

TELECOM PROFILE FOR TIME/PHASE ITU-T G.8275.1

WSTS 2014, San Jose

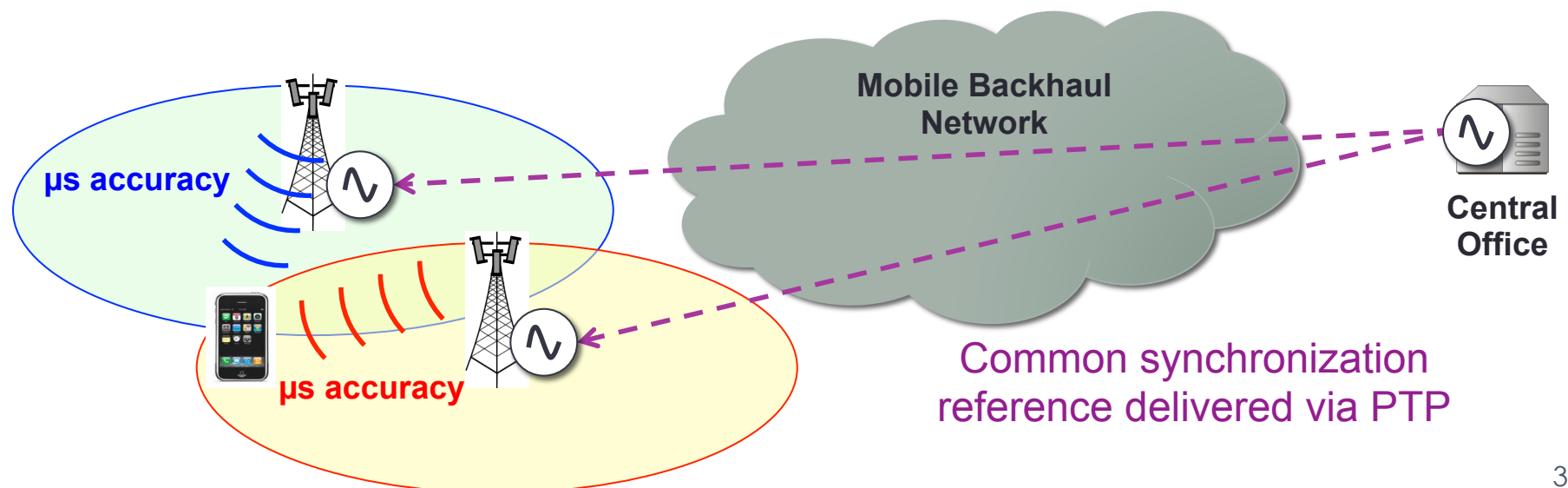
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Why defining time profiles in ITU-T?

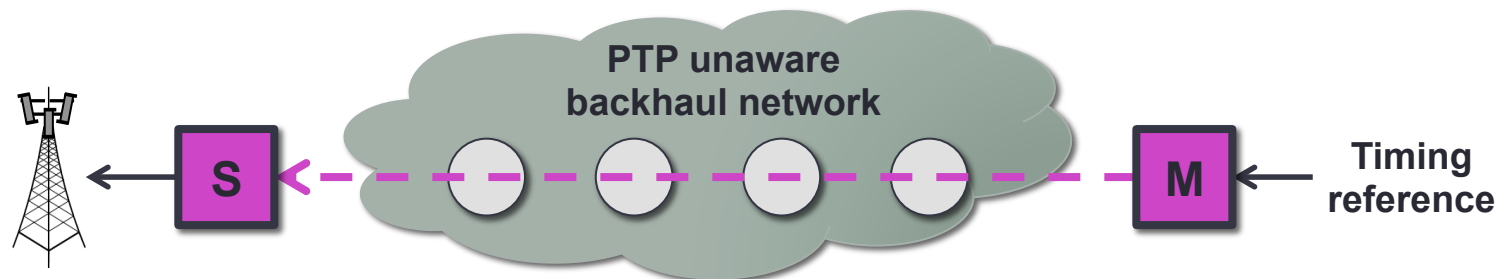
- New mobile applications requiring very accurate phase/time sync:
 - TDD, LTE-A CoMP, MBSFN, location-based services, ...
- Cost/vulnerabilities of GNSS systems
- Distribution of time synchronization by the network requested by the network operators
- Specific telecom requirements led to define PTP telecom profiles in ITU-T

