Guaranteeing Interoperability of Efficient and Flexible Wake-up/Sleep in a 100BASE-T1 Environment

Dr. Philip Axer (NXP)
Fabian Nikolaus (C&S)

C&S NXP

OPEN Alliance TC10 - Reducing CO2 emissions

- “Cars are responsible for around 12% of total EU emissions of carbon dioxide” [2]
- New ADAS and electric vehicle use-cases
  - Over the air update
  - Overnight charging
  - Remote connectivity

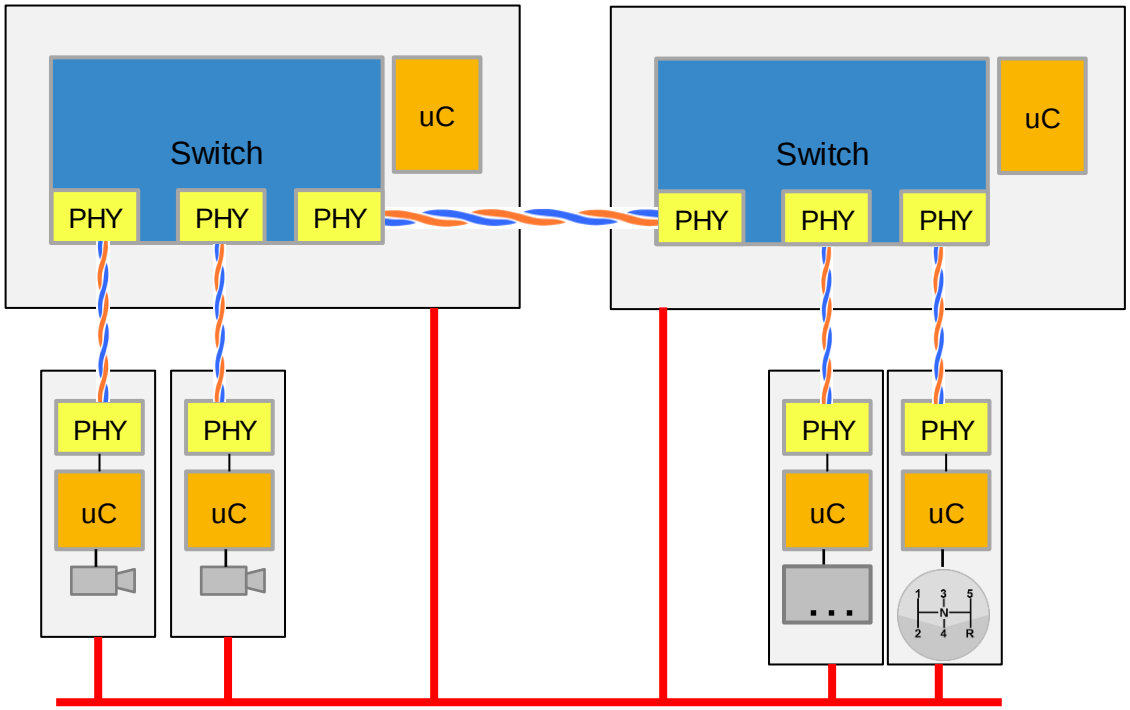
TC10 Goals:

Support fast wake-up and wake-up request forwarding to support a global wake-up on layer 1

Support controlled link shutdown to hibernate selected parts of network

[1] Cornelius Butzkamm and David Bollati, „Partial Networking for CAN bus systems: Any saved gram CO2/km is essential to meet stricter EU regulations.”, iCC 2012,
[2] https://ec.europa.eu/clima/policies/transport/vehicles/cars_en

