SPECTRACOM

Synchronization issues from packet encapsulation to air interface in DVB

Sponsored by B21C project

Gilles BOIME
CTO, France

B21C project

- Broadcast for the 21st Century
  - Propose broadcast standard in order to facilitate the deployment and early adoption of application terminal for all types of transfer medium:
    - Ground fixed enhanced: DVB – T2
    - Satellites for handheld terminals: DVB – SH
    - Ground for mobile terminals: DVB - H

B21C

WP1
Project Management
(TeamCast)

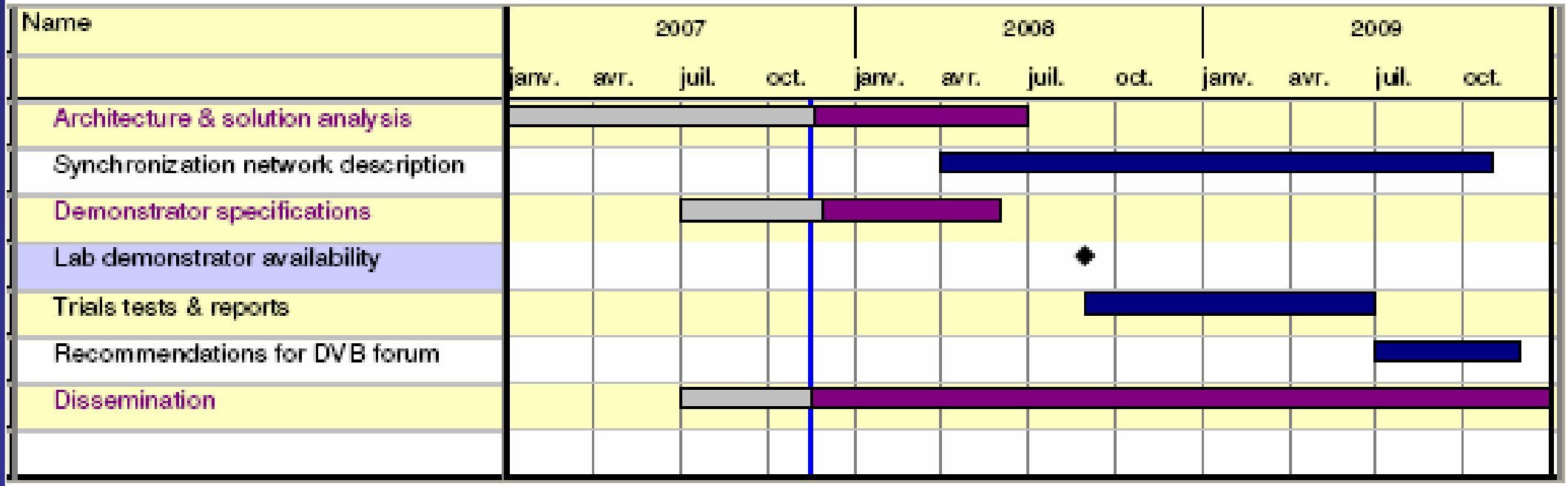
	WP2 System Architecture & Simulation (France Telecom)	WP3 Channel Studies & Network Aspects (Digita)	WP4 Prototyping & Trials (Abertis)	WP5 Standardisation & Dissemination & Demonstration (Thomson BM)
DVB-H Activity (Nokia)		. Pedestrian Channels, . SFN model, . IP distribution NW, . NW using Gap Fillers, ...	. Small Gap Fillers, . AL-FEC experiment, ...	. Gap-Filler Specifications, . CELTIC Event'07, . Conference Papers, . IBC'07, ...
DVB-SSP Activity (Alcatel)	. Radio Resource Mngt, . Predistorsions (PAPR), . Alternative Rx Techniques, ...	. Performance in Shadowed path, . NW Planning, . Channel Measurement (model for Hybrid), ...	. Rx Enhancement, . Satellite Emulation, . RF coexistence, . Field Measurement, . Micro Gap Filler, ...	. SSP Guide Lines, . CELTIC Event '08, . Conference Papers, . IBC'08, ...
DVB-T2 Activity (BBC)	. Waveforms, . FEC / MIMO, . Channel Encoding (Layered Interleaver), . Predistorsions (PAPR), . Alternative Rx Techniques, . Framing, . Synchronisation, ...	. MIMO channels, . MIMO Mobile Channel, . Coverage with MIMO, . SFN requirements, ...	. HW implementation For FEC / TI / MIMO, . Test methodology Definition, . Laboratory tests for Perf, Interoperability, . Field Trials, ...	. DVB-T2 specifications, . CELTIC Event '09, . Demonstrator, . Conference Papers, . IBC'09, ...

