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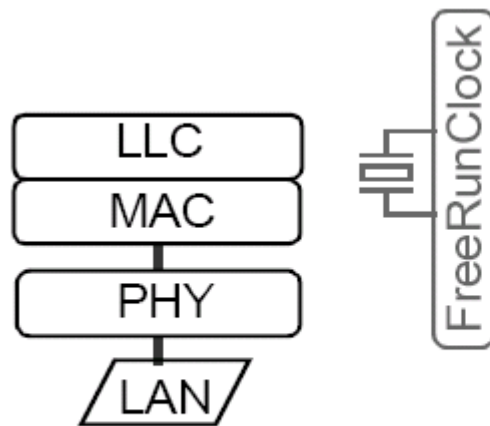
**AV bridging:**  
**Time-synchronization background**

David V James

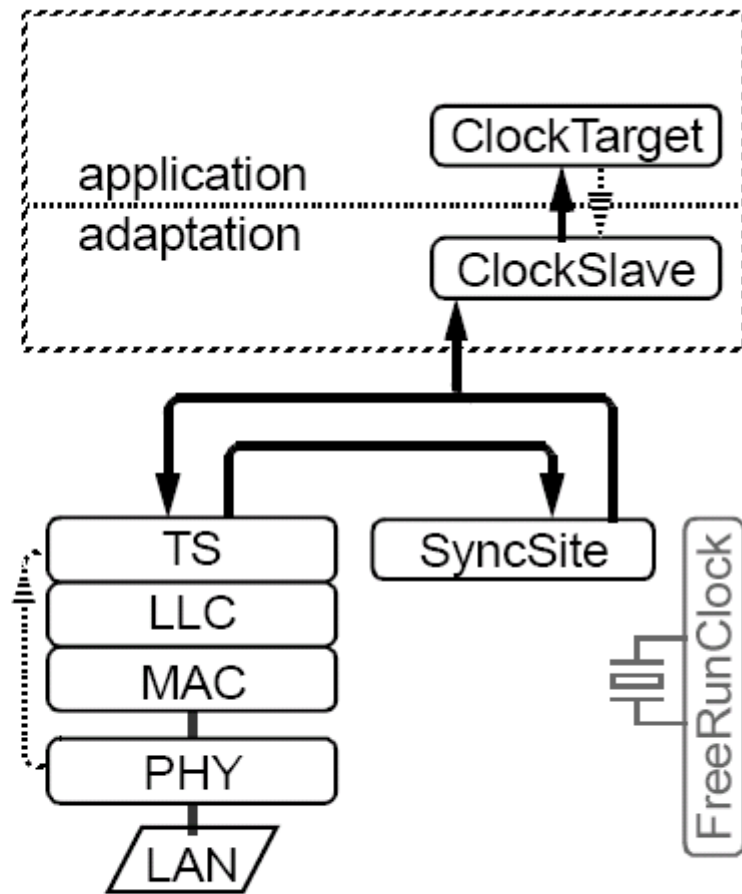
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# Station clock possibilities