Global Wake-up with Activation Line

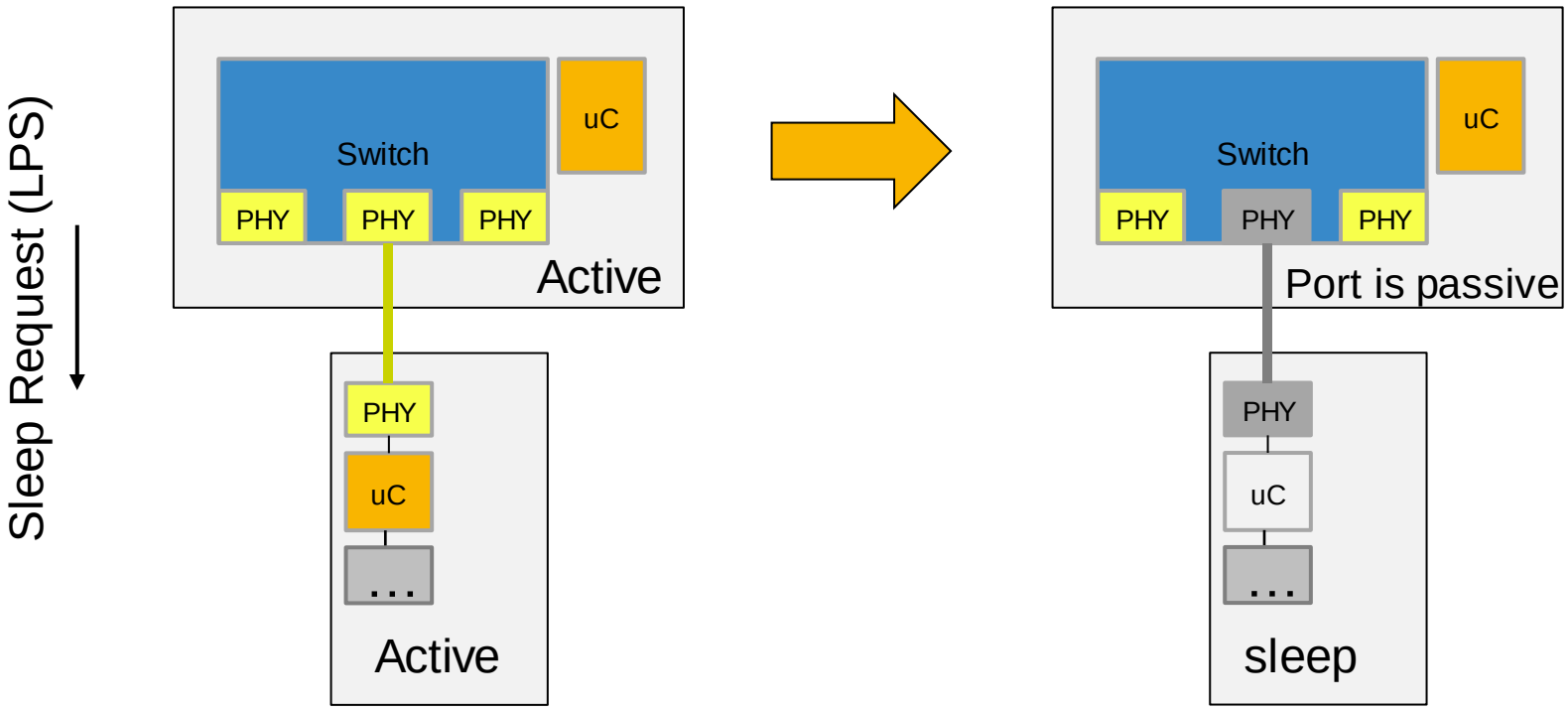


Wakeup-line asserted: active
Wakeup-line deasserted: sleep

→ Fast startup times, but more wireing

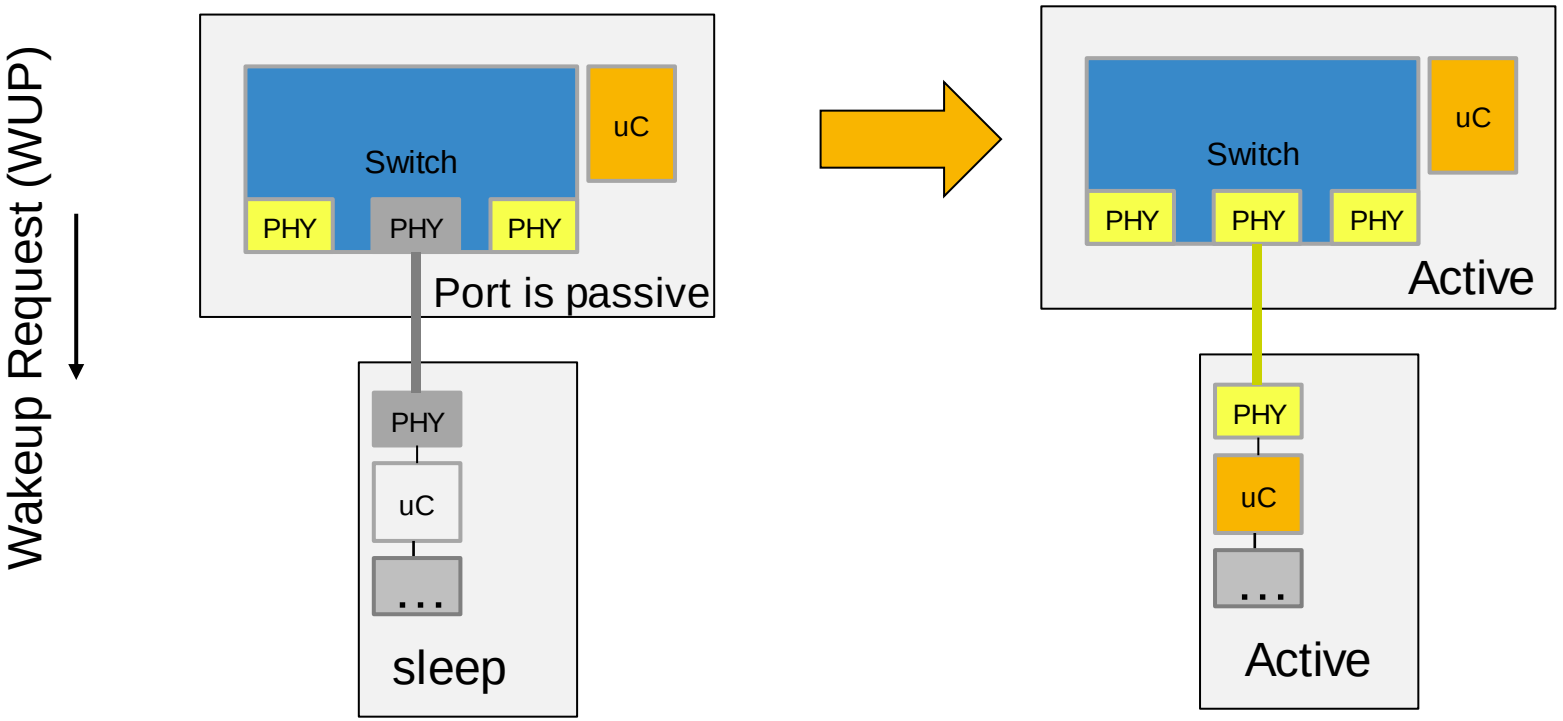
Use-Cases (1/3)

