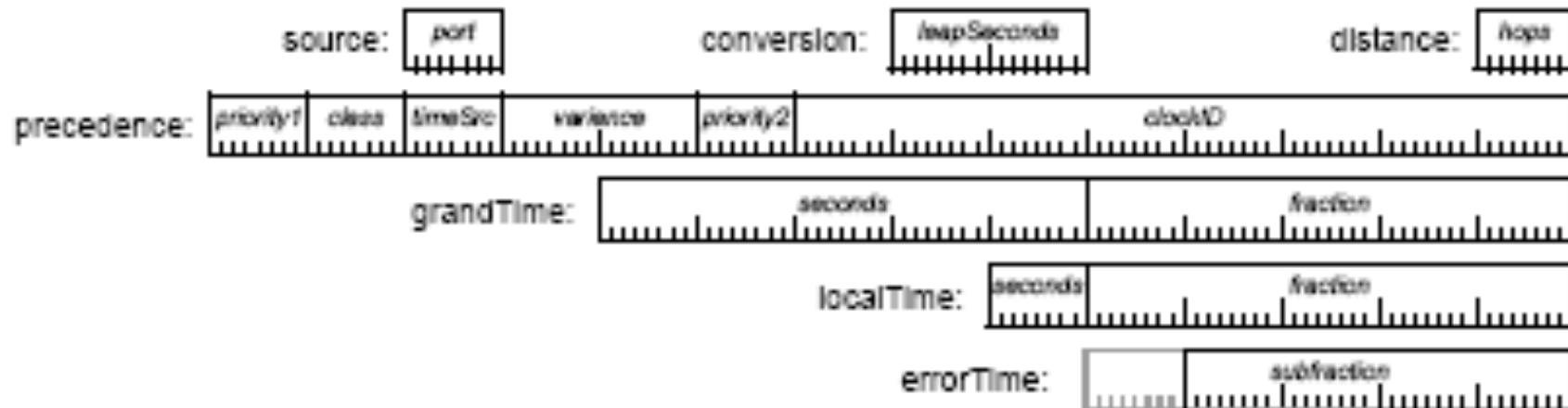
Grand-master precedence



Standardized interface



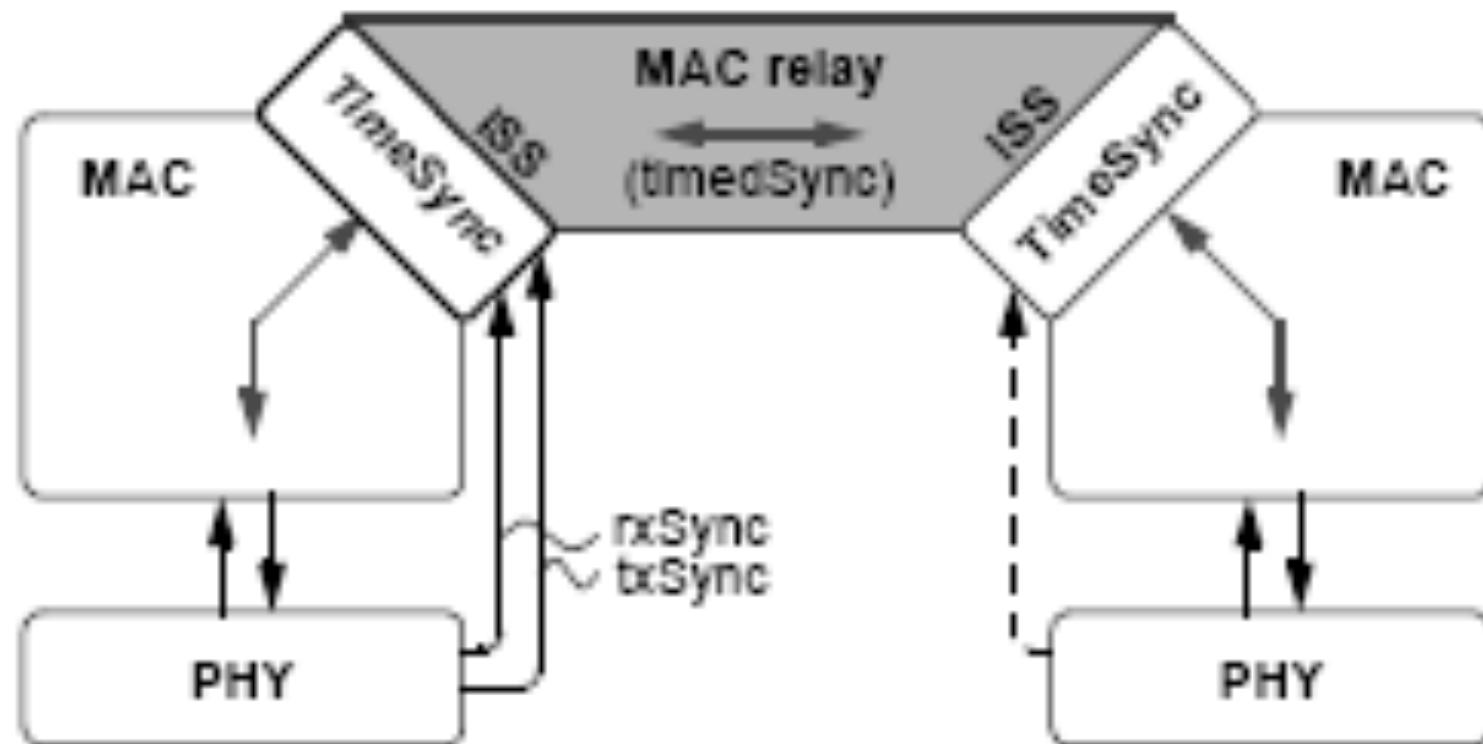
MAC-relay information



MAC-relay frame

6	da	— Destination MAC address
6	sa	— Source MAC address
2	protocolType	— Distinguishes AVB frames from others
1	function	— Distinguishes timeSync from other AVB frames
1	version	— Distinguishes between timeSync frame versions
14	precedence	— Precedence for grand-master selection
10	grandTime	— Transmitter global-time snapshot (1 cycle delayed)
4	errorTime	— Frame check sequence
1	portID	— A (sequence number) count of time-sync frames
1	hopCount	— Hop count from the grand master
2	leapSeconds	— Additional seconds are introduced as time passes
6	localTime	— Transmitter local-time snapshot (1 cycle delayed)
6	tockTime	— Nominal timeSync transmission Interval