# Source-less station alternatives

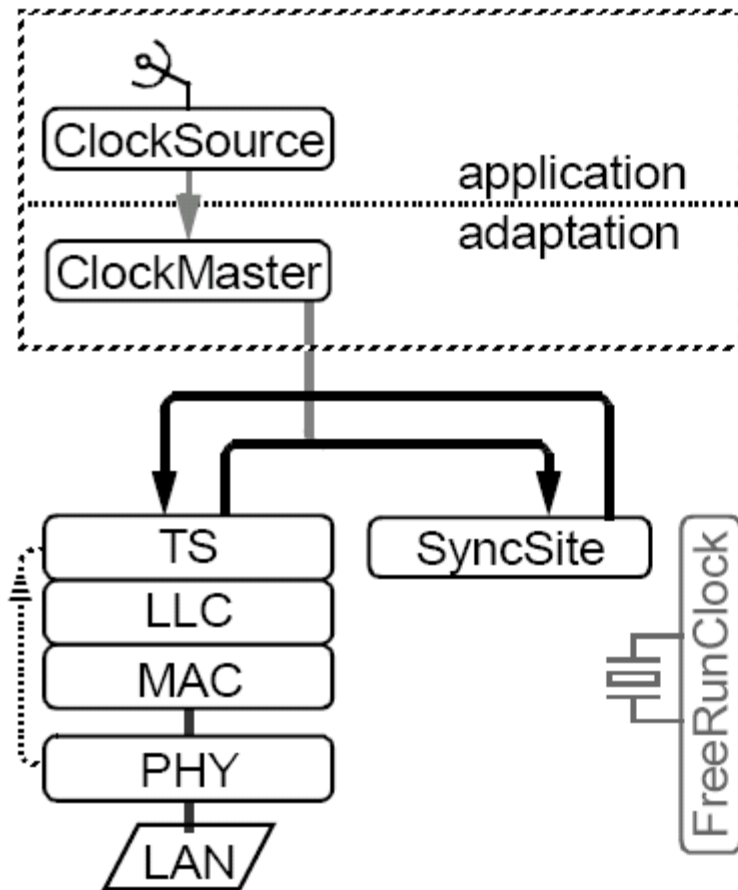


a) *Time unaware*

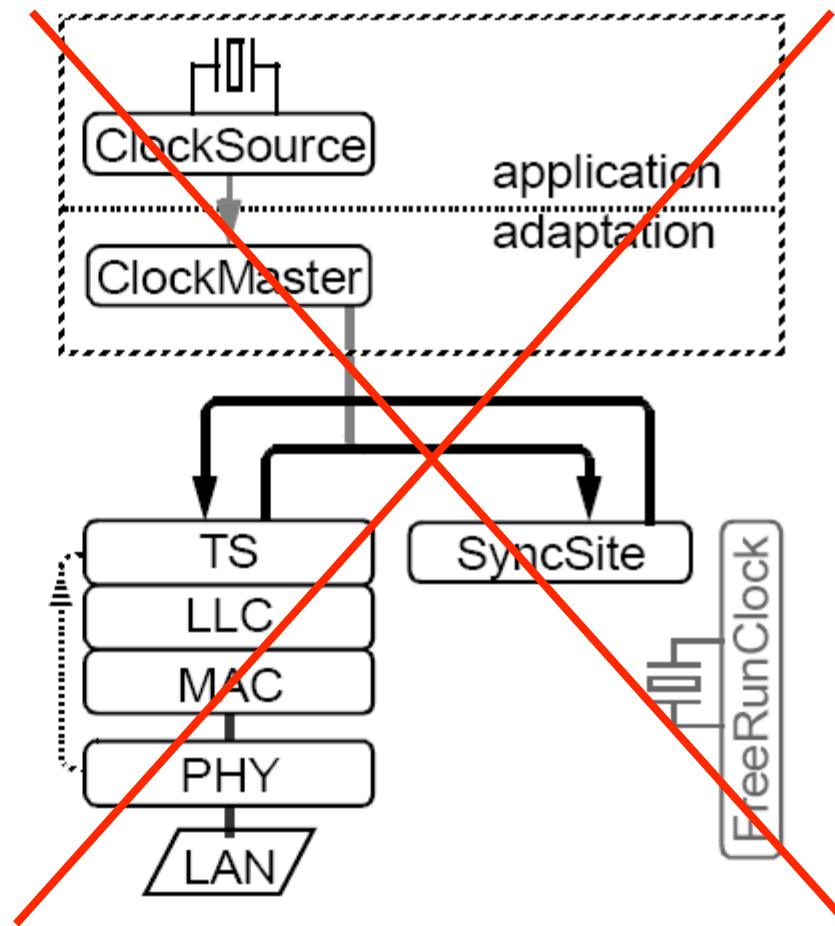


b) *Target only*

# Source-only alternatives

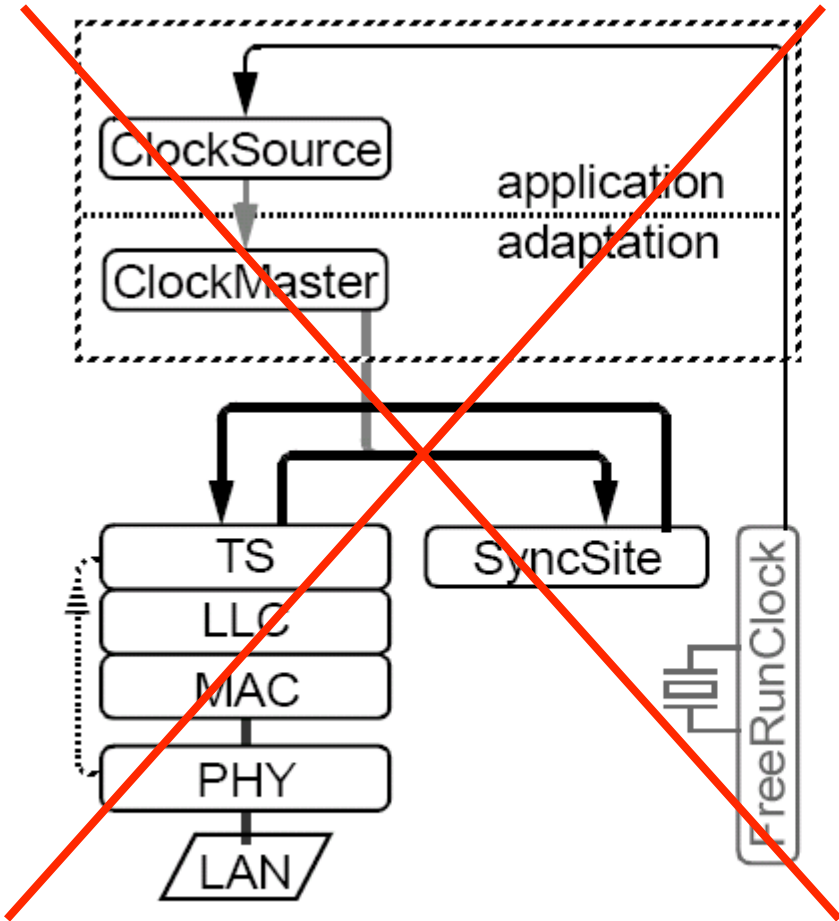


c) Traceable source

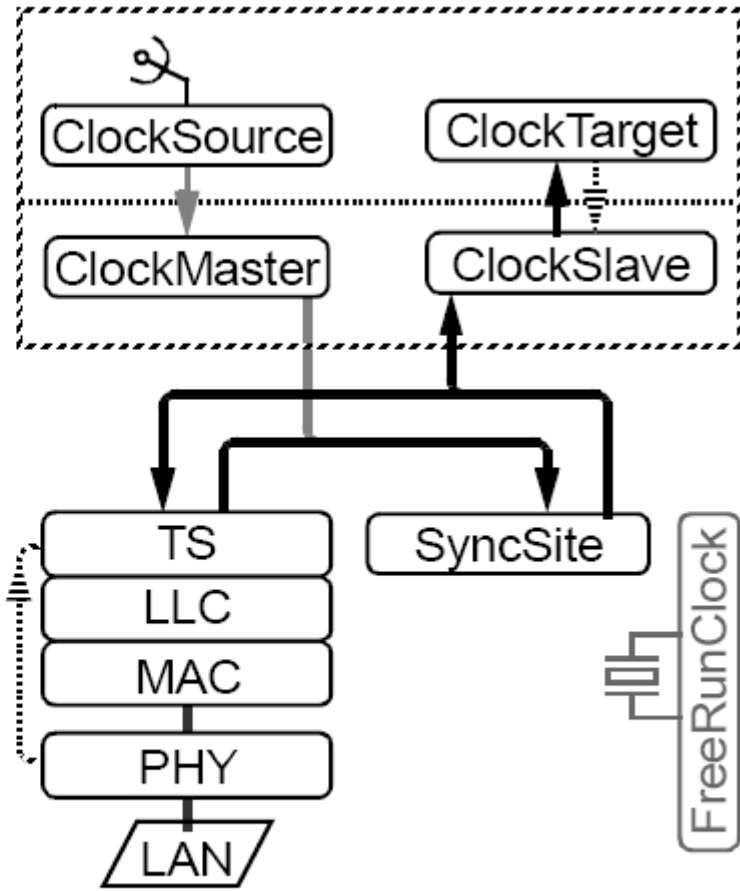


d) *Nontraceable source*

# Integrated/Traceable sources

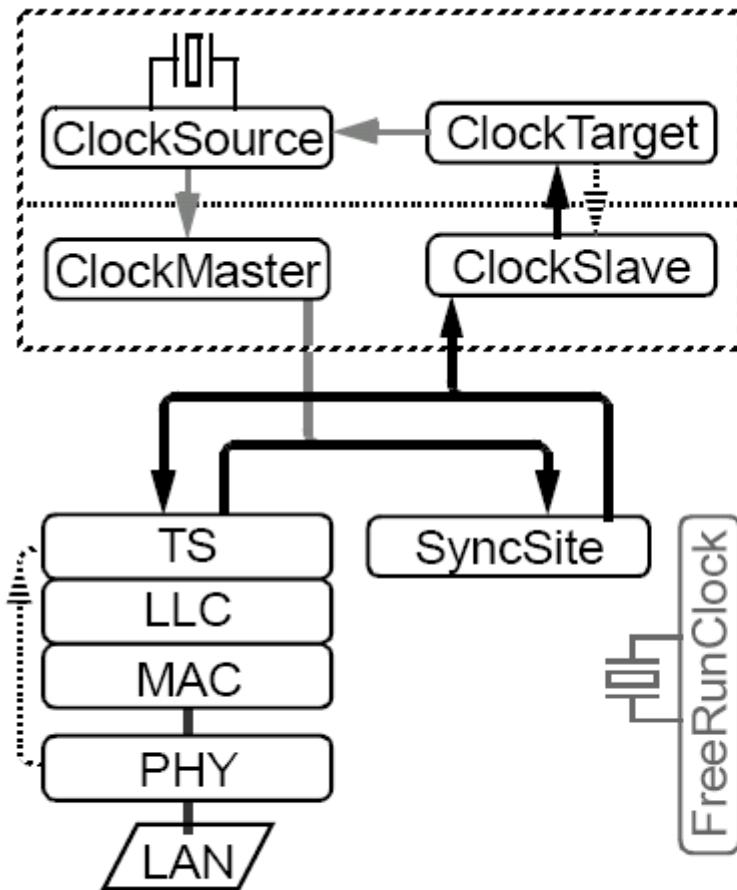


**e) *Integrated source***

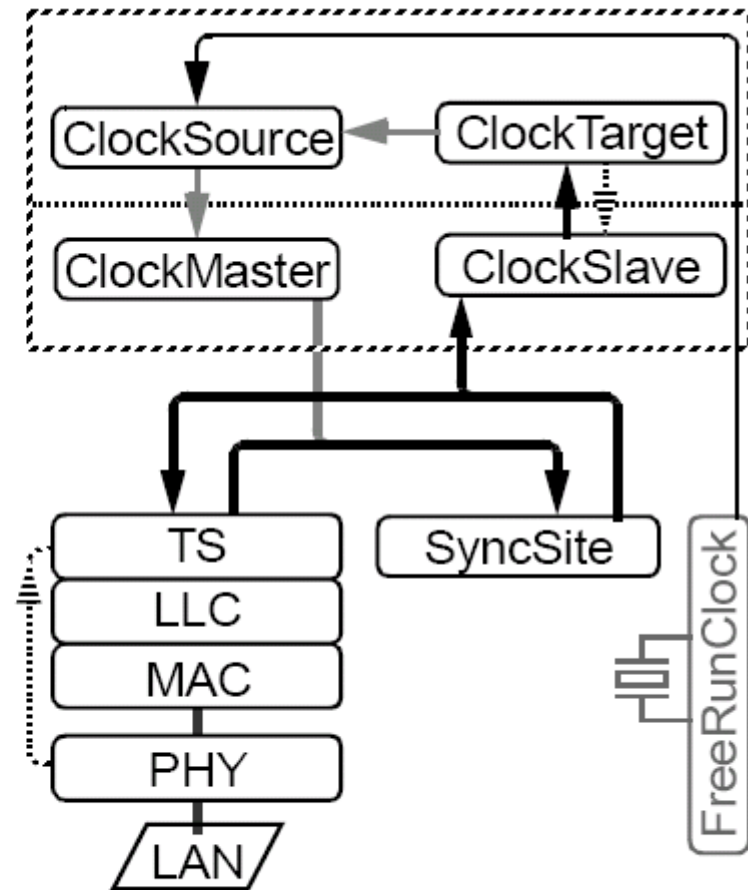


**f) *Traceable duplex***

# Nontraceable sources



**g) Nontraceable duplex**

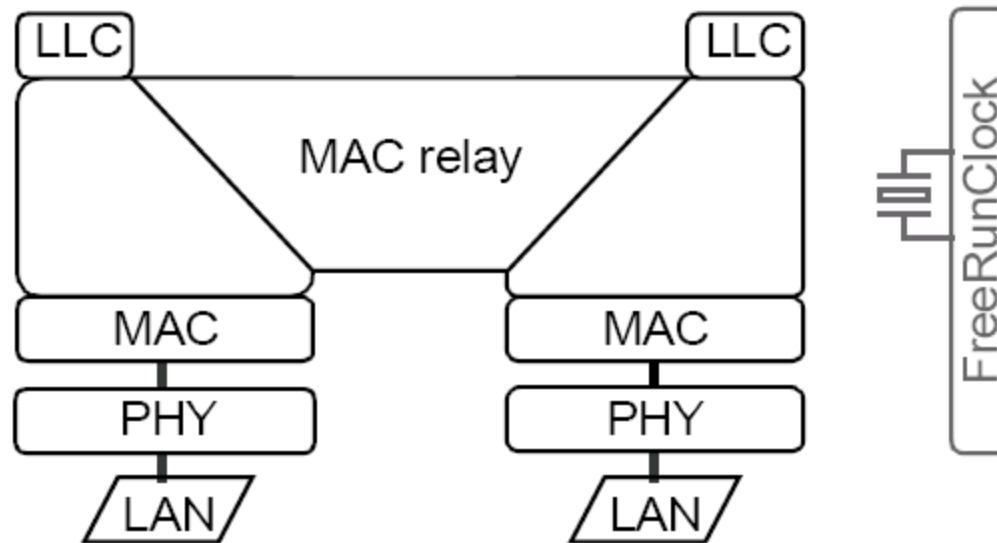


**h) Integrated duplex**

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# Bridge clock possibilities