Time sync is critical for MBSFN & CoMP

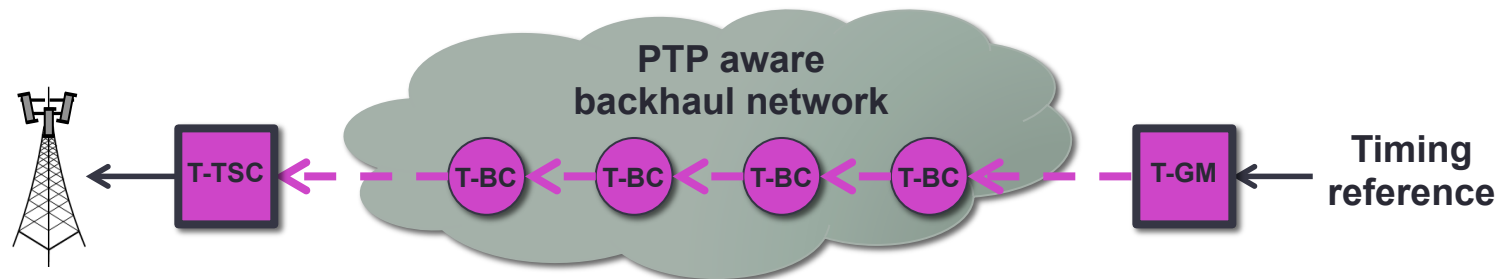
- MBSFN or LTE-A CoMP implies that the same content (or synchronized data) is delivered at the same moment by neighbor base stations
 - If the phase alignment is not good enough, the interferences cannot be handled by cyclic prefix
 - Poor synchronization results in poor user experience caused by dropped calls and erratic throughput



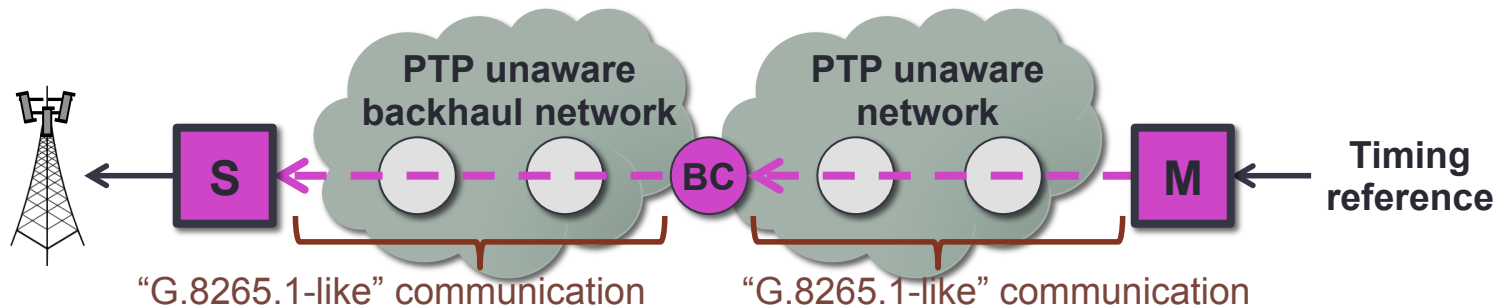
IEEE 1588™ & PTP telecom profiles



PTP in end-to-end mode, ITU-T G.8265.1 telecom profile



PTP with full timing support from the network, ITU-T G.8275.1 telecom profile



PTP with partial timing support from the network, ITU-T G.8275.2 telecom profile, under study in ITU-T

PTP messages and clocks

| | G.8265.1 | G.8275.1 |
|--|---|--|
| PTP messages used in the profile | Sync, Follow_Up, Announce, Delay_Req, Delay_Resp, and Signaling; Management messages are FFS | Sync, Follow_Up, Announce, Delay_Req, and Delay_Resp; Signaling and Management messages are FFS |
| PTP types of clock used in the profile | Packet Master Clock: master-only Ordinary Clock Packet Slave Clock: slave-only Ordinary Clock | T-GM: master-only Ordinary Clock or master-only Boundary Clock T-BC: Boundary Clock T-TSC: slave-only Ordinary Clock Transparent Clocks for future versions |