B21C Synchronization issues

- Addressed in WP2 with Task Force 207
- Main targets:
  - Find an innovative synchronization solution to deliver Time & Frequency references to all transmission sites by using installed architectures
  - Identification and description of a cost-optimized, secured, right performance delivering synchronization over existing IP network
  - Suggested architectures are evaluated in terms of cost (LCC) and performances ratio
  - Manufacturing and lab / trial testing of a demonstrator
  - Recommendations will be transferred to DVB Forum for standardization
- Partners involved:
  - Spectracom, TeamCast, Teracom, Thomson B&M, Universitat Ramon Lull, University of Bologna

B21C Synchronization milestones

- Compact calendar: main steps

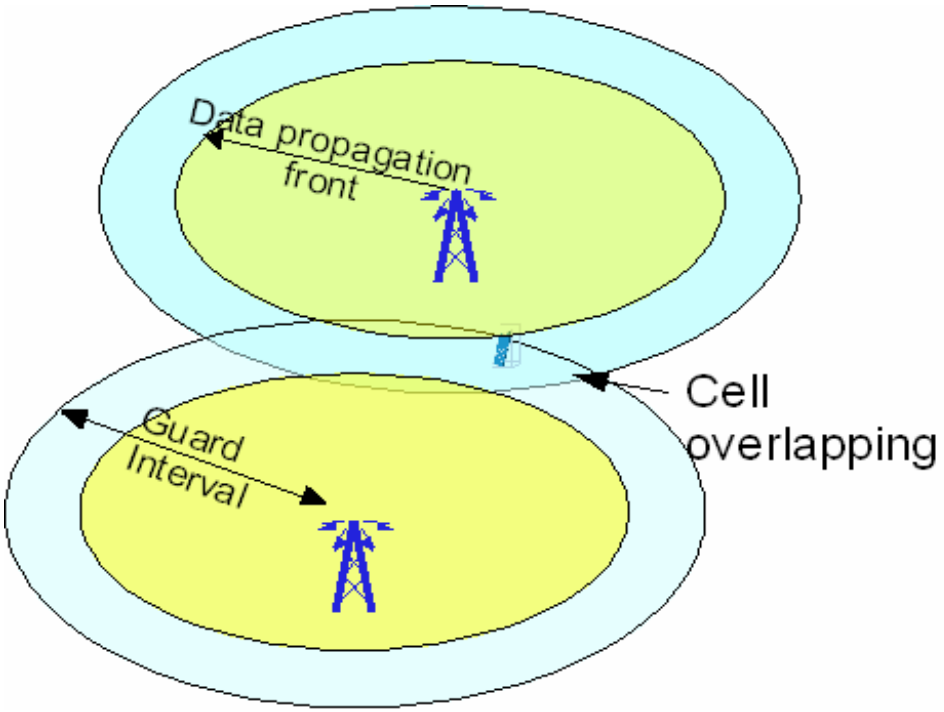


Synchronization at the air interface for SFN

- Why Simple Frequency Network?
  - Bandwidth optimization
  - Roaming simplification
- Packet emission synchronization (burst mode)
- Carriers frequency syntonization (radio interference mitigation)
- **The Time & Frequency Synchronization function is mandatory to achieve the perfect functionalities in SFN mode**

Synchronization for the air interface

- Reception scheme roaming and cell overlap:
  - Guard interval propagation shall overlap the neighbour cells in order to enable simple handheld terminal roaming over the whole SFN geographical area.
  - Radio emission must be syntonized in order to control interference between emitters.