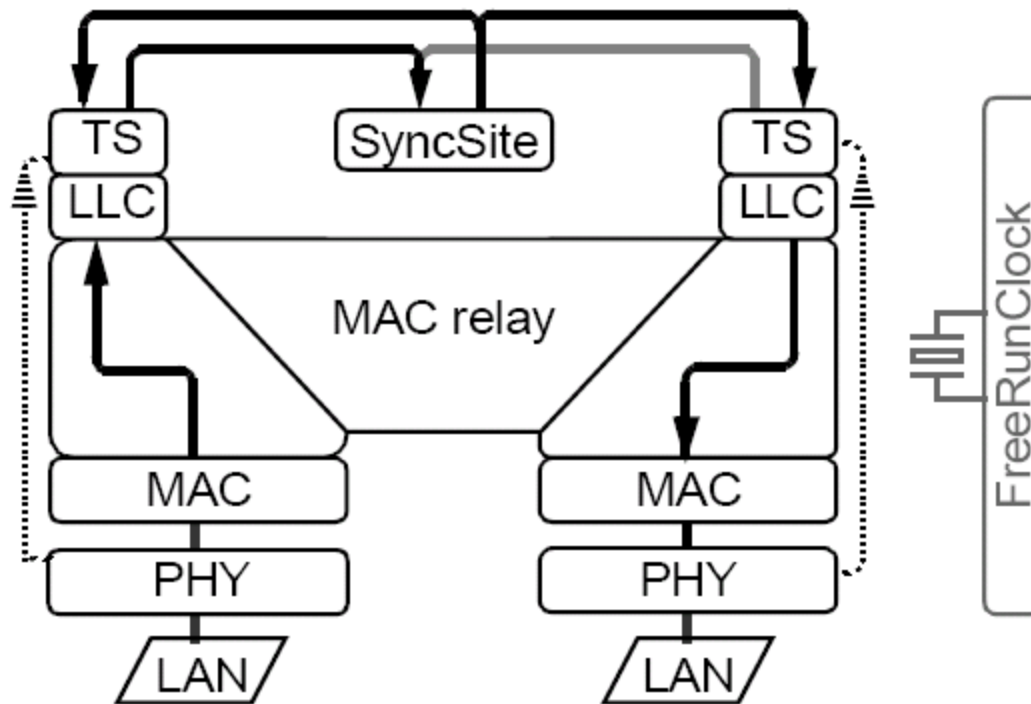
# Time-unaware bridge



a) Time-unaware bridge

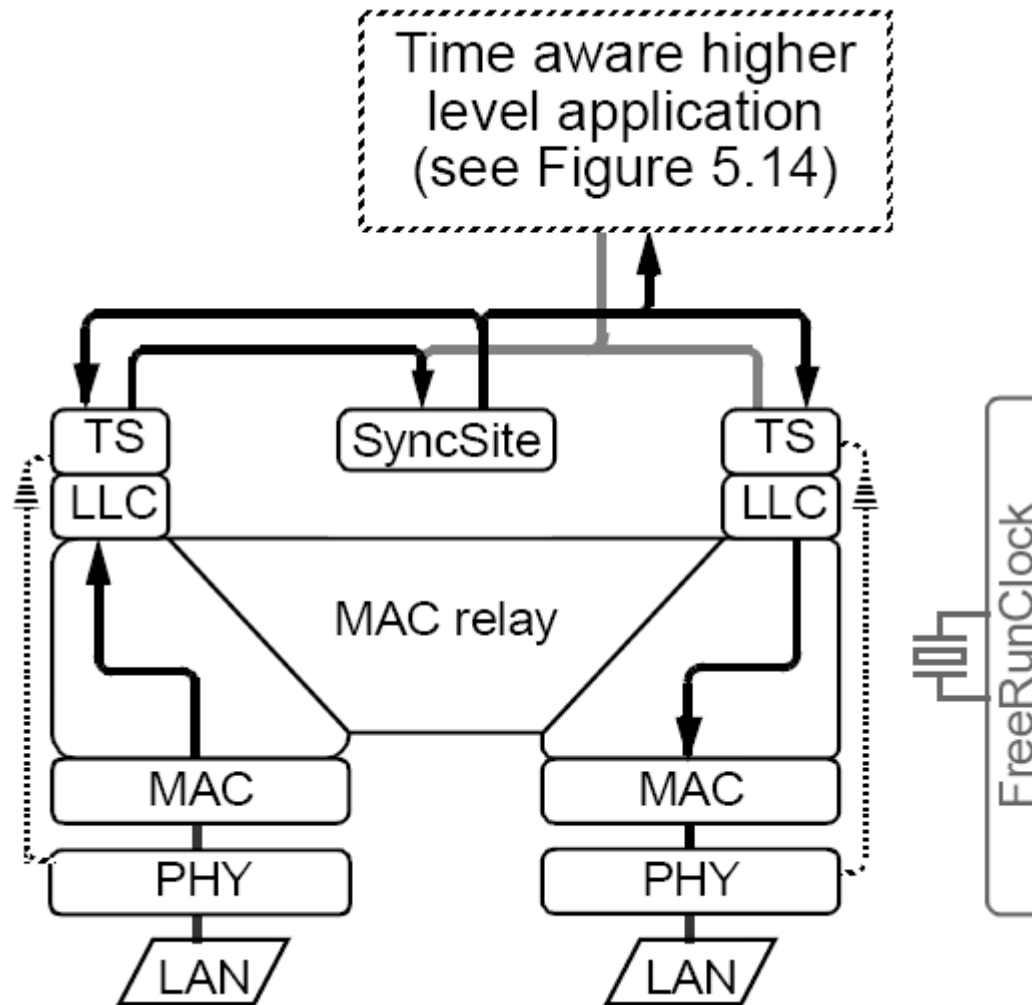


# Time-aware bridge



b) Time-aware bridge

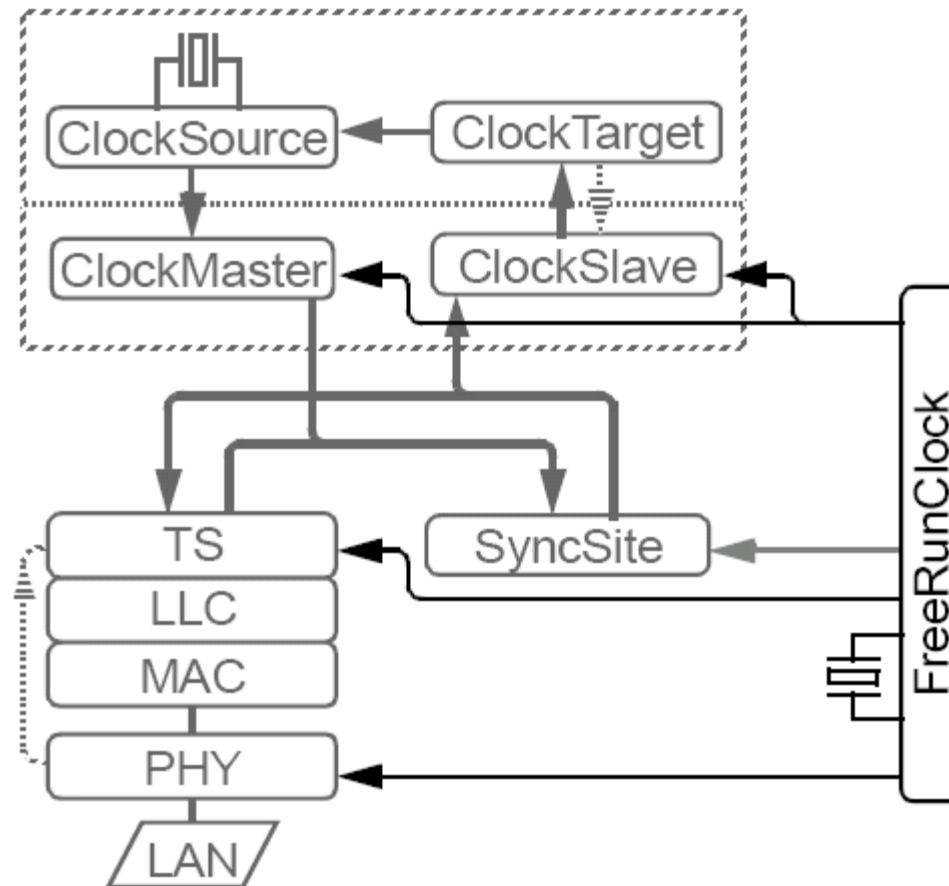
# Clock-capable bridge



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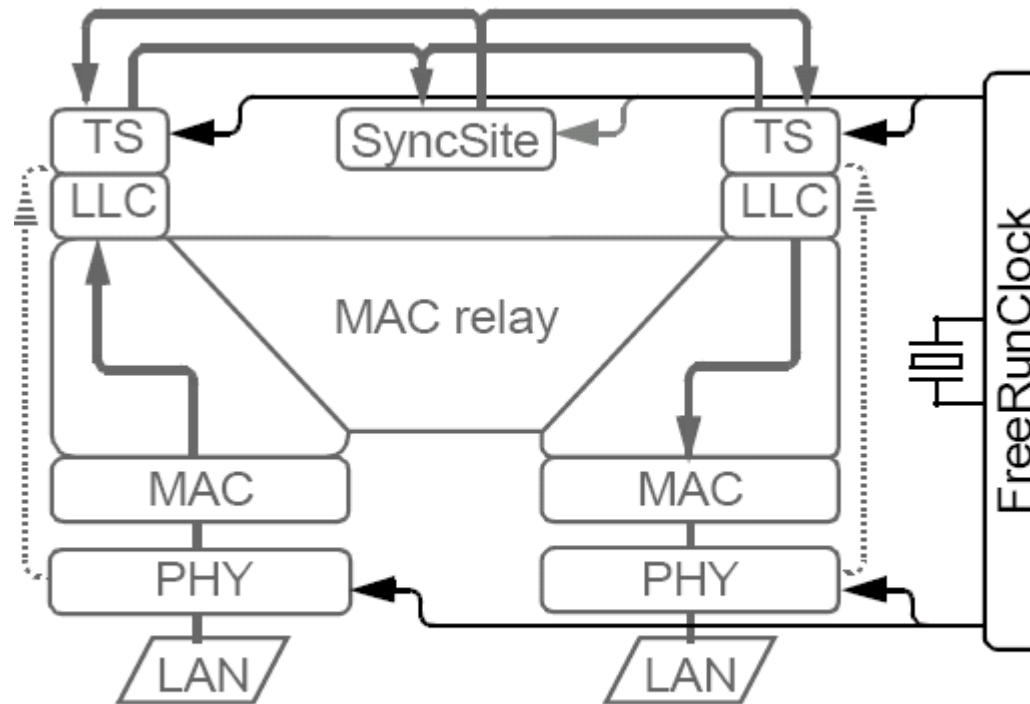
# Bridge clock possibilities

# Station clock distribution



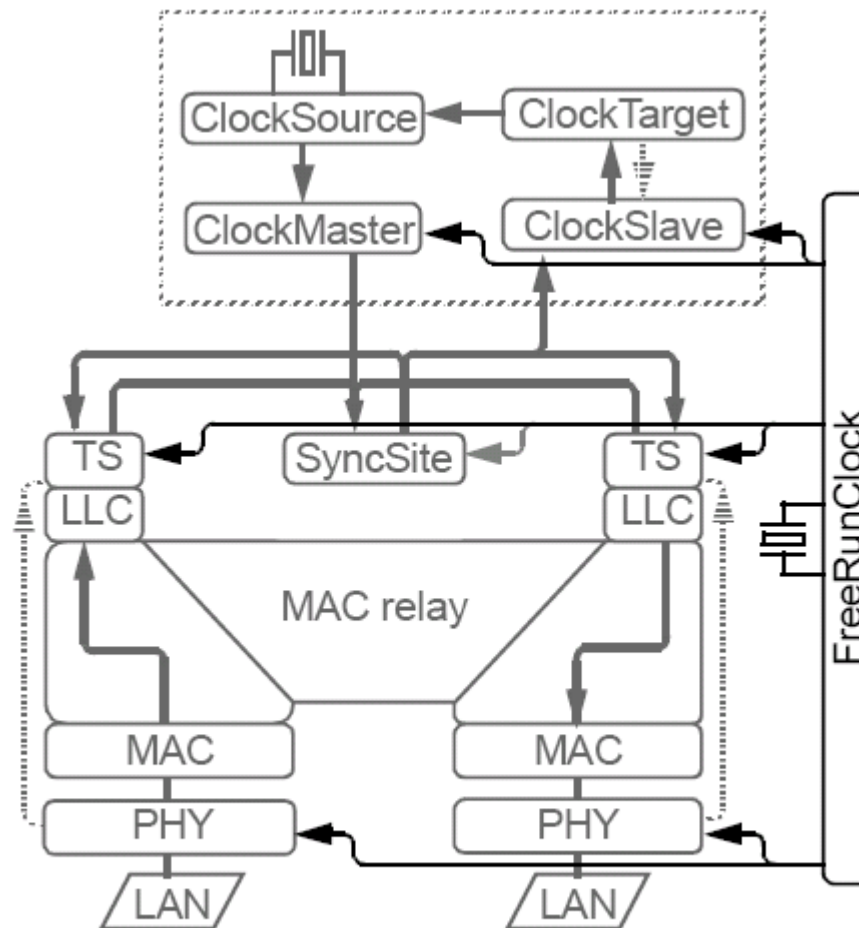
a) Time-aware station

# Time-sync clock interfaces



**b) Time-aware bridge**

# Time-sync clock interfaces

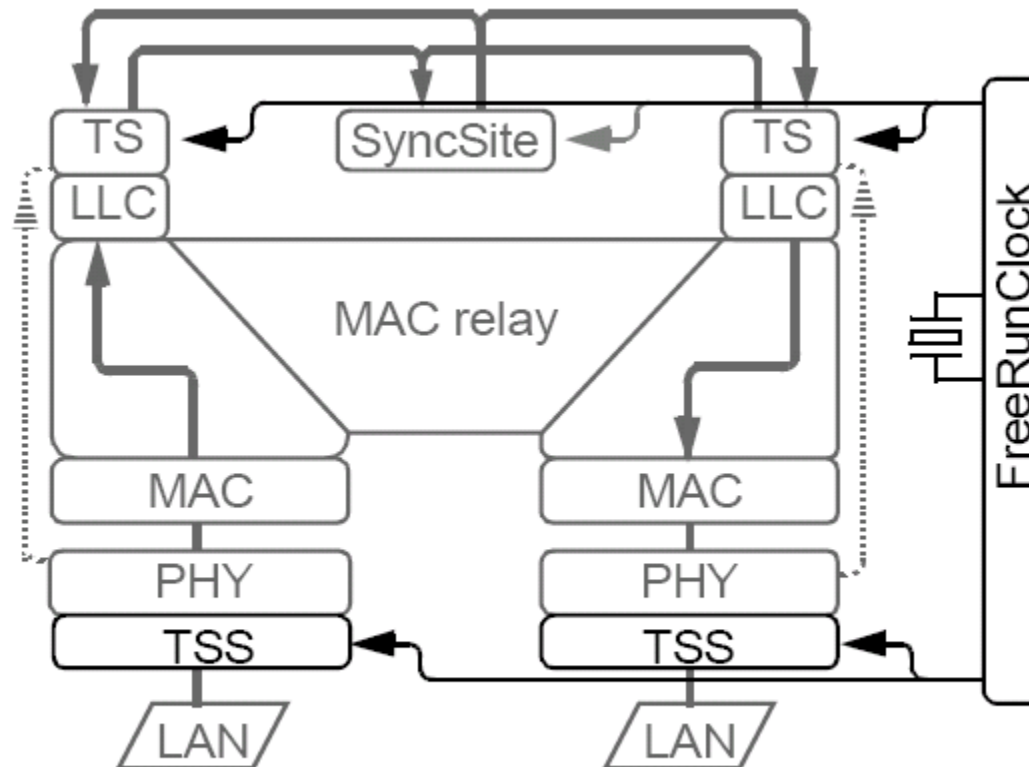


c) Clock-resident bridge

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# Time-stamp reference points