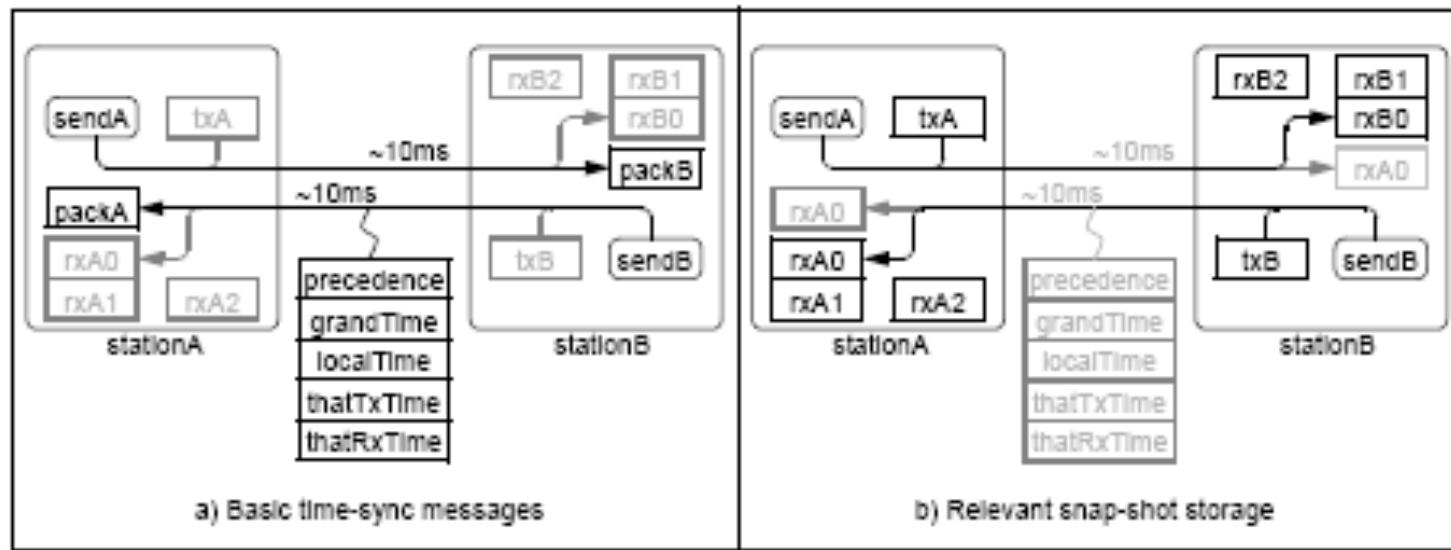
Duplex-link MACs



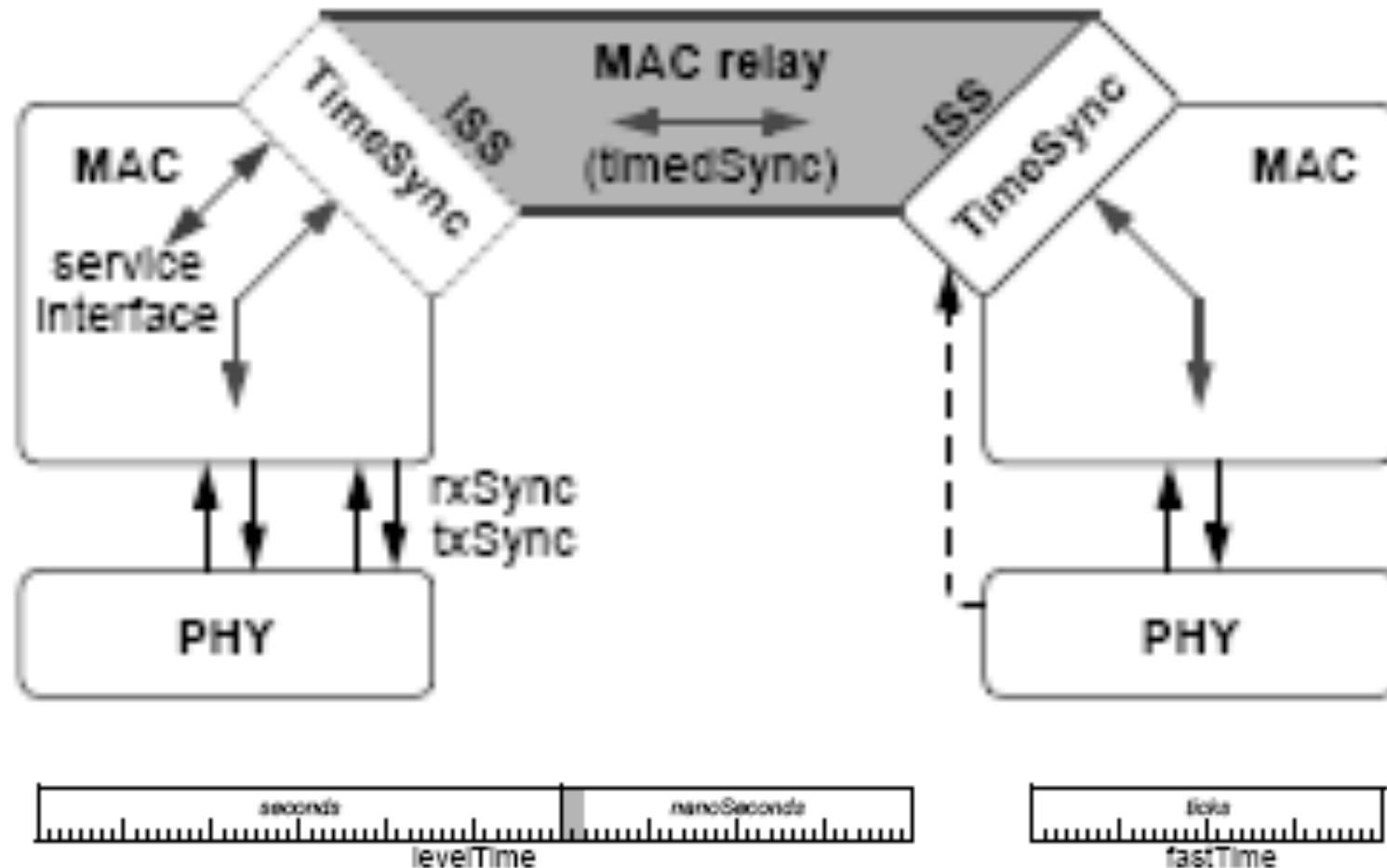
Duplex-link packet format

6	da	— Destination MAC address
6	sa	— Source MAC address
2	protocolType	— Distinguishes AVB frames from others
1	function	— Distinguishes timeSync from other AVB frames
1	version	— Distinguishes between timeSync frame versions
14	precedence	— Precedence for grand-master selection
10	grandTime	— Transmitter grand-time snapshot (1 cycle delayed)
4	errorTime	— Back-prediction error for grandTime computation
1	frameCount	— A (sequence number) count of time-sync frames
1	hopCount	— Hop count from the grand master
2	leapSeconds	— Additional seconds are introduced as time passes
6	localTime	— Transmitter local-time snapshot (1 cycle delayed)
6	thatTxTime	— Opposing link's frame transmission time
6	thatRxTime	— Opposing link's frame reception time
4	fcs	— Frame check sequence
70 bytes total		