Negotiate Sleep over active link



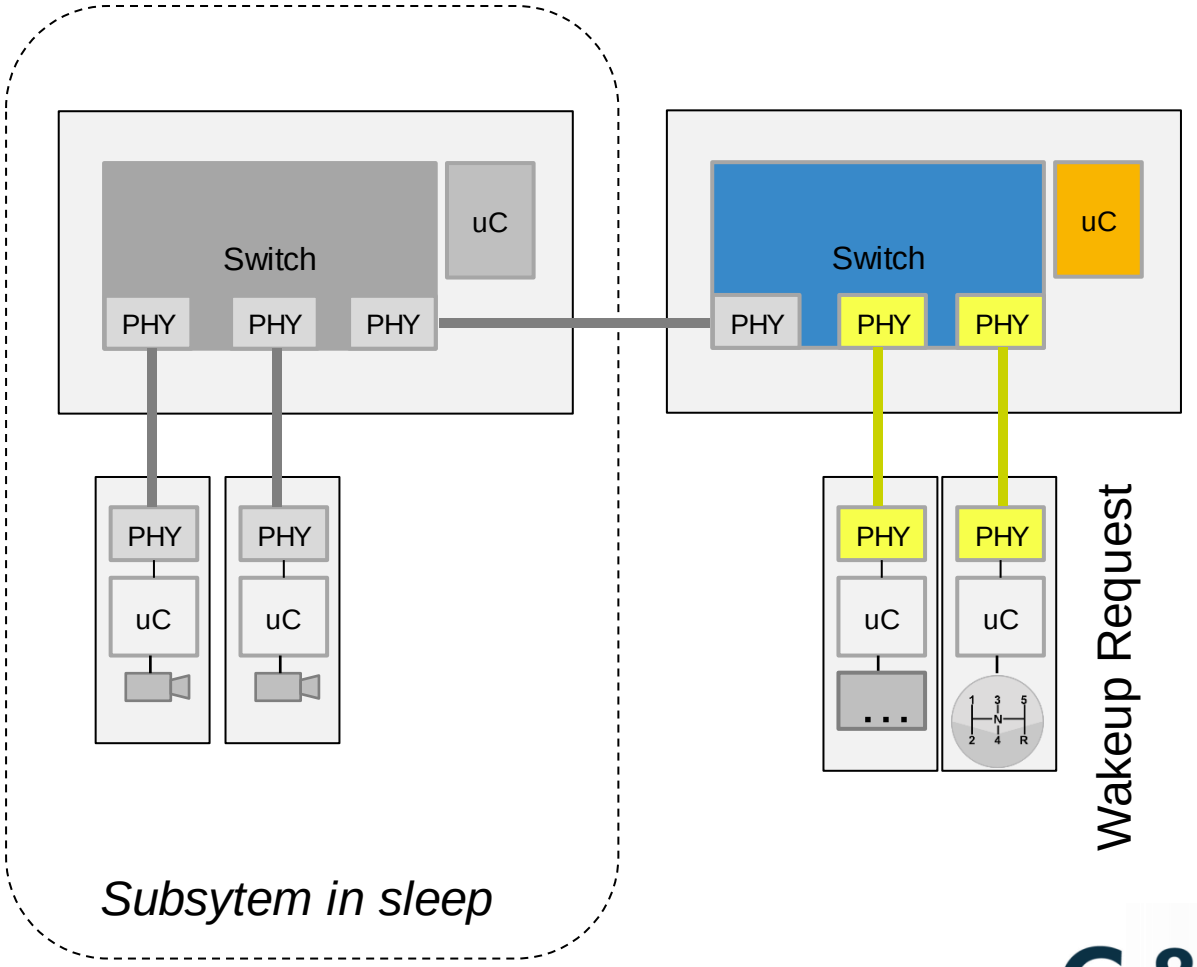
Use-Cases(2/3)

Wakeup over passive link



Use-Cases(3/3)

Wakeup Forwarding over active and passive link (WUP and WUR)