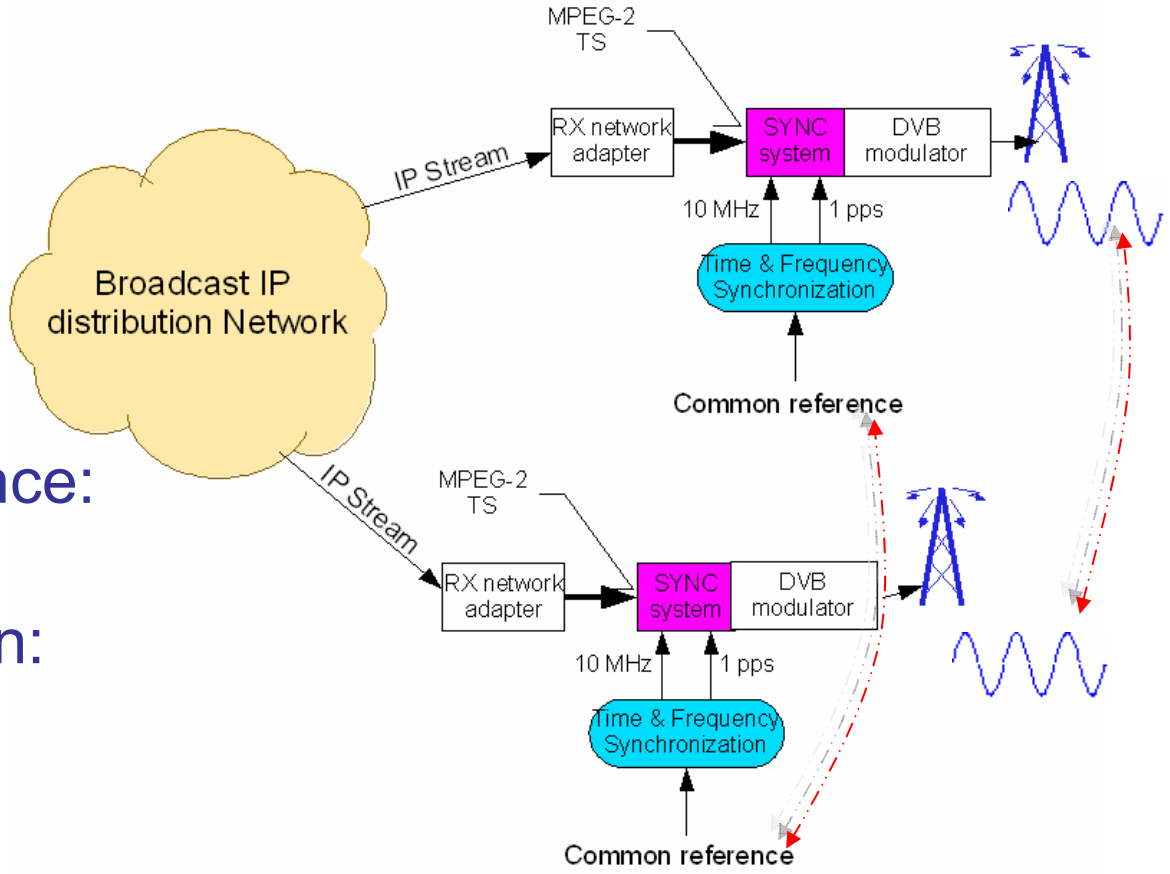


- Table of Guard interval for DVB-T:
  Synchro budget is <1/10th

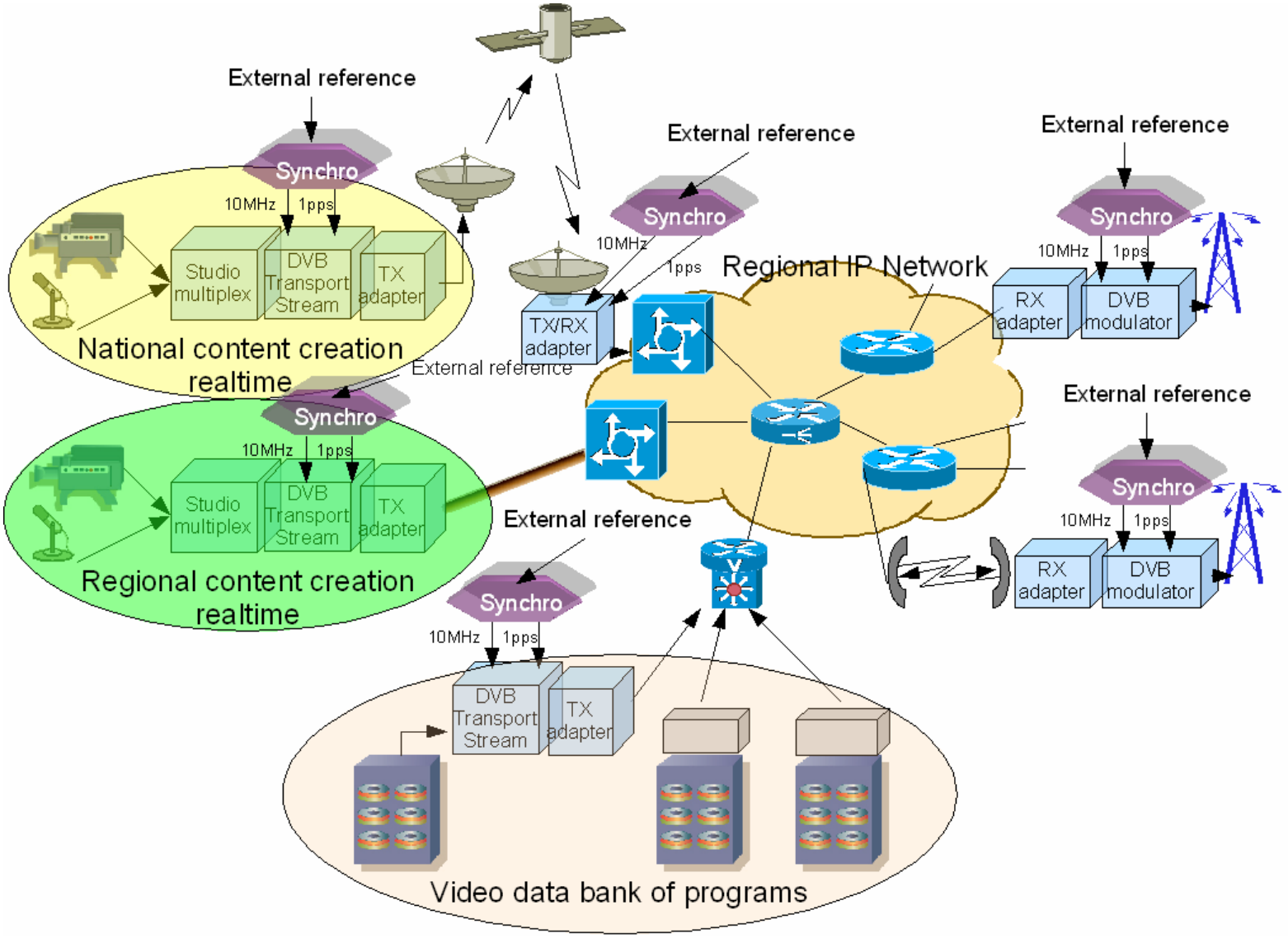
GI duration	Modulation
224 µs	8k 1/2
112 µs	8k 1/4
56 µs	8k 1/8
28 µs	8K 1/32

Synchronization implementation for air interface

- Common reference:
  - Time stamping and frequency alignment
  - Cover the whole SFN geographical area
  - Synchronization limit: 3µs over the air
  - Synchronization reference: **1µs**
  - Frequency syntonization: **1.10^{-9}**



Packet encapsulation and transport to TS



Synchronization for packet distribution

- Content delivery from studio to TS (Transmission Sites):
  - IP level encapsulation for MPEG Transfer Stream multiplex
  - Packet sequence chronology restitution after multi-support transmission, routing and switching
  - WAN/ MAN heterogeneous networks under IP, multi source data and video on demand for multi stream synchronization