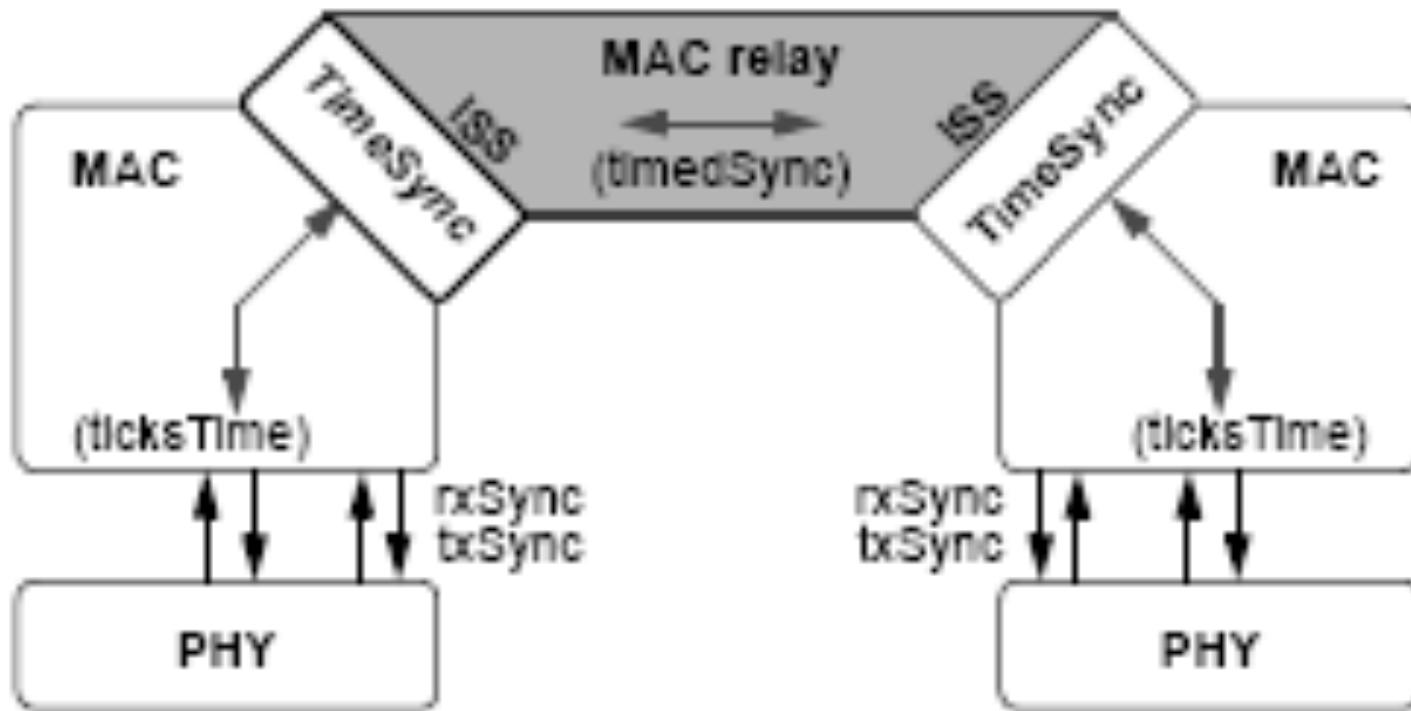
Duplex-link timing



Radio times



Ethernet PON



State of the proposal

- First-pass completion
 - Very few “we will” items
 - Compiled w/o errors C code
 - Wrap-around and unknown bugs
 - A few overlooked items
- MAC-relay
 - Ethernet-PON and Radio
 - Model to understand/justify complexities
- Details
 - State machines for all
 - A few details are missing

State of the proposal (A)

Table 8.1—TimeSyncRxRadio state machine table

Current		Row	Next	
state	condition		action	state
START	(req1 = Dequeue(Q_S1_IND)) != NULL	1	// Summary of TimeSyncRxRadio1Indicate() pPtr->rxTurnRound = req1.fastTime3 - req1.fastTime2;	WAIT
	—	2	localTimes = RadioLocalTimes(pPtr);	START
WAIT	(req2 = Dequeue(Q_S2_IND)) != NULL	3	// Summary of TimeSyncRxRadio2Indicate() rPtr = &(relayFrame); twice = req2.roundTrip - pPtr->rxTurnRound; moved = localTimes.ticksTime - req2.fastTime4; SetRelayFrame(pPtr, rPtr); rPtr->grandTime = RadioToGrand(req2.radioTime) + MultiplyHi((twice/2) + moved, RADIO_TIME); rPtr->localTime = localTimes.localTime; Enqueue(Q_MR_HOP, relayFrame);	START
	—	4		—