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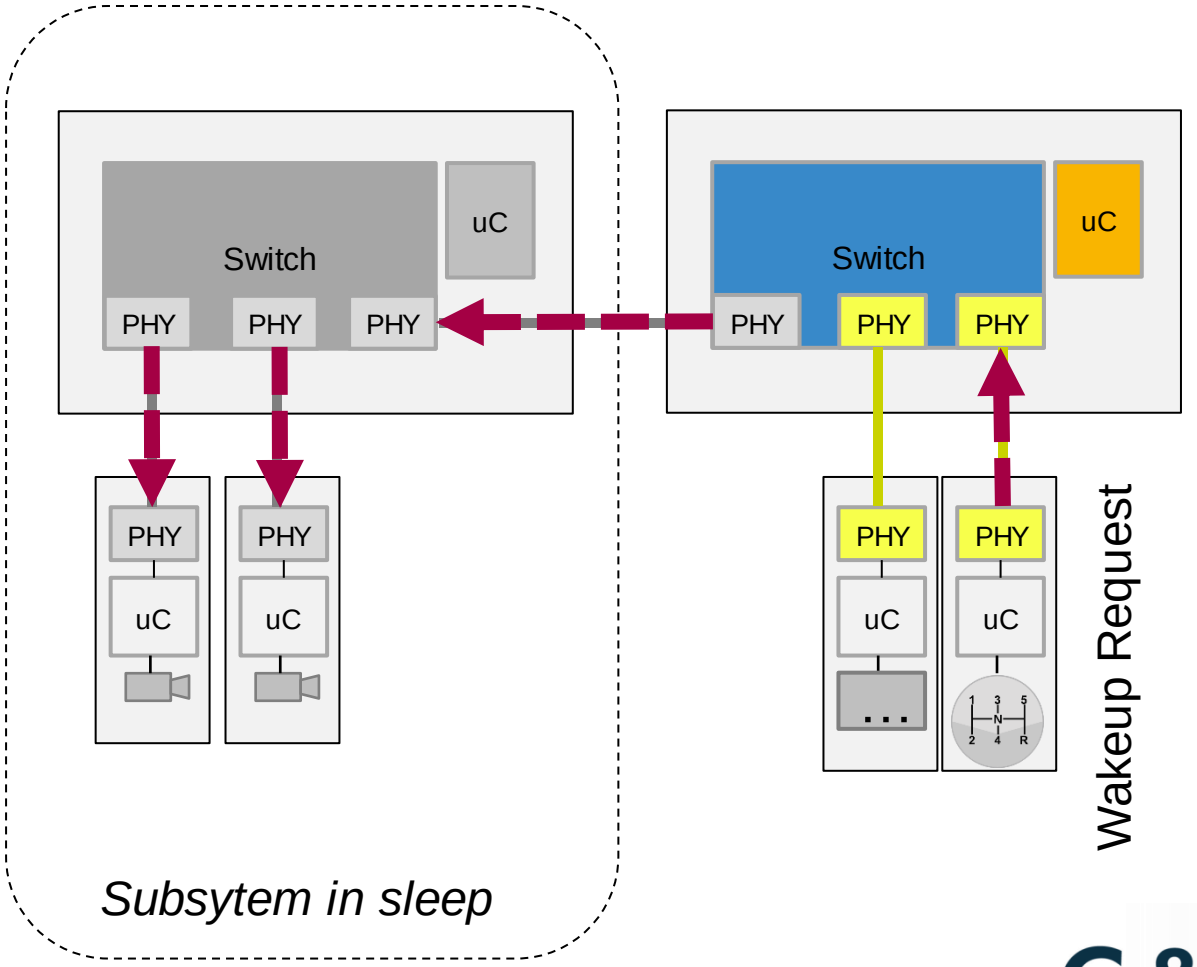