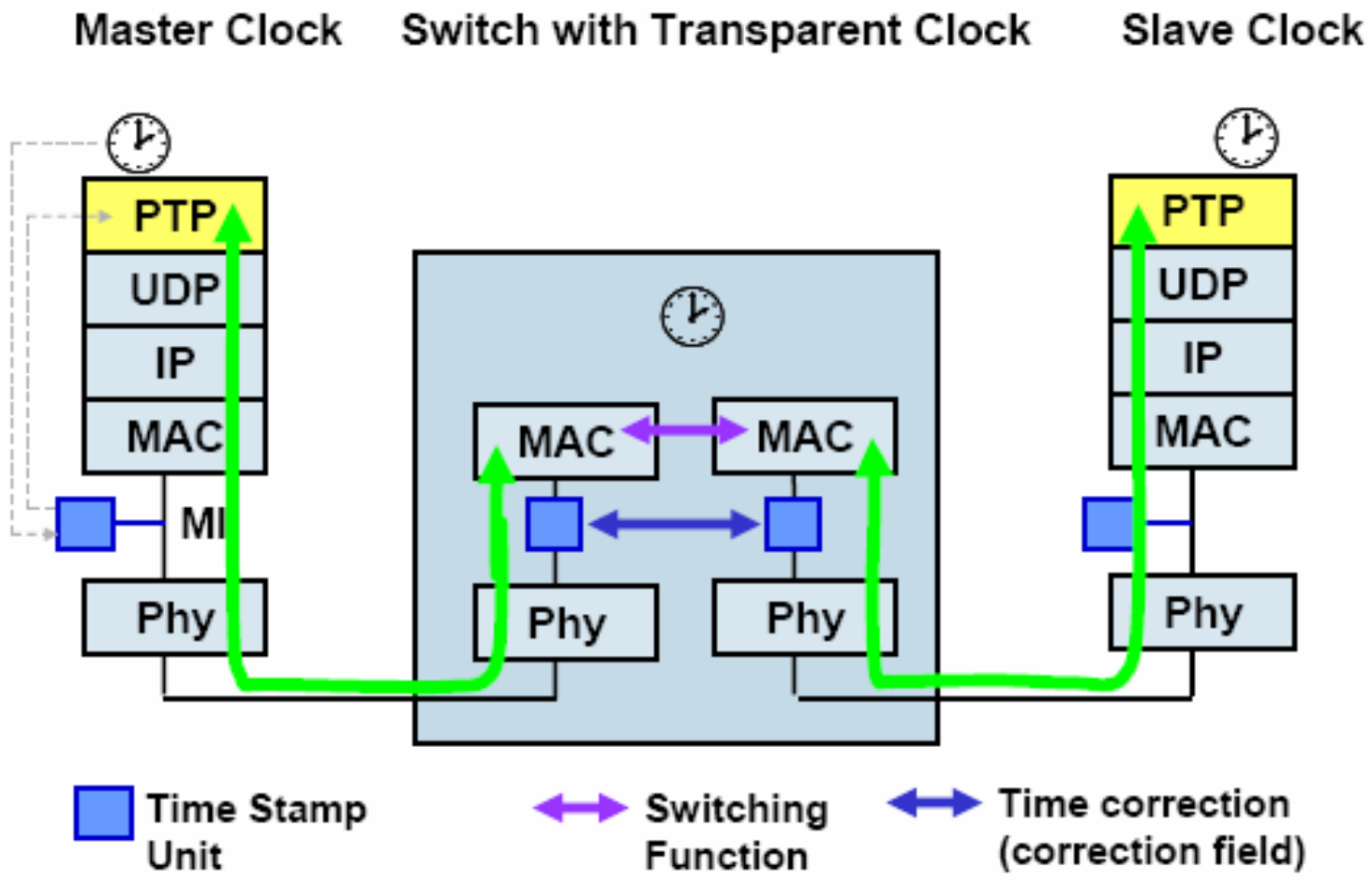
Synchronization service optimization

- Lower Life Cycle Cost (LCC)
- Increase reliability
- Increase availability
- Increase Quality of Service (QoS)
- Heterogeneous network synchro independence
- Target performance: **1µs**
- Synchronization distribution use existing data IP architecture