PTP modes

| | G.8265.1 | G.8275.1 |
|----------------------------|--|--|
| One-way vs Two-way | One-way and Two-way mode authorized | Two-way mode only |
| One-step vs two-step clock | One-step clock and Two-step clock supported | One-step clock and Two-step clock supported |
| Mapping | IPv4/IPv6 unicast mapping (IEEE Std 1588™ Annexes D and E) | Ethernet multicast mapping (IEEE Std 1588™ Annex F), non-forwardable multicast address 01-80-C2-00-00-0E and forwardable multicast address 01-1B-19-00-00-00 can be used |
| Unicast negotiation | Used to establish unicast sessions (IEEE Std 1588™ Clause 16.1 + specific requirements from ITU-T) | Not used |

PTP message rates

| | G.8265.1 | G.8275.1 |
|---------------------------------------|---|------------------------|
| Announce message rate | Minimum rate: one packet every 16 seconds Maximum rate: 8 packets per second Default rate: one packet every 2 seconds | 8 packets per seconds |
| Sync message rate | Minimum rate: one packet every 16 seconds Maximum rate: 128 packets per second | 16 packets per seconds |
| Delay_Req/ Delay_Resp message rate | Minimum rate: one packet every 16 seconds Maximum rate: 128 packets per second | 16 packets per seconds |

Alternate BMCA

| | G.8265.1 | G.8275.1 |
|---|---|--|
| Type of Alternate Best Master Clock Algorithm | Static Alternate BMCA, master selection is done outside the scope of the PTP protocol | Alternate BMCA with 2 modes: - Fully automatic topology setup (similar to IEEE1588v1 BMCA) - Semi-automatic topology setup |
| Master selection | Based on G.781 principles: comparison of Quality Level / SSM first, then comparison of local priorities | Based on default BMCA with adaptations (if localPriorities unused), or based on G.781 principles (if localPriorities used) |
| Multiple active masters | Multiple masters active at the same time is allowed | Multiple masters active at the same time is allowed |
| PTP attributes used in master selection | clockClass (carries Quality Level information), local priority* | clockClass, clockAccuracy, offsetScaledLogVariance, GM priority2, localPriority*, GM clockId, stepsRemoved, portId, portNumber |

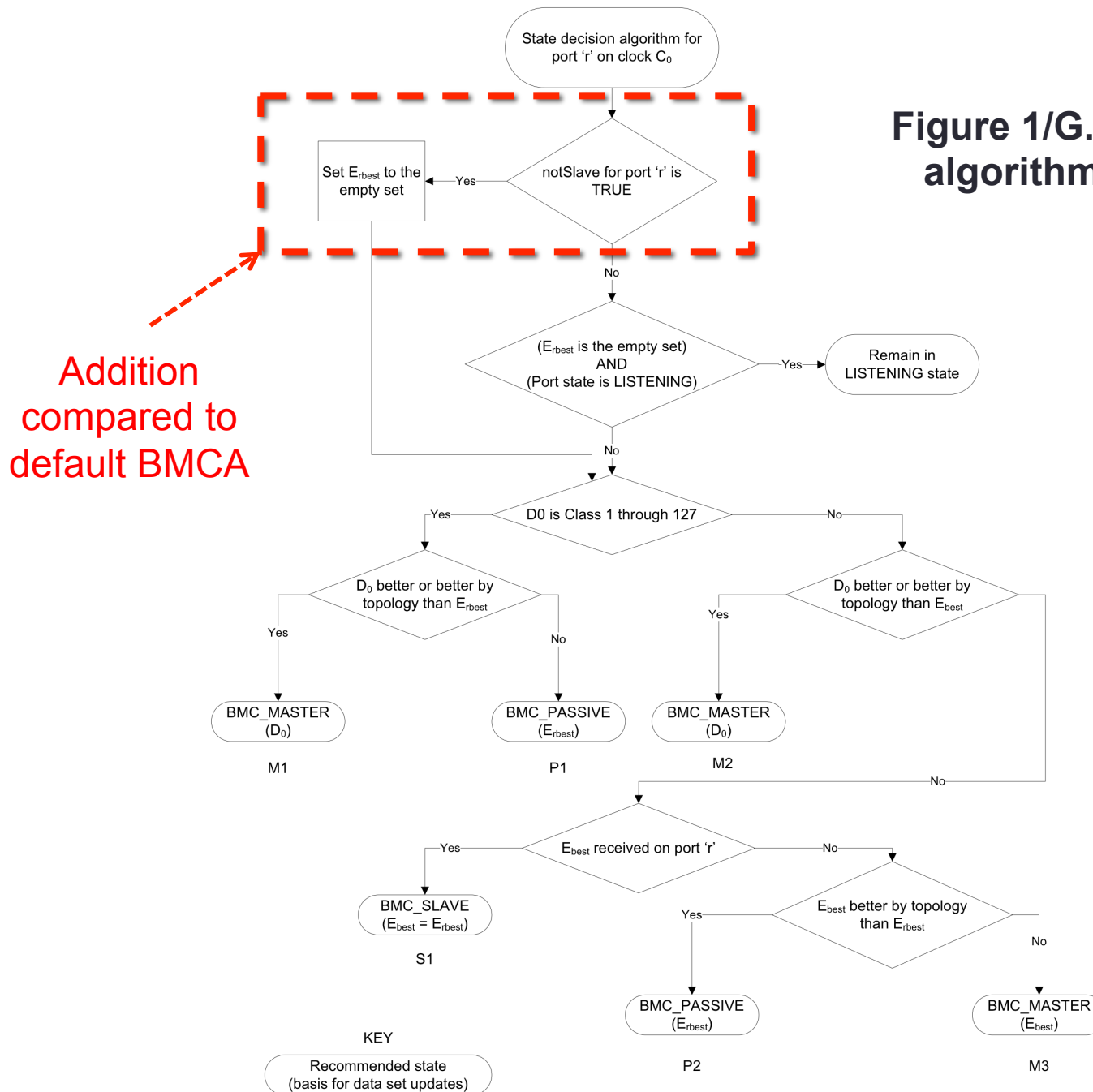
* not an attribute carried in PTP Announce messages 8