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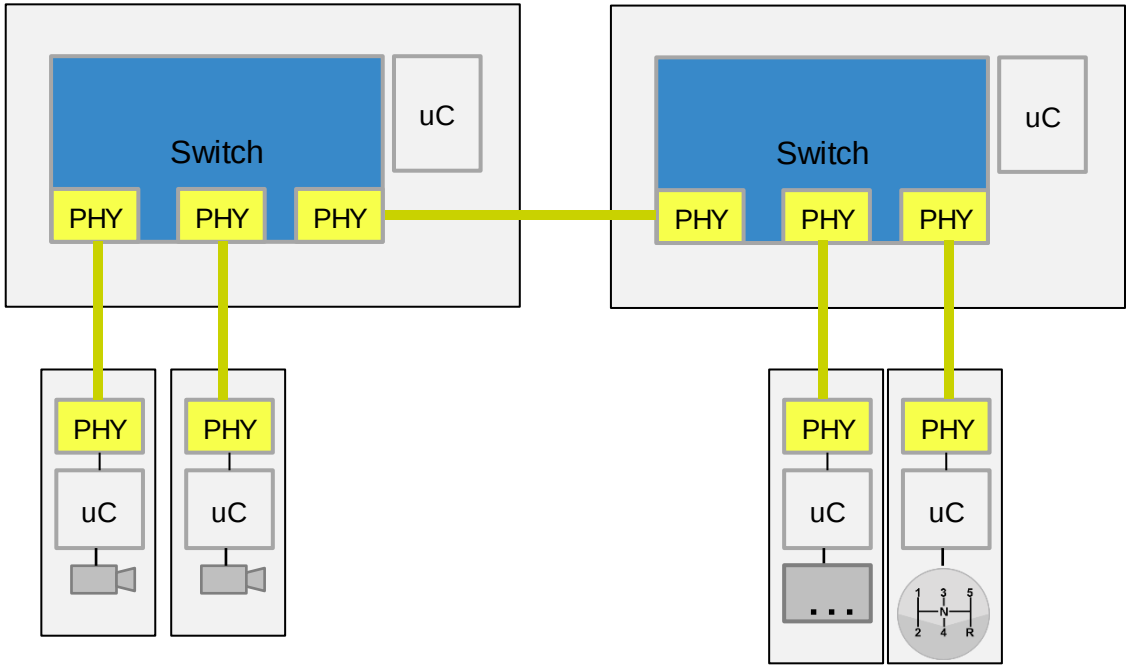
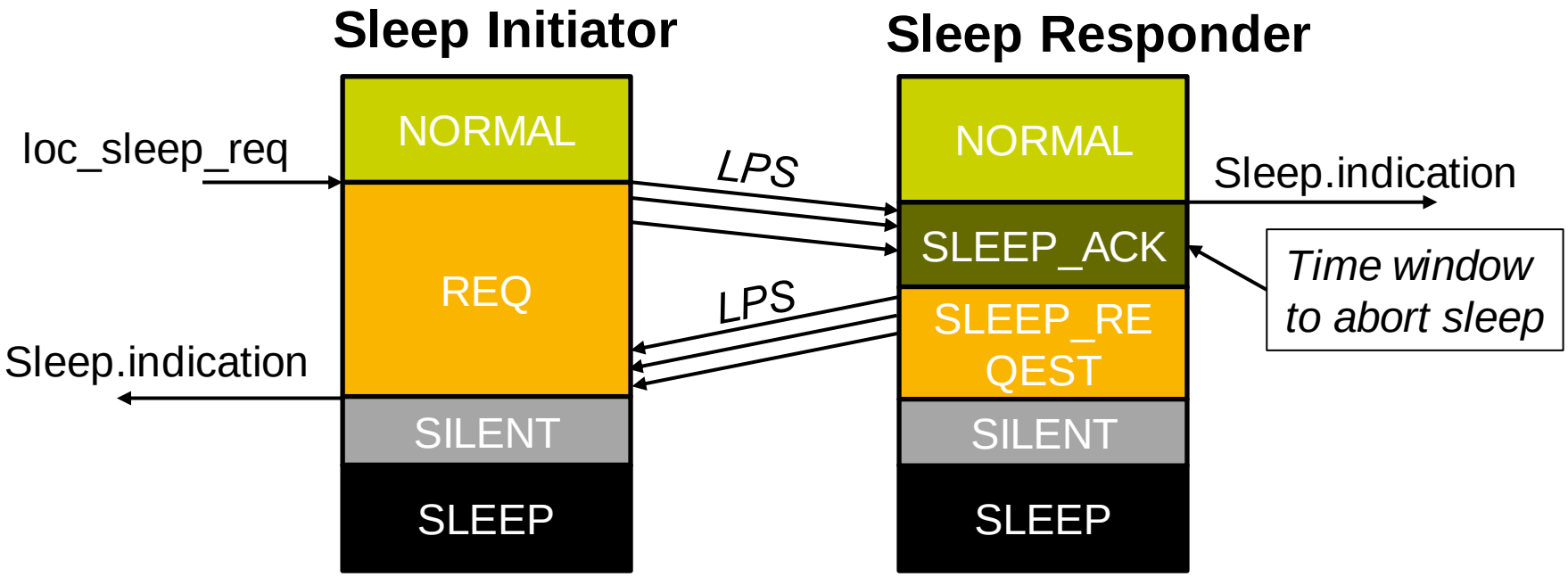