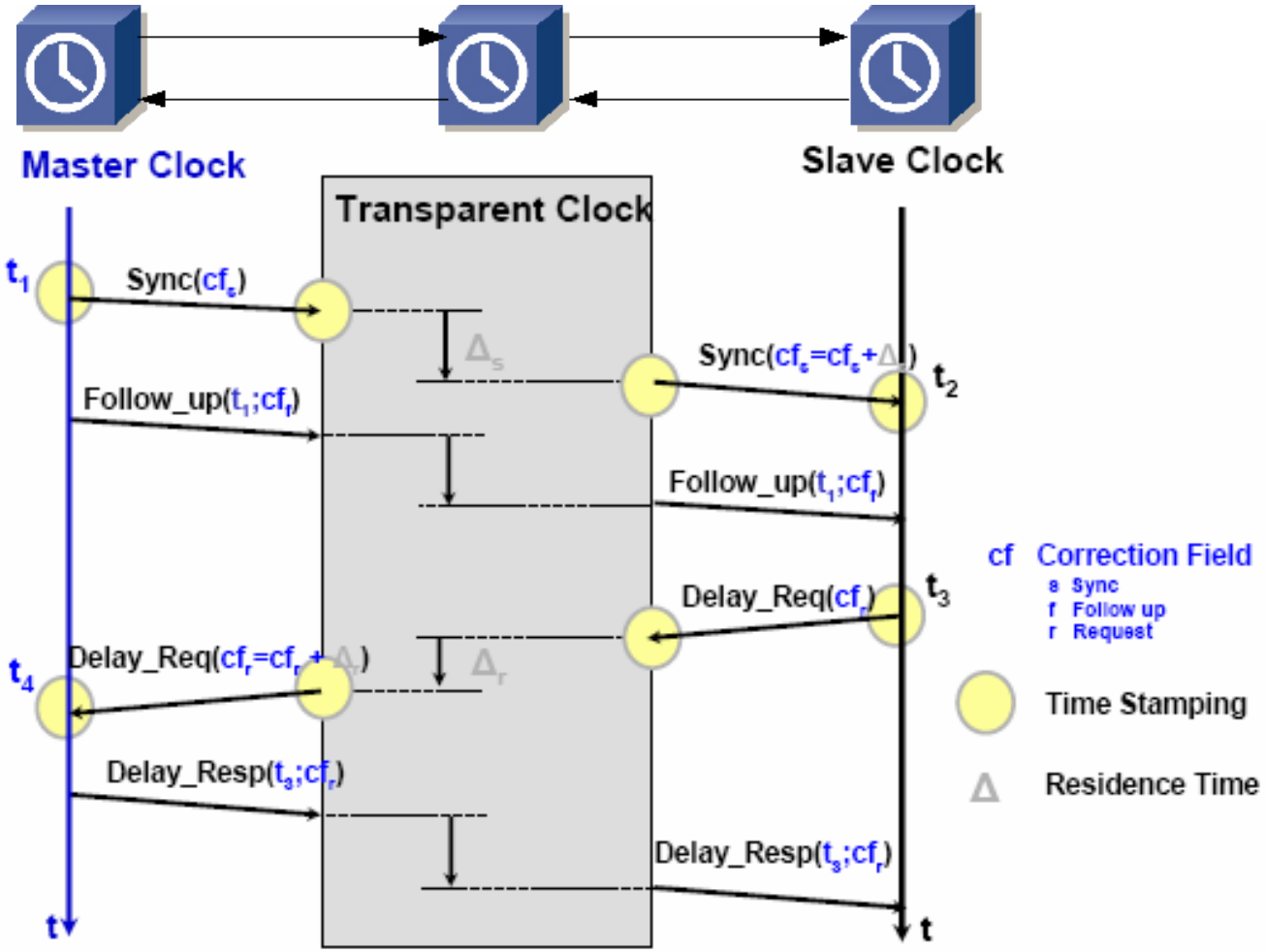
Candidate technologies

- GPS / GNSS:
  - Direct synchronization, accurate time stamping, mature, availability in progress with replenishment and new systems : GLONASS, GALILEO, COMPASS (Beidou).
  - Limited reliability, accessibility limited to open sky view access, medium LCC.
- Synchronous Ethernet: ITU-T G8261
  - Synchronizes the transport stream.
  - Does not provide time stamp to IP level, non mature.
- NTP: IETF, RFC1305
  - Time stamp distribution over UDP/IP with symmetric network delay compensation, very mature, low LCC.
  - Syntonization performances limited to long term regarding jitter data path mitigation post processing capability. Time transfer performances over MAN ~10ms
- PTP: IEEE1588v2
  - Time stamp distribution with unitary path compensation. Network elements delay and jitter shall be removed.
  - Propagation dissymmetry variation is not compensated. Syntonization capabilities shall be fair with integration time. High pressure from industry to rush maturity. Time transfer performances expected over MAN ~1µs