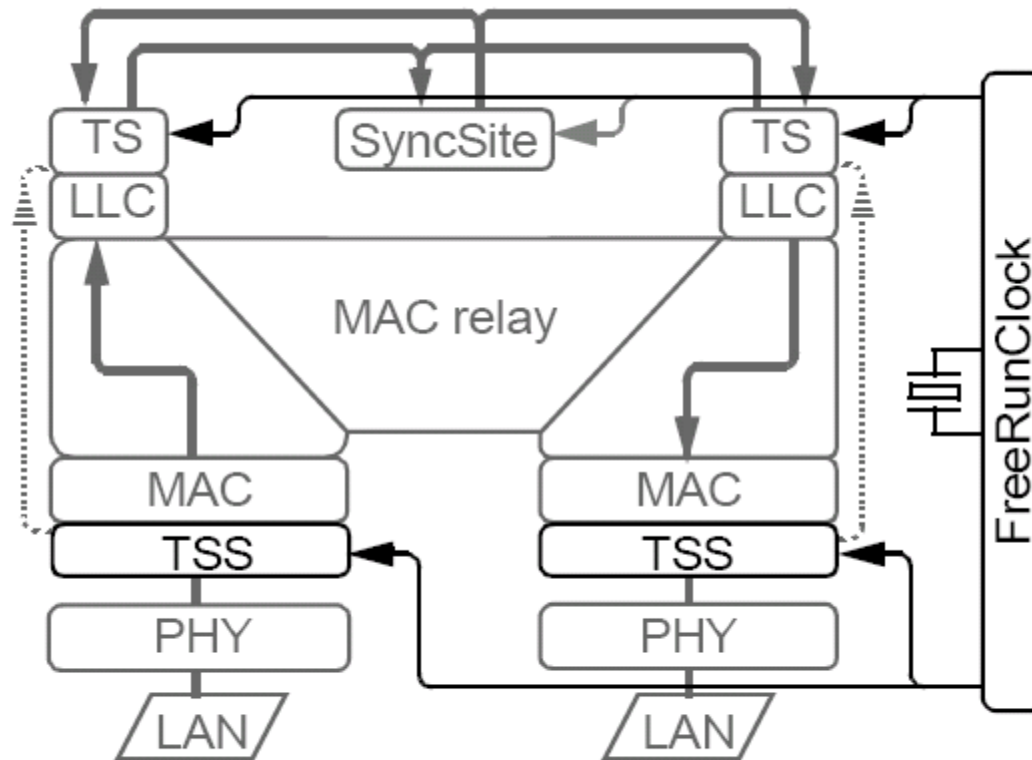
# Formal: at the media interface



a) PHY-to-media reference point

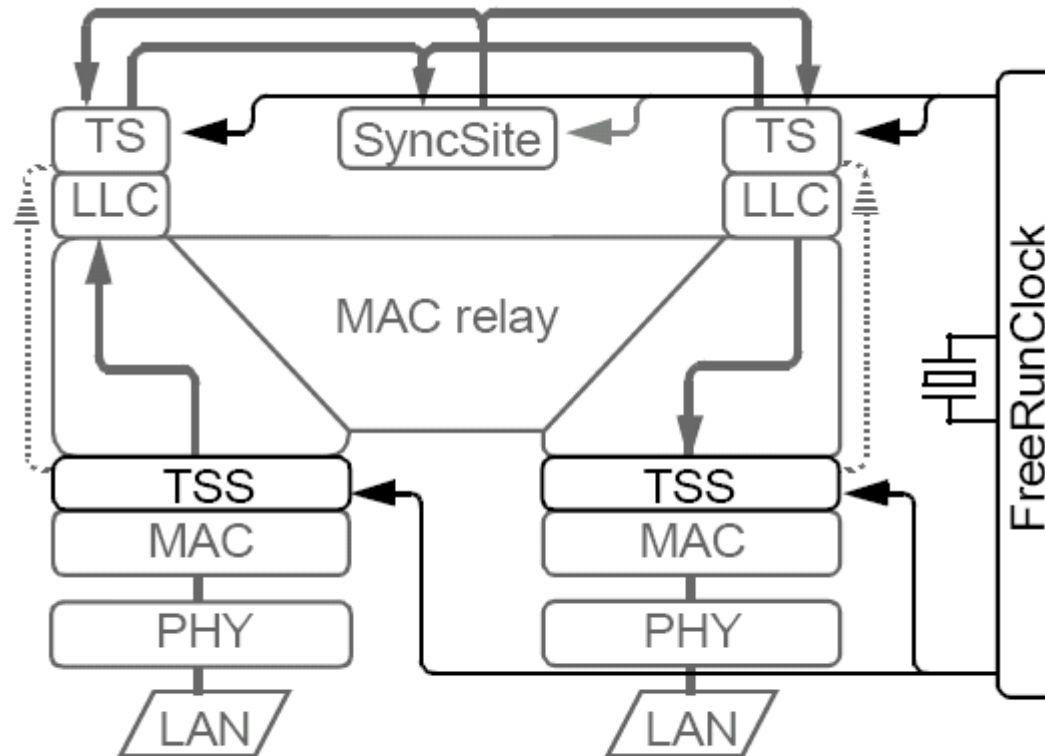


# Reality: on the MAC address



**b) MAC-to-PHY alternative**

# Possible: above the MAC



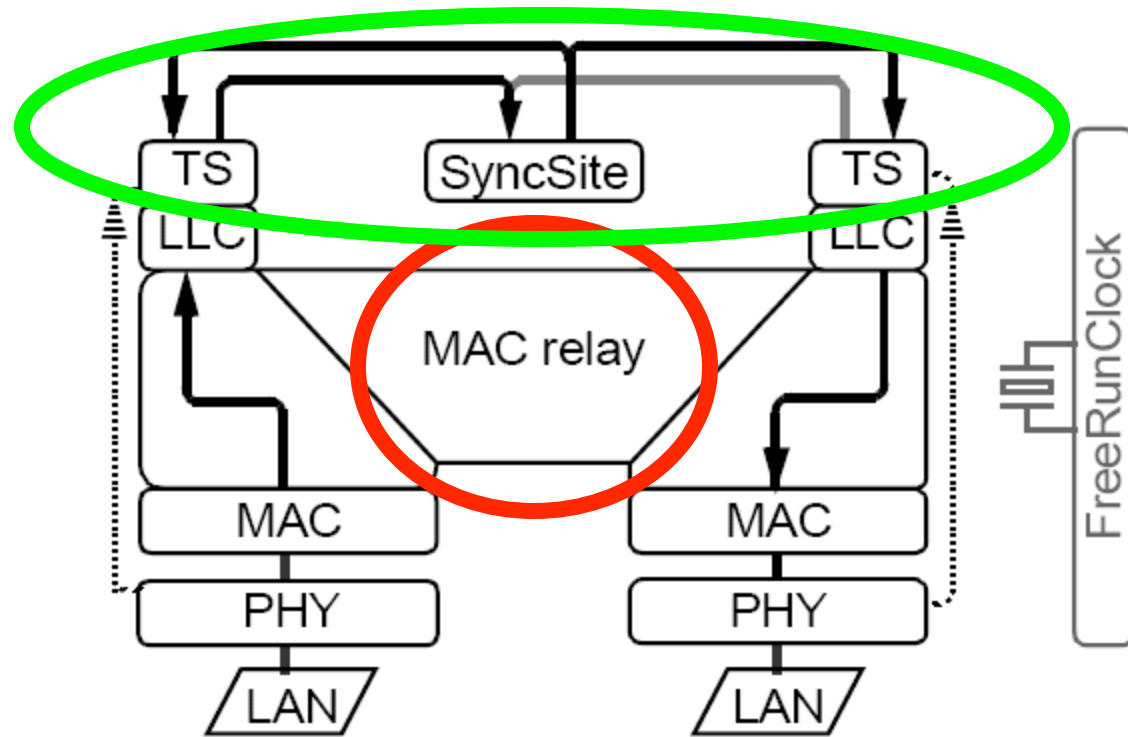
**c) Above-the-MAC attachment**

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# Bridge “relay” possibilities

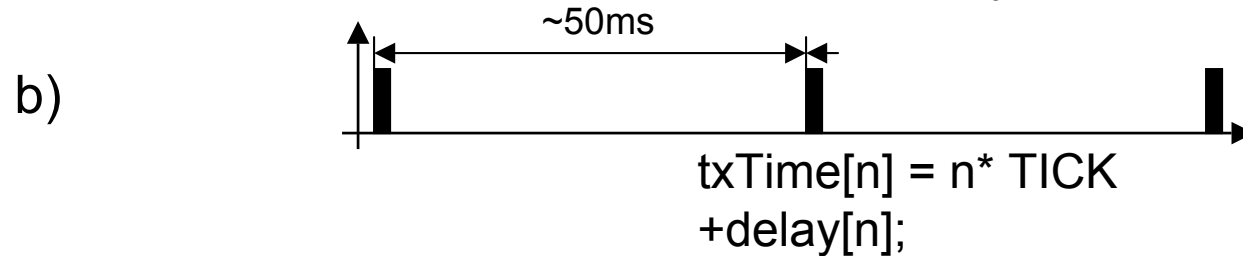
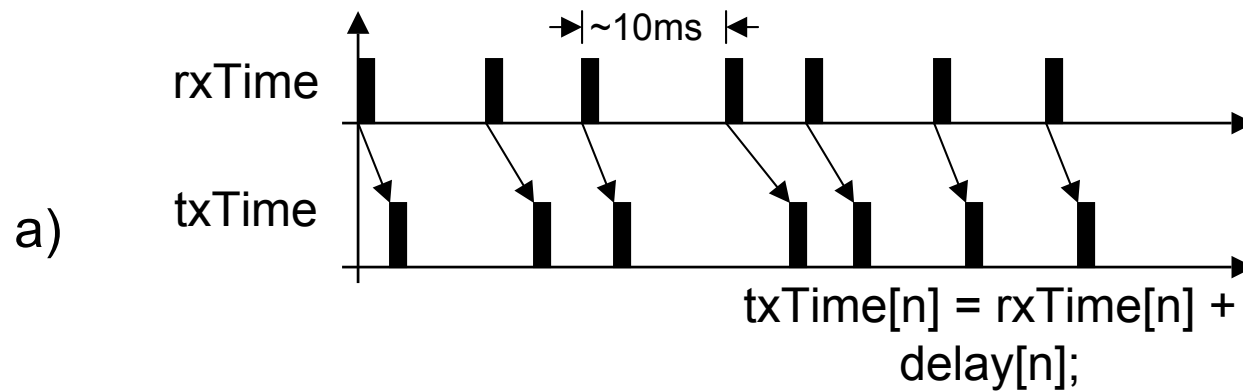
- 1) Sync frame triggering
- 2) Grand-master selection