clockClass values

| | G.8265.1 | G.8275.1* |
|----------------------------|--|--|
| T-GM / Packet Master Clock | <u>G.781 Option 1</u> : 84 (PRC), 90 (SSU-A), 96 (SSU-B), 104 (EEC-1), 110 (DNU) <u>G.781 Option 2</u> : 80 (PRS), 82 (STU), 86 (ST2), 90 (TNC), 100 (ST3E), 102 (EEC-2), 106 (SMC), 108 (PROV), 110 (DUS) <u>G.781 Option 3</u> : 82 (UNK), 104 (SEC) | 6 (ref from PRTC in locked mode), 7 (within holdover specification), 140 (out of holdover, Category 1), 150 (out of holdover, Category 2), 160 (out of holdover, Category 3), 248 (without time reference since start-up) |
| T-BC | Not Applicable | 135 (within holdover specification), 165 (out of holdover specification), 248 (without time reference since start-up) |
| T-TSC / Packet Slave Clock | 255 (slave does not send Announce messages) | 255 (slave does not send Announce messages) |

* G.8275.1 also describes values for equipment deployed prior to this Recommendation

Figure 1/G.8275.1: State decision algorithm for Alternate BMCA



Insight to future G.8275.2

- Many aspects expected to be similar to G.8265.1
- G.8275.2 first draft based on G.8265.1 text, with adaptations
- Assisted Partial Timing Support vs General Partial Timing Support, G.8275.2 telecom profile expected to support both architectures
- Focus on architecture with no BC and single master for the first version
- A-BMCA: expected to be static in first version
- IP unicast mapping has been agreed
- Packet selection will be performed in the slave PTP ports, in order to filter traffic load-related PDV and asymmetry

Conclusion

- G.8275.x time PTP telecom profiles are designed to support the needs of current and future mobile technologies
- G.8275.1 (full timing support) has been finalized recently in ITU-T
- G.8275.2 (partial timing support) definition is now on-going, and will reuse many aspects specified in G.8265.1



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IEEE 1588 Testing
IEEE Std. 1588™-2008 (v2)



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Acronyms

- PTP: Precision Time Protocol
- M: Master
- S: Slave
- T-GM: Telecom-Grandmaster
- T-BC: Telecom-Boundary Clock
- T-TSC: Telecom-Time Slave Clock
- BC: Boundary Clock
- QL: Quality Level
- PRC: Primary Reference Clock
- PRS: Primary Reference Source