Sleep Handshake



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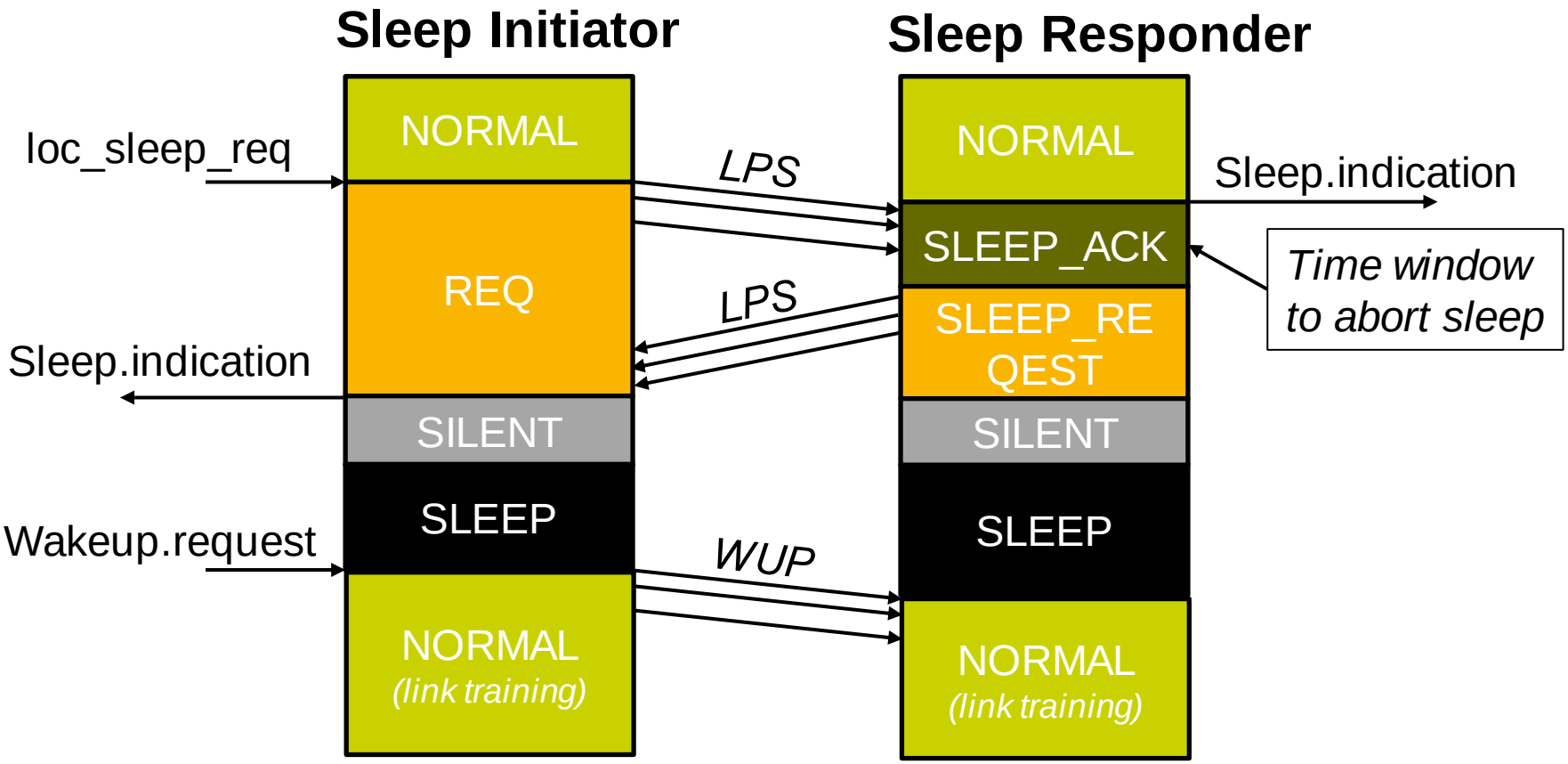
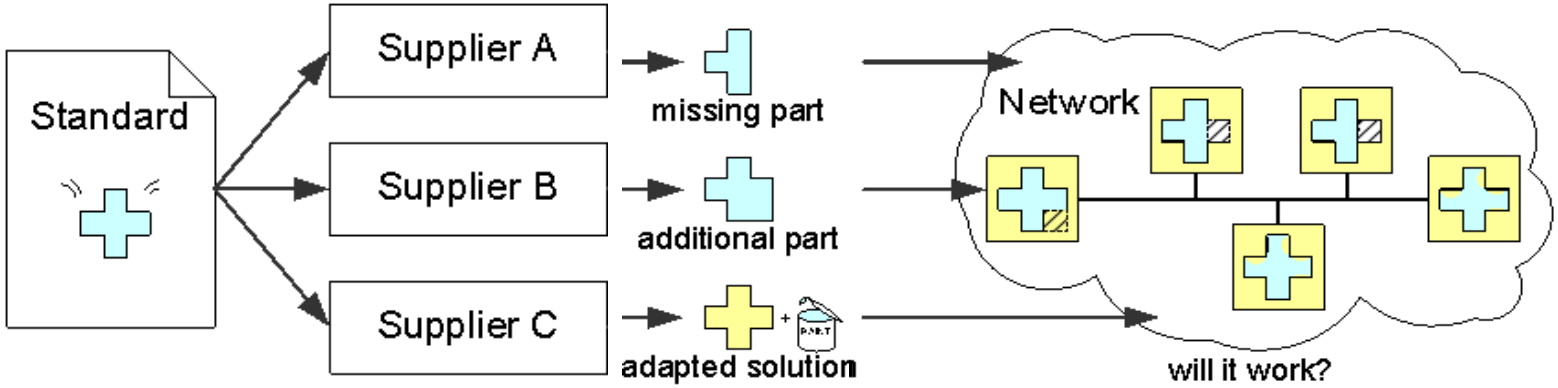


Interoperability

- Problem description



- Multi-Supplier-Solutions
  - (Mis-)Interpretation is especially a problem in an environment in which products of different suppliers have to interoperate
  - One single specified standard can be interpreted differently by different implementers, because:
    - Human language itself is ambiguous
    - A specified standard might contain coverage gaps, missing details
    - The implementer might misunderstand the specification