# What is the bridge “relay”



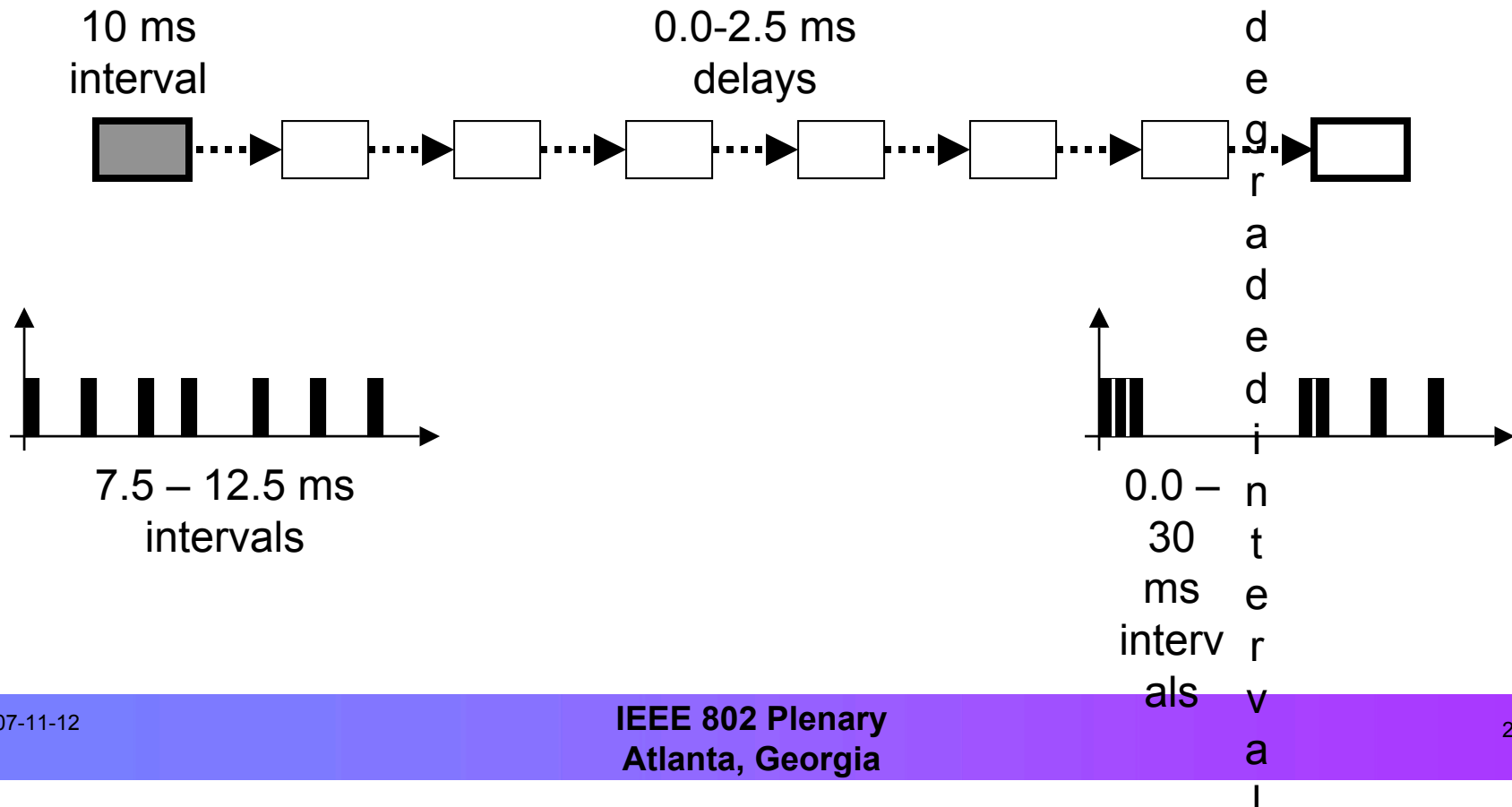
b) Time-aware bridge

# Sync-forwarding alternatives



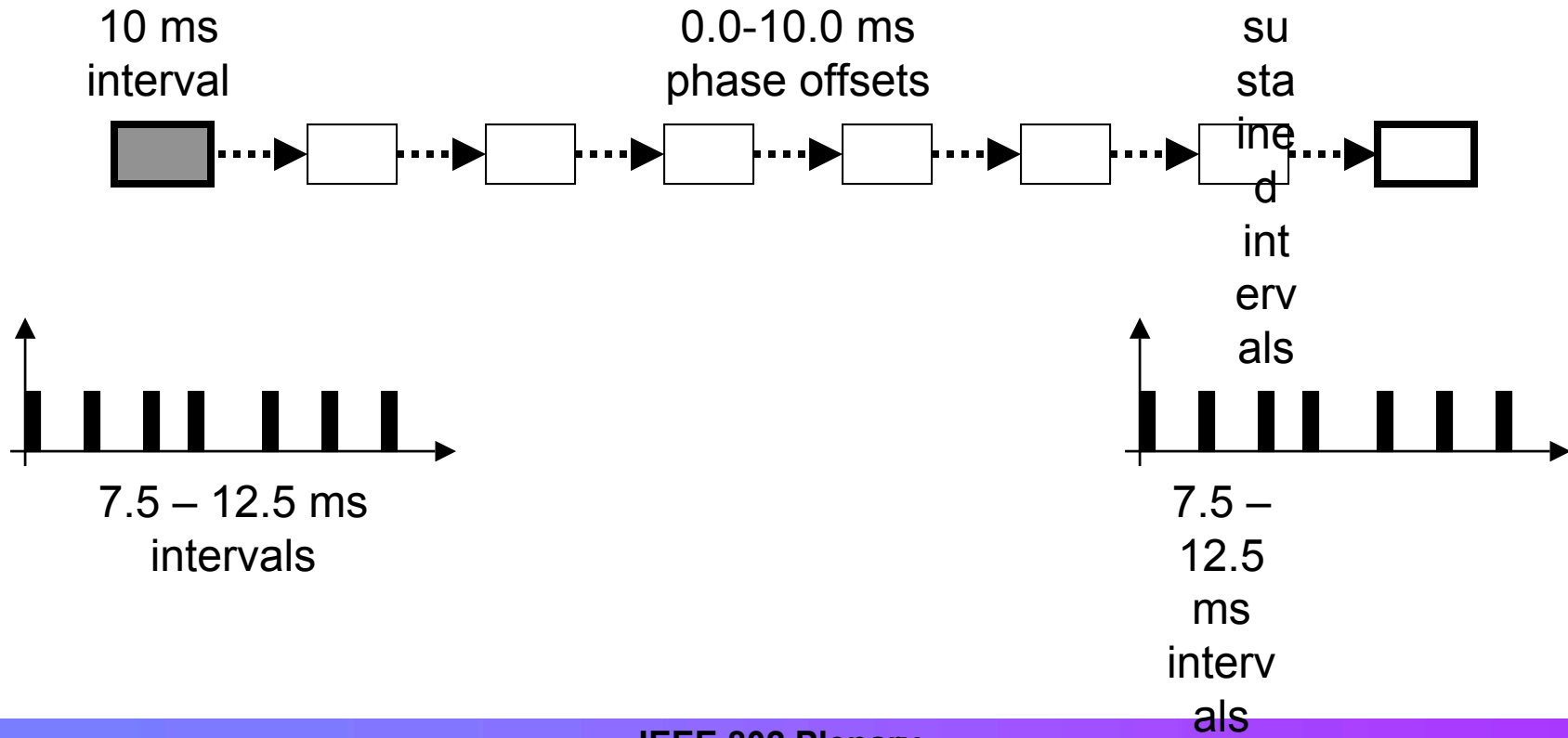
# Cascaded TOD synchronization

(a nonscalable approach)



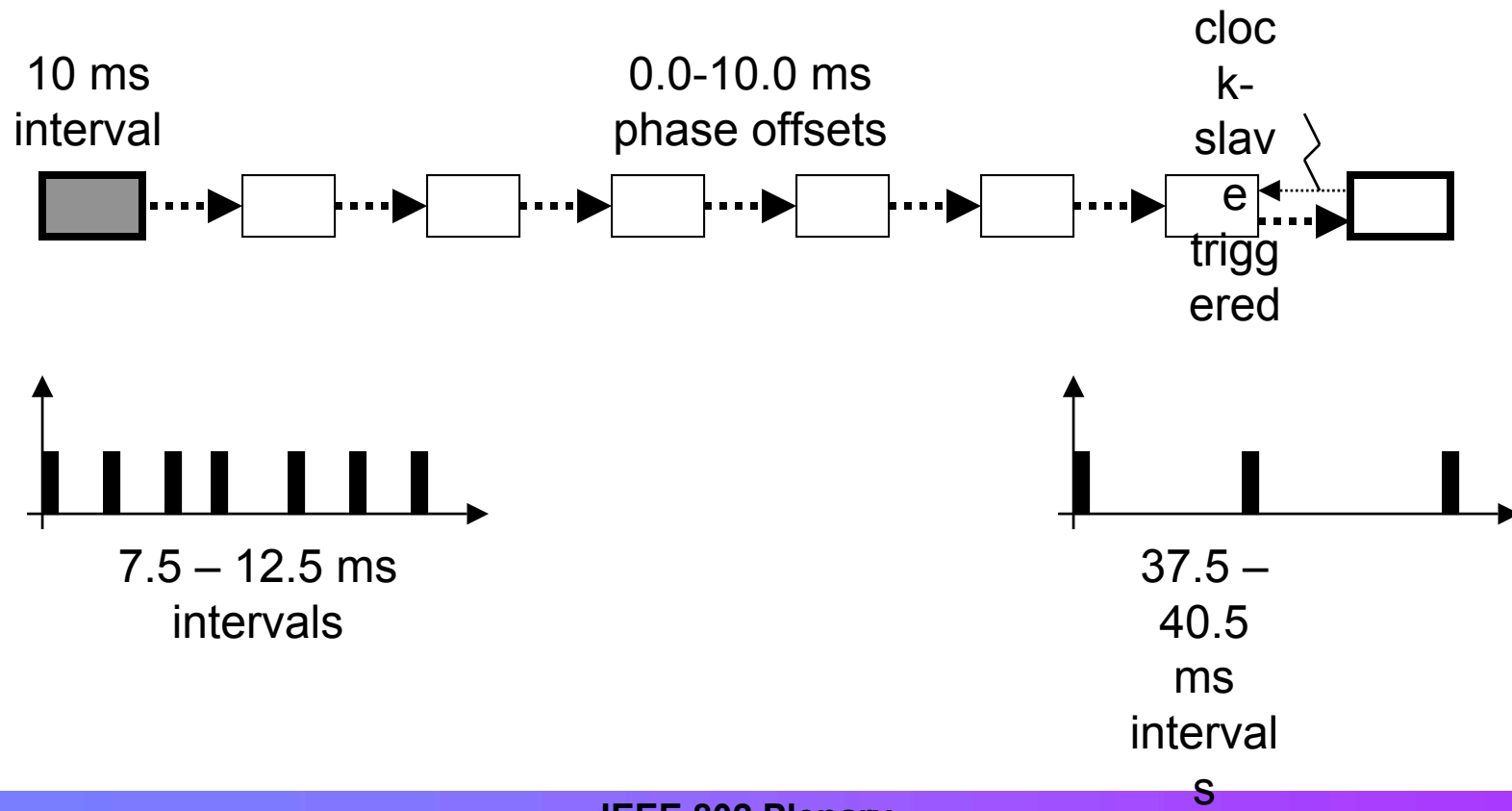
# Reclocked TOD synchronization

(a scalable approach)