PTP v2 time stamping transfer

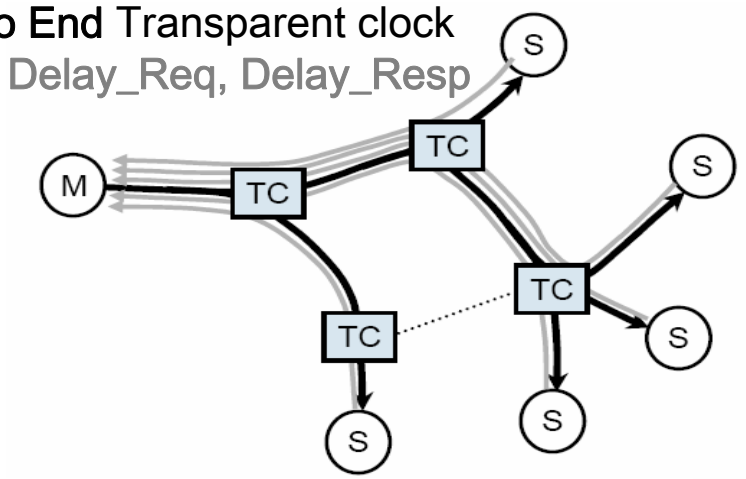


PTP v2 message dialog

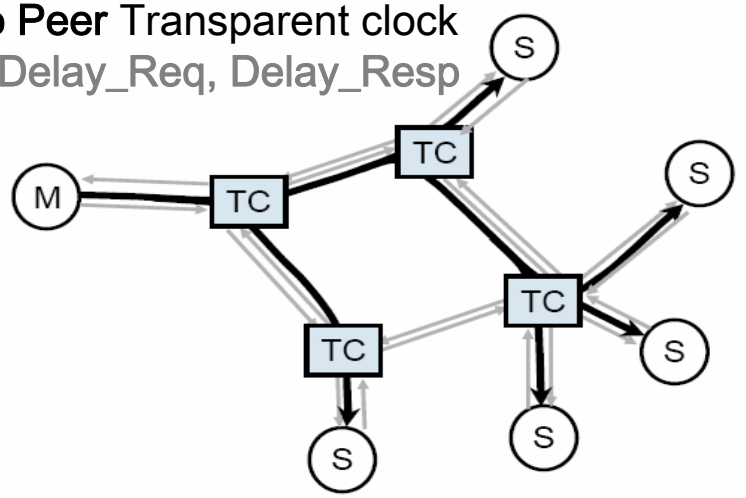


PTP V2 transparent clock topology

End to End Transparent clock
Sync , Delay_Req, Delay_Resp



Peer to Peer Transparent clock
Sync , Delay_Req, Delay_Resp

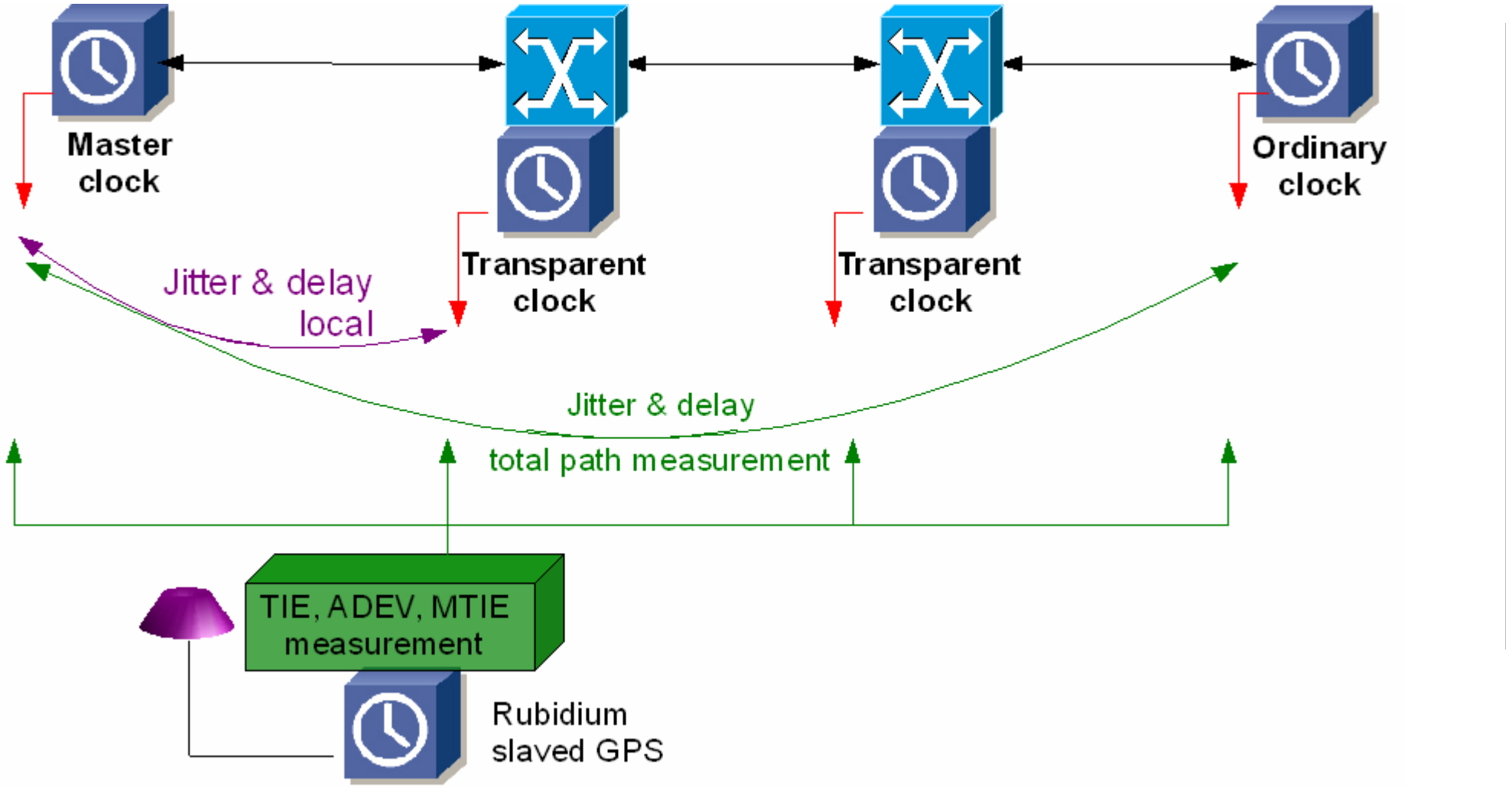


	E2E Transparent	P2P Transparent
Clock	Syntonized	Syntonized
Topology limitations	None	1:1 connection each link
State maintained	Upon Sync_Req	Per link state, upon Sync_Req
Slave scalability	Master see all slaves	Hierarchical
Linear scalability	Available	Available
Topology change	Measure new delay	Pre-compute link delays

PTP v2 delay variations compensation

- MPLS mandatory for fixed path (not in standard but will improve QoS in distribution network)
- Router / Switch delay variation compensation:
  - Boundary clock: local clock delay uncertainty cumulates
  - Transparent clock (E2E): Multicast compatible but heavy load to the master clock as it shall answer to every slaved clock Delay_Req message.
  - Transparent clock (P2P): Unicast compatible, local calculation of compensation limit the master clock computation process.
- Upgrade of network elements with transparent clock function is mandatory to reach 1µs maximum jitter and delay

PTP v2 typical test topology (draft)



Broadcast network implementation conclusion

- Recommendations to be proposed for future DVB standards
- Formal liaison between DVB forum and B21C project

DVB Digital Video Broadcasting

B21C

B21C task force contributors

- Abertis Telecom (Retevision)
- Agilent
- BBC
- Dibcom
- Elektrobit
- France Telecom
- Hispasat
- Mier
- NXP
- Rohde & Schwarz
- Sidsa
- Space Hellas S.A.
- Tampere University of Technology
- TDF
- Teracom
- Turku University of Applied Sciences
- University of Bologna

Abo Akademi
Alcatel – Lucent
Braunschweig Technical University
Digita
ENST Bretagne
Fraunhofer IIS
INSA / IETR
Nokia
RAI
Robotiker
Sony
Spectracom
TeamCast
Telefonica
Thomson B & M
Universitat Ramon Lull
University of Surrey

- Thank You
- Any Question?