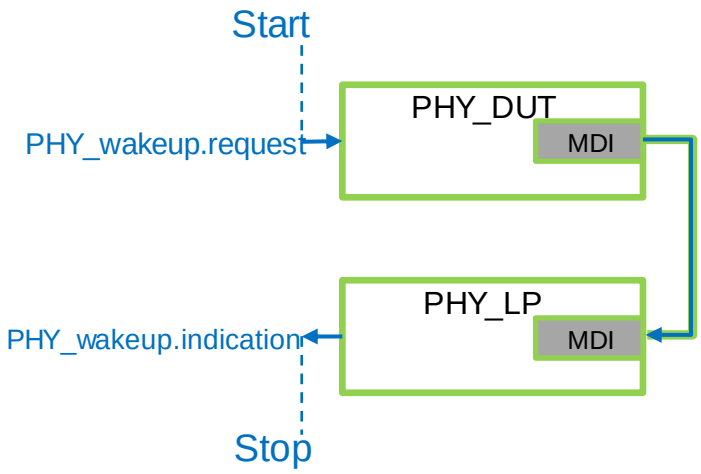
OABR Wake-up IOP Test Suite

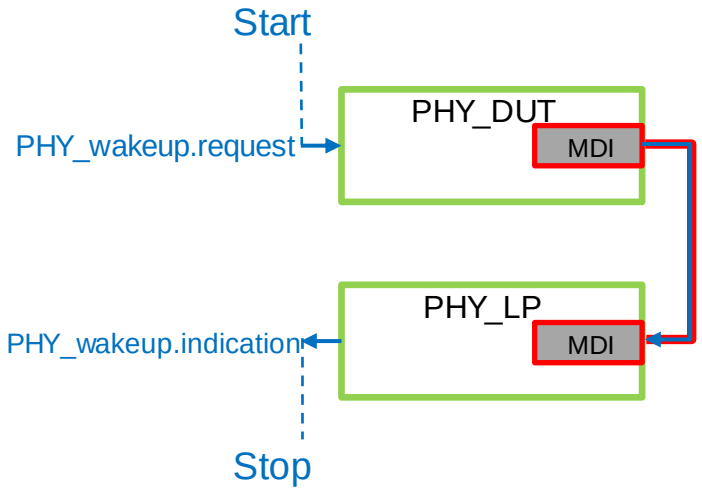
- Facts and Numbers
  - 13 Test cases
  - Reflecting in 46 instances
    - Master/Slave, Swapped Polarity , Channel Type
- Test Groups

Test Group	Number of test cases
Wake-up reception and signalizing	3
Wake-up transmission	3
Wake-up forwarding	5
Sleep	2

Timing Measurement

- Wakeup over an active link
  - TWU_Link_active
  - <1ms
- Wakeup over a passive link
  - TWU_Link_passive
  - <2ms

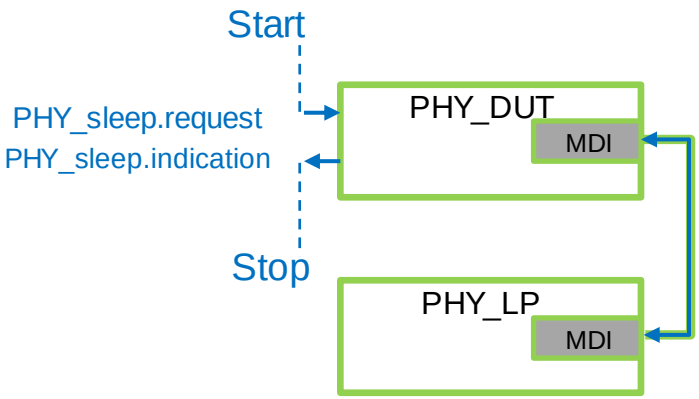


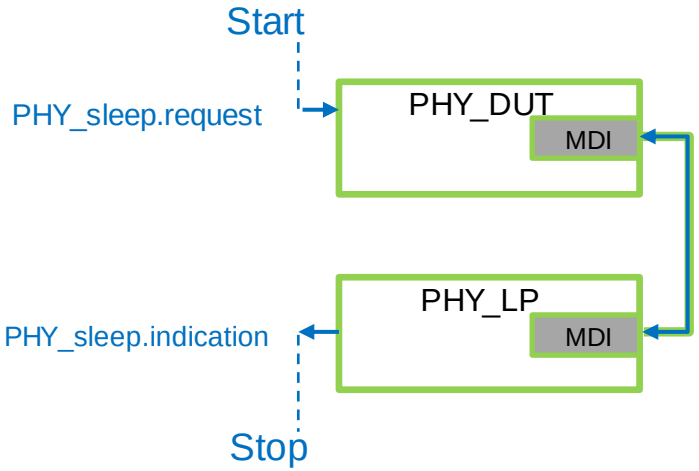


PHY powered
Link established
PHY unpowered
Link not established
Measurement Path

Timing Measurement

- Local sleep request
  - T_LinkSleep
  - <16ms
- Remote sleep request
  - T_LinkSleep
  - <24ms