# Synchronization rate quirks

(a more heterogeneous cascade)





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# Bridge “relay” possibilities

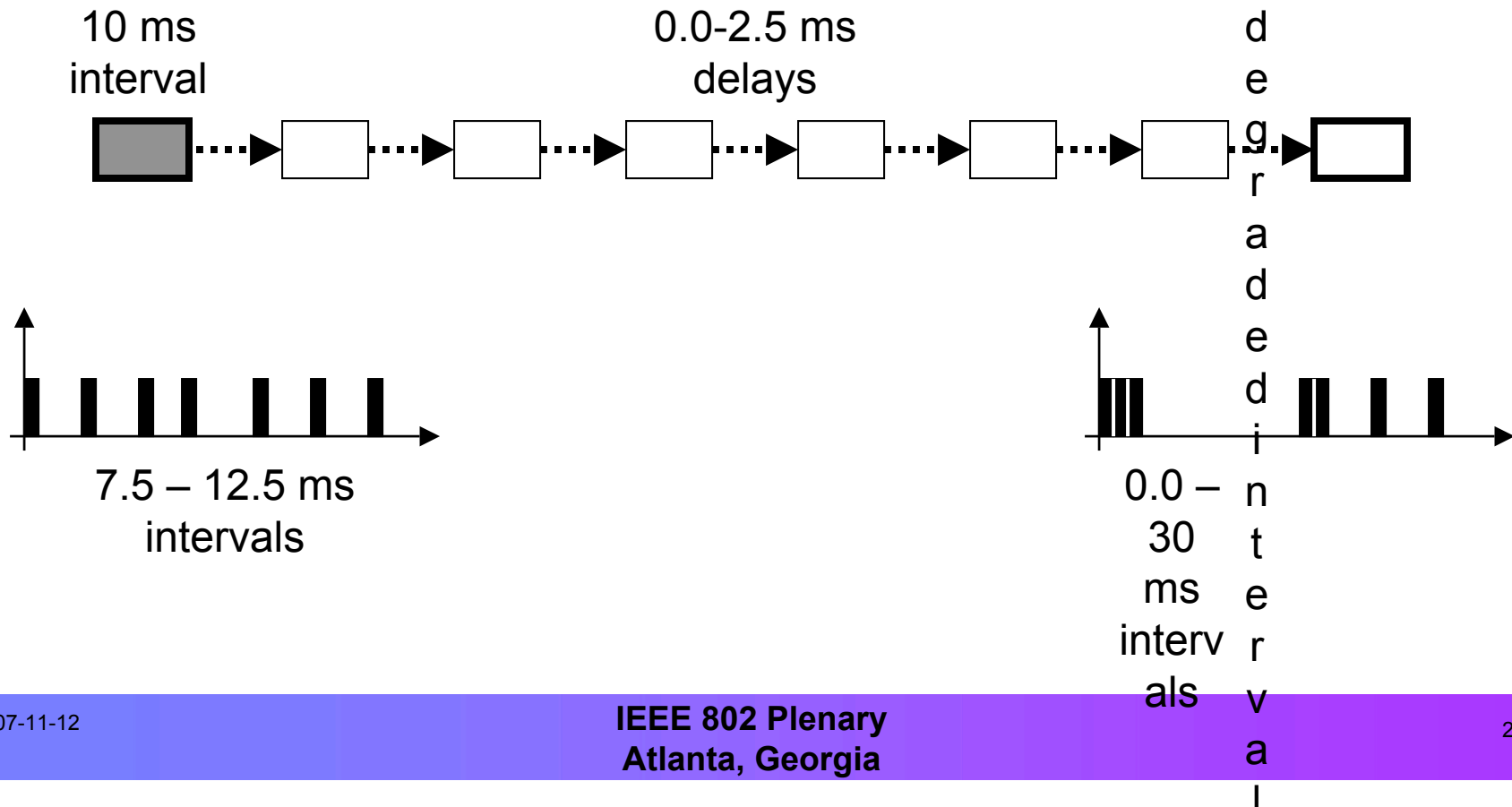
- 1) Sync frame triggering
- 2) **Grand-master selection...**

# 802.1as basic requirements

- Media friendly
  - Link-dependent time-sync intervals
  - Clock-master or clock-slave initiated
- Accurate
  - Errors limited by snapshot accuracies
  - Eliminate: gain peaking
  - Incorporate: per-stage low-pass filtering
- Responsive
  - RX: linkDelay—neighbor local-clock syntonization
  - TX: Minimal grandTime syntonization
- Simple
  - Minimal residence-time constraints

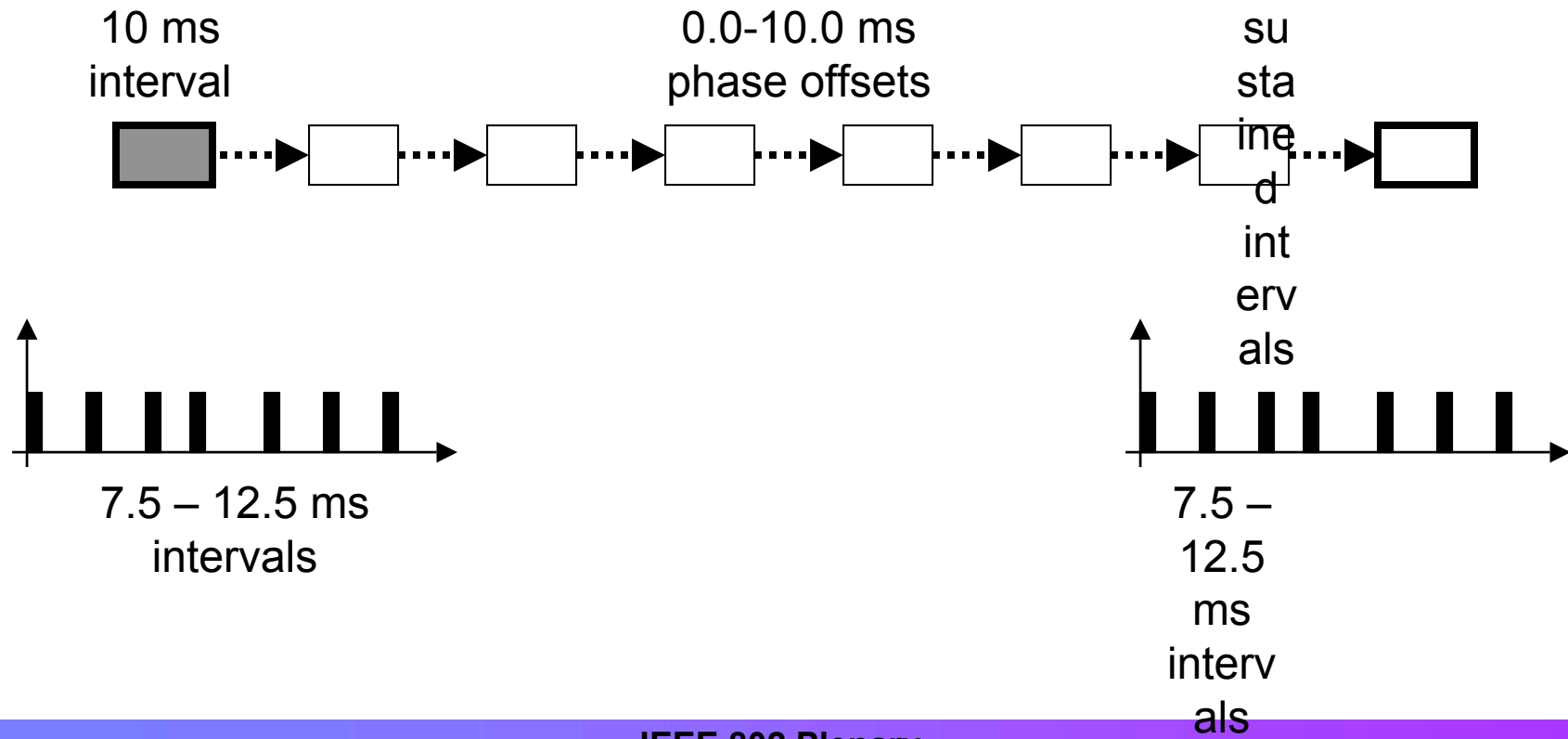
# Cascaded TOD synchronization

(a nonscalable approach)



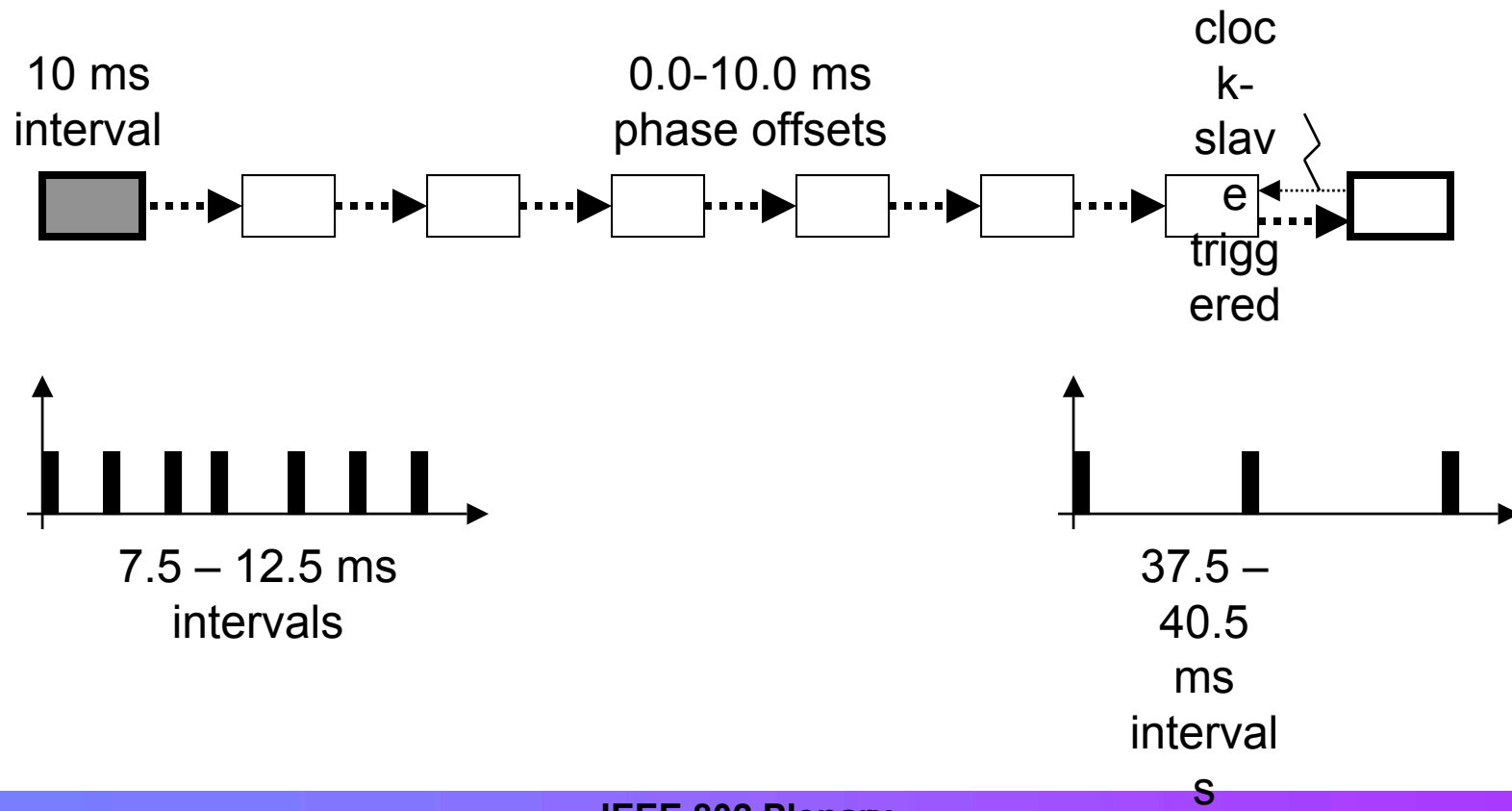
# Reclocked TOD synchronization

(a scalable approach)