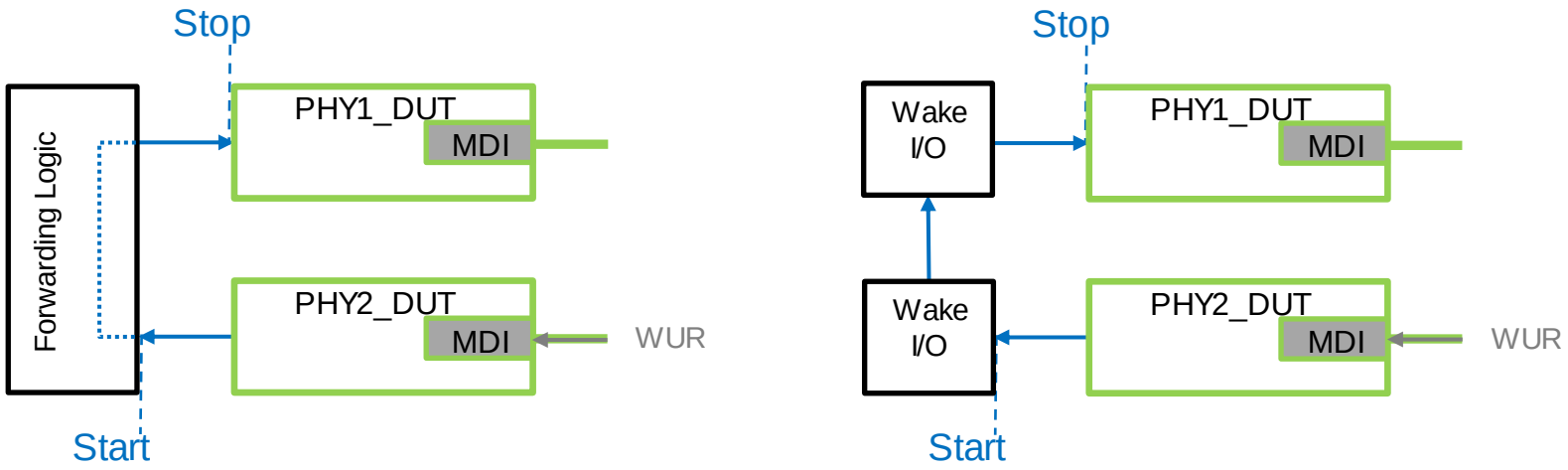




PHY powered
PHY unpowered
Link established
Link not established
Measurement Path

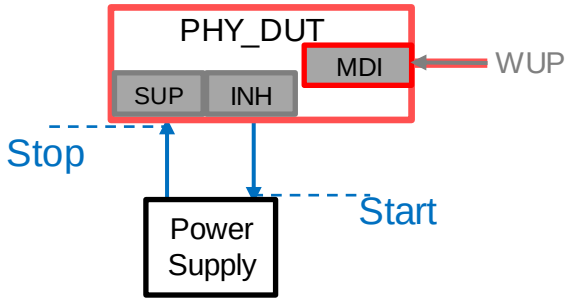
Timing Measurement

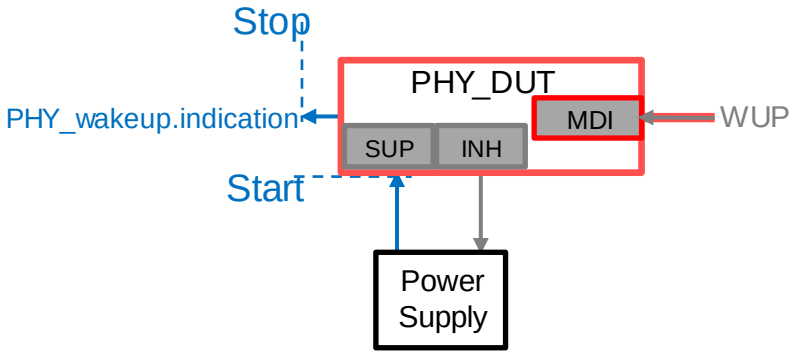
- Wakeup forwarding integrated
  - TWU_Forwarding
  - <1ms
- Wakeup forwarding via optional I/O
  - TWU_WakeIO
  - <1ms



Timing Measurement

- Power Supply Stable
  - T_Powersupply_Stable
  - 90% of nominal value
  - <5ms
- PHY Initialization
  - T_PHY_Initialization
  - <5ms

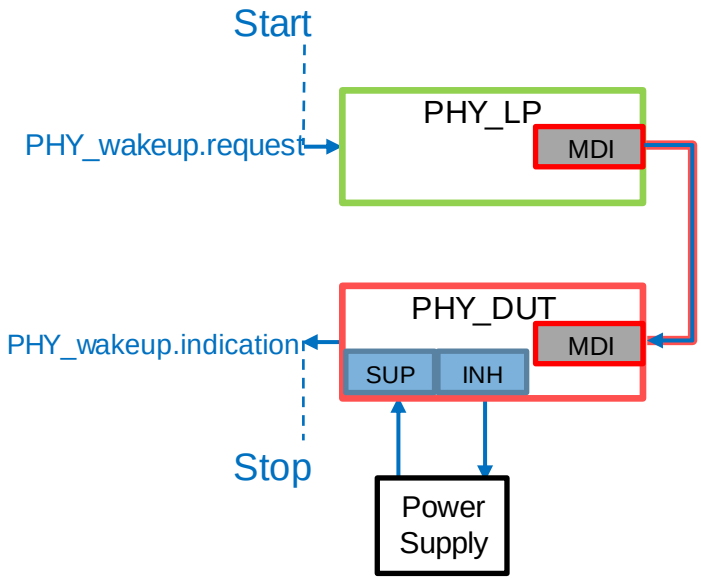




PHY powered
PHY unpowered
Link established
Link not established
Measurement Path

Timing Measurement

- Reception of a Wakeup Pulse (WUP)
  - TWU_Link_passive + T_Powersupply_Stable + T_PHY_Initialization
  - 2ms + 5ms + 5ms
  - <12ms



PHY powered — Link established

PHY unpowered — Link not established — Measurement Path

First Results

- TBD

Thanks for your attention!

SECURE CONNECTIONS
FOR A SMARTER WORLD