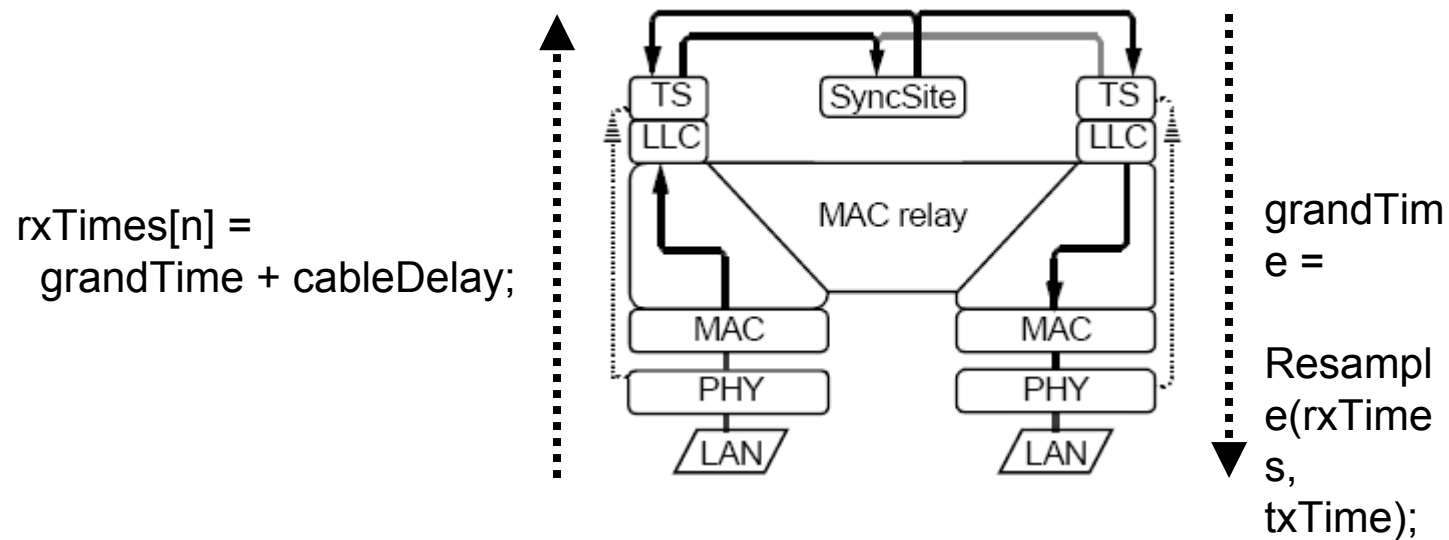
# Slave-triggered synchronization

(a more heterogeneous cascade)

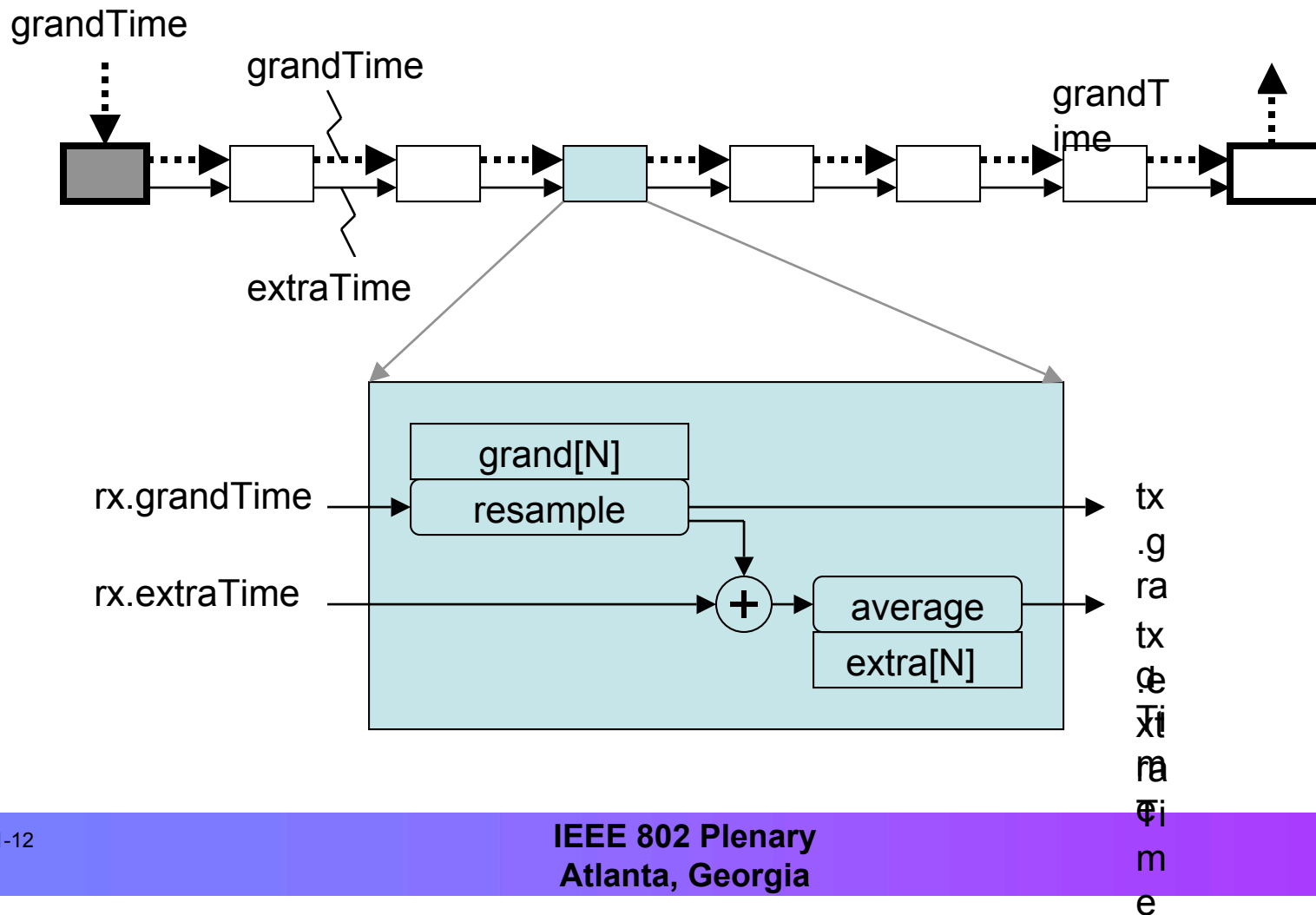


# Compensation and conversion

(decoupled processes)

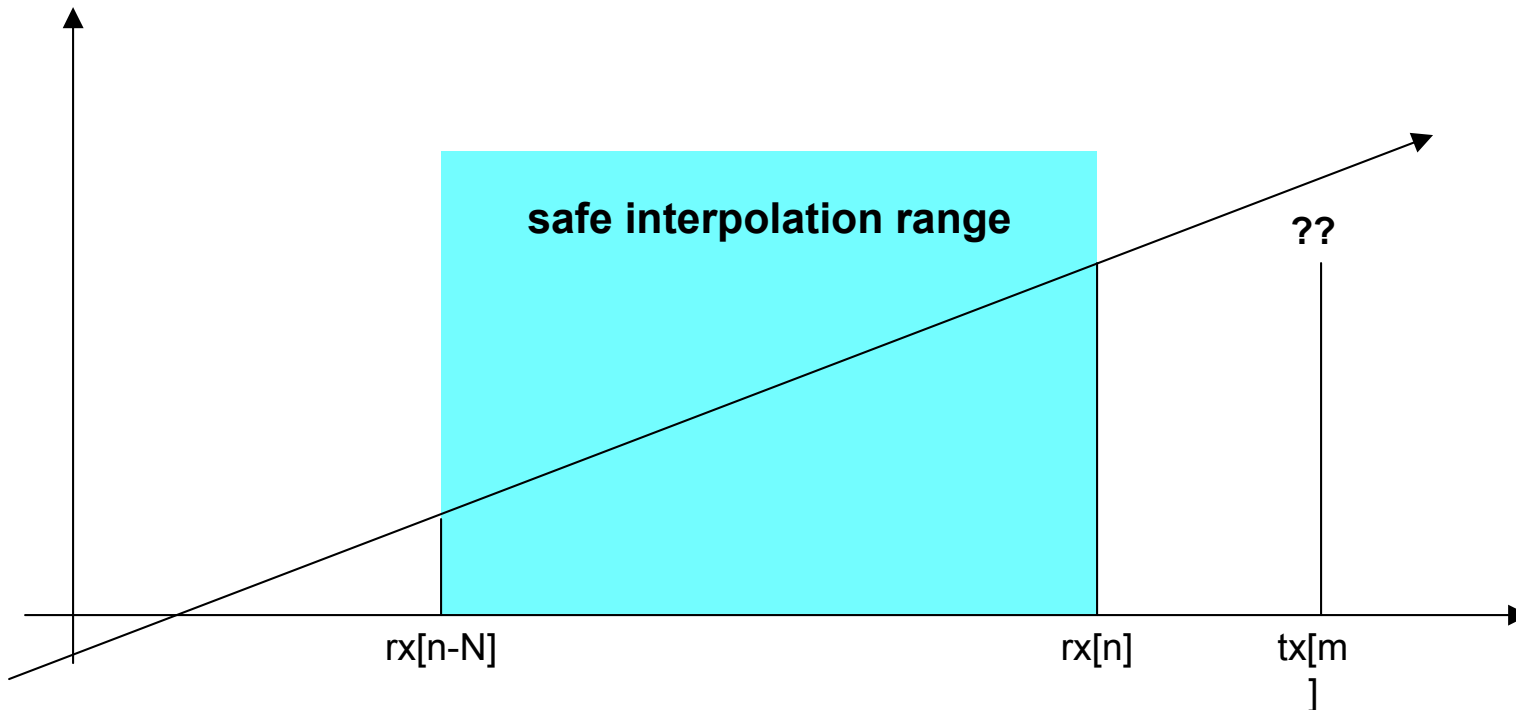


# “Bounary” like reclocking



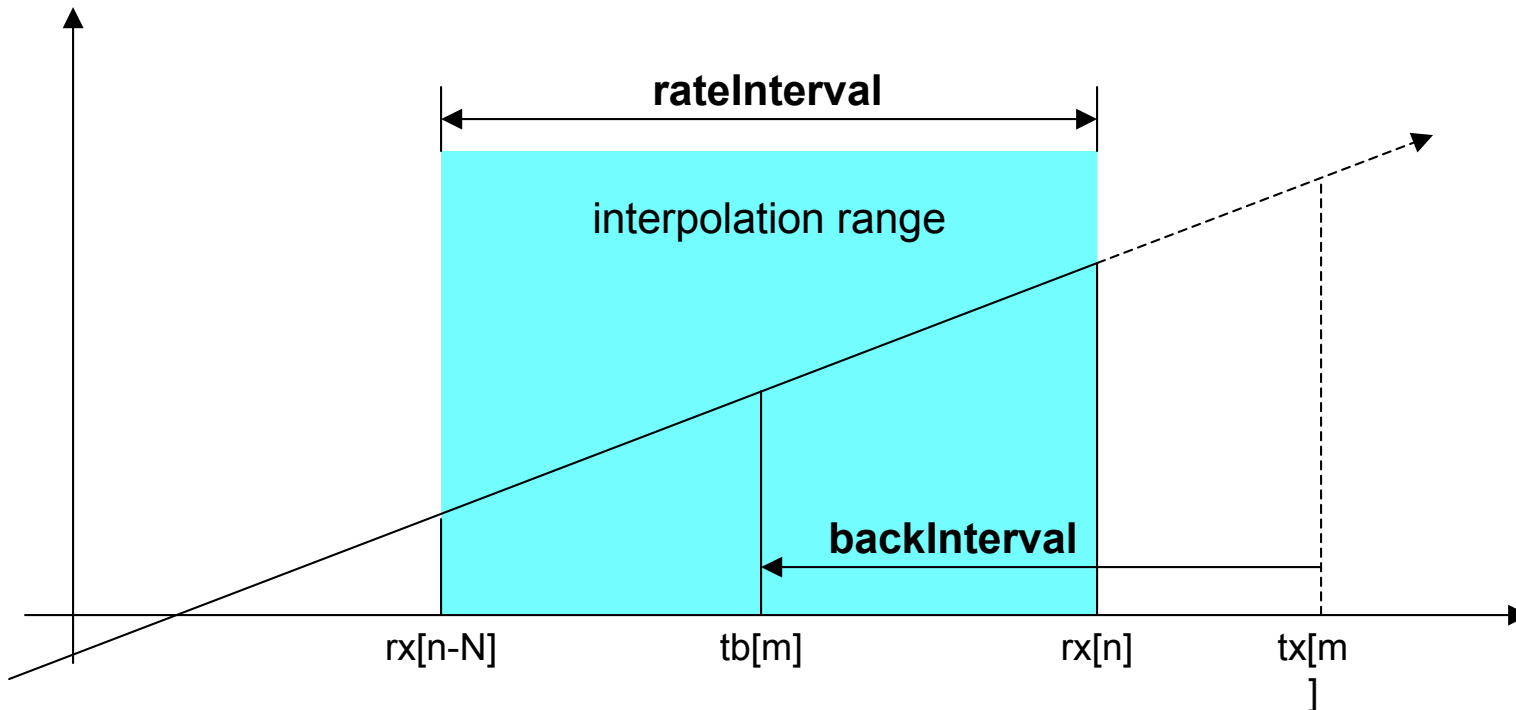
# Interpolation concepts

(interpolation range)

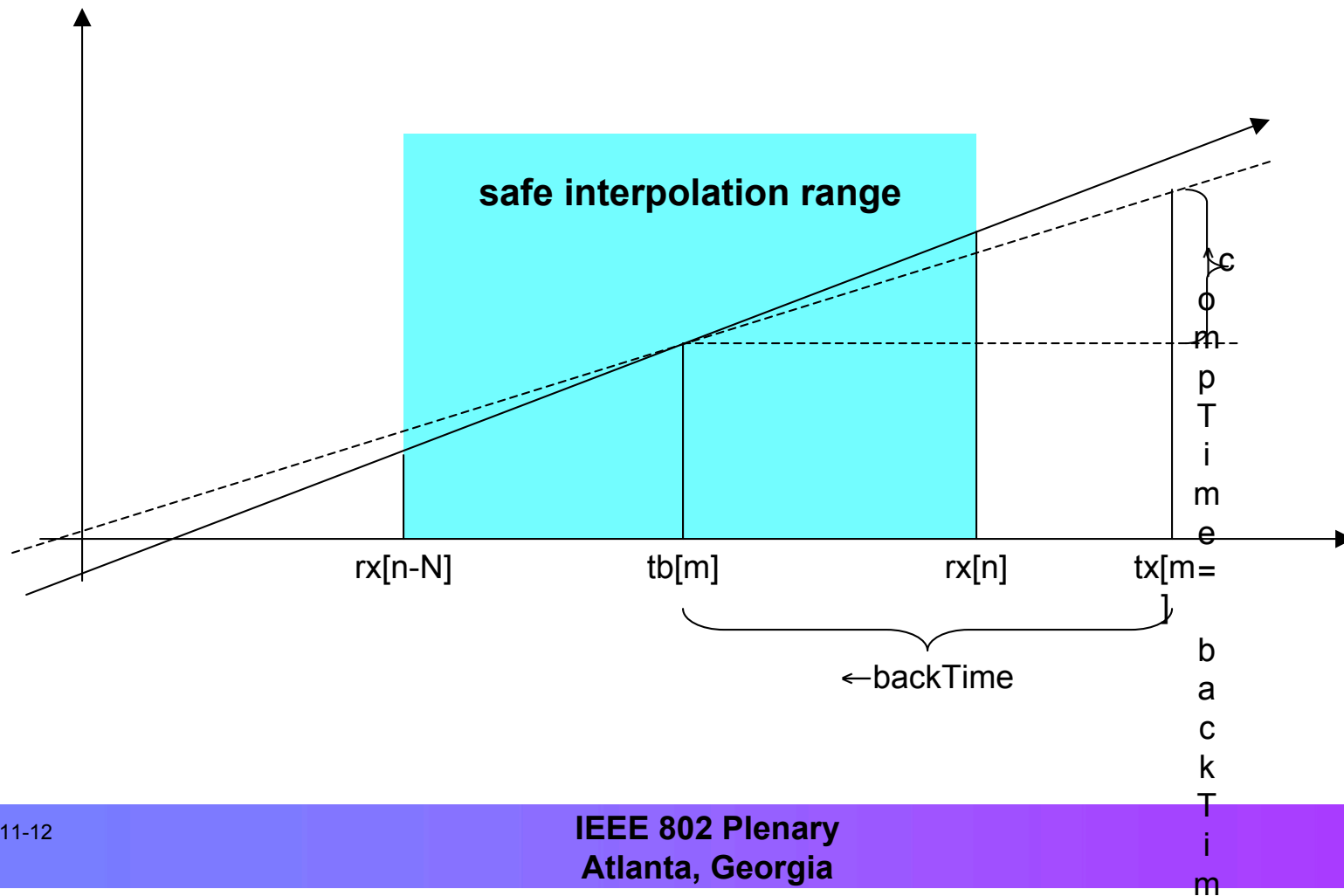




# Interpolation intervals

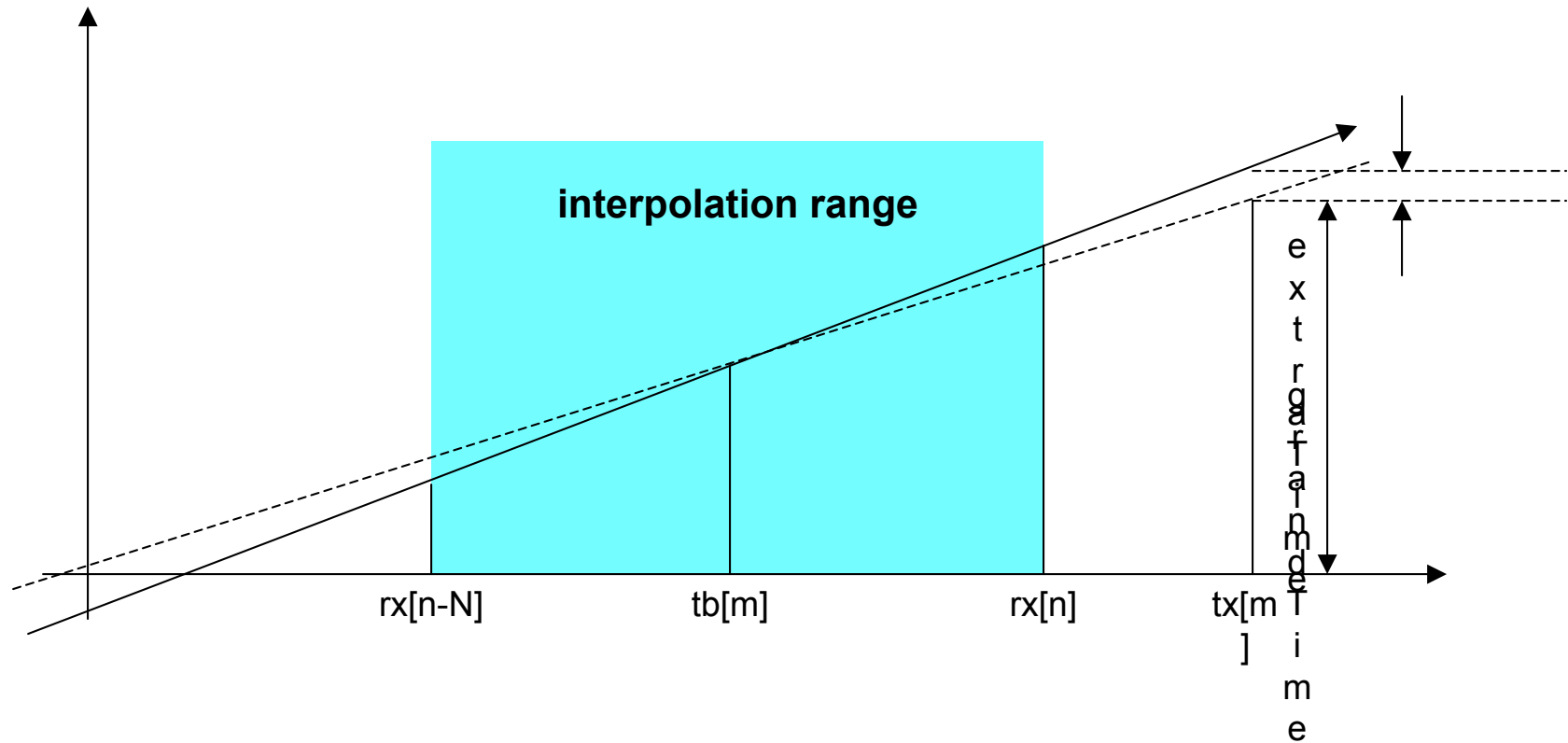


# Interpolation adjustments



# Interpolation errors

(extraTime supplement)



# Time formats

