



# Synchronization for Next Generation Network Equipment

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**Laurent Montini – Consulting Engineer**  
**Stewart Bryant – Tech Leader**

# Agenda

- **Network vs. application**
- **Network synchronization service**
- **Case Study: Mobile operator**
- **Packet-based equipment clock distribution**
- **Network equipment requirements**
- **Synchronization network**
  - Impact on design and architecture**
  - Requirements**
- **Summary**

# Network and applications

- **There is a dichotomy between applications and packet switched networks**
- **Historically, clock was an intrinsic part of the data transmission**
- **Today, packet switched networks (PSN)**
  1. **Transmit traffic from/to applications**
  2. **Do not need synchronization**
- **Some applications require synchronization**
- **Would the applications require PSN to be synchronized?**
- **Or do PSN need only to provide a synchronization service to those applications?**

**Synchronization would become another data traffic**

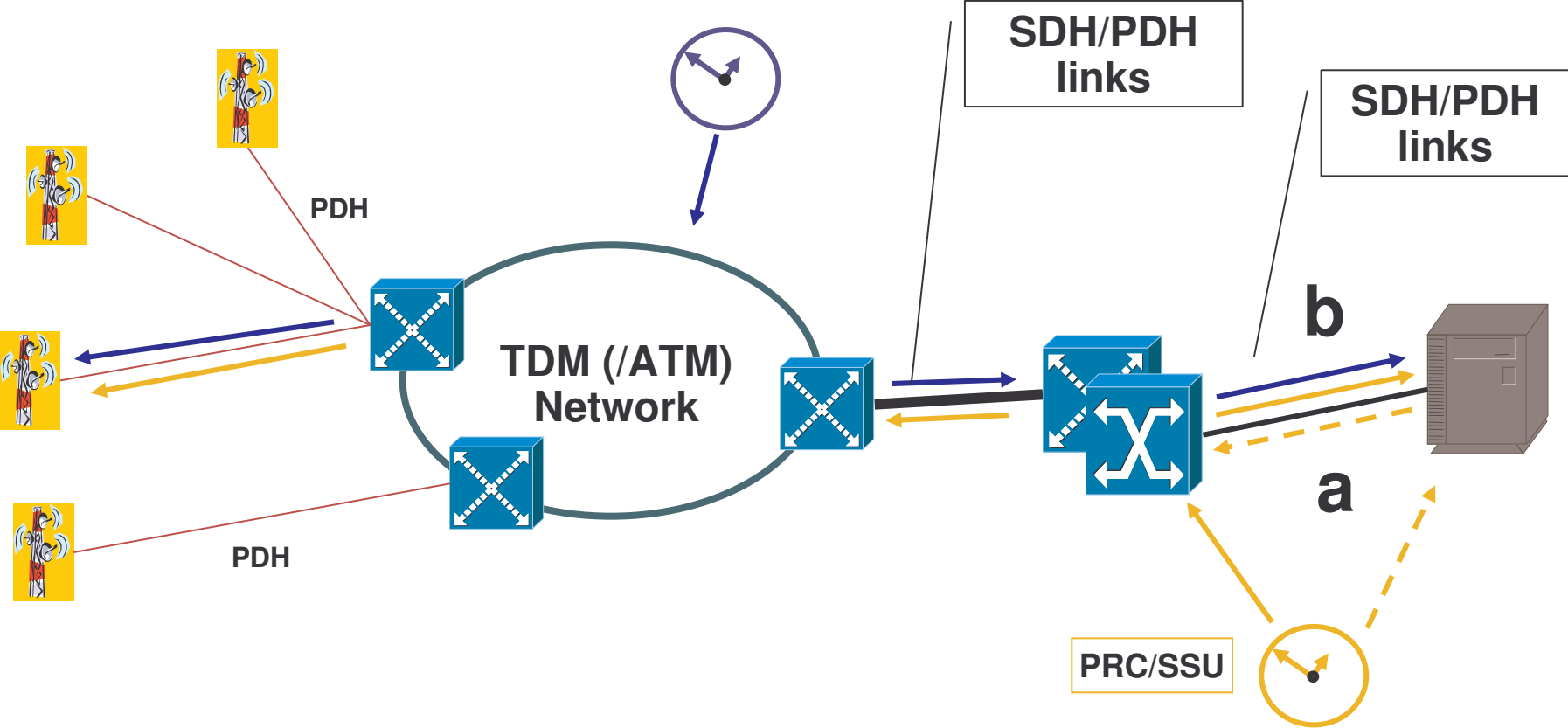
# Clock transmission demand

- **Certain applications need an accurate clock**
- **Examples of current applications that potentially require synchronization**
  - Cellular base station
  - Legacy services: E1, fax, modem...
  - Media gateways
  - Video equipments
- **PSN with synchronization transmission should enable introduction of new application**
  - E.g. wide area precise information gathering
- **The reason an application needs an accurate clock is out of scope**
  - This presentation focus on the network elements and architecture requirements...
  - ...not on the applications and possible benefits of synchronization to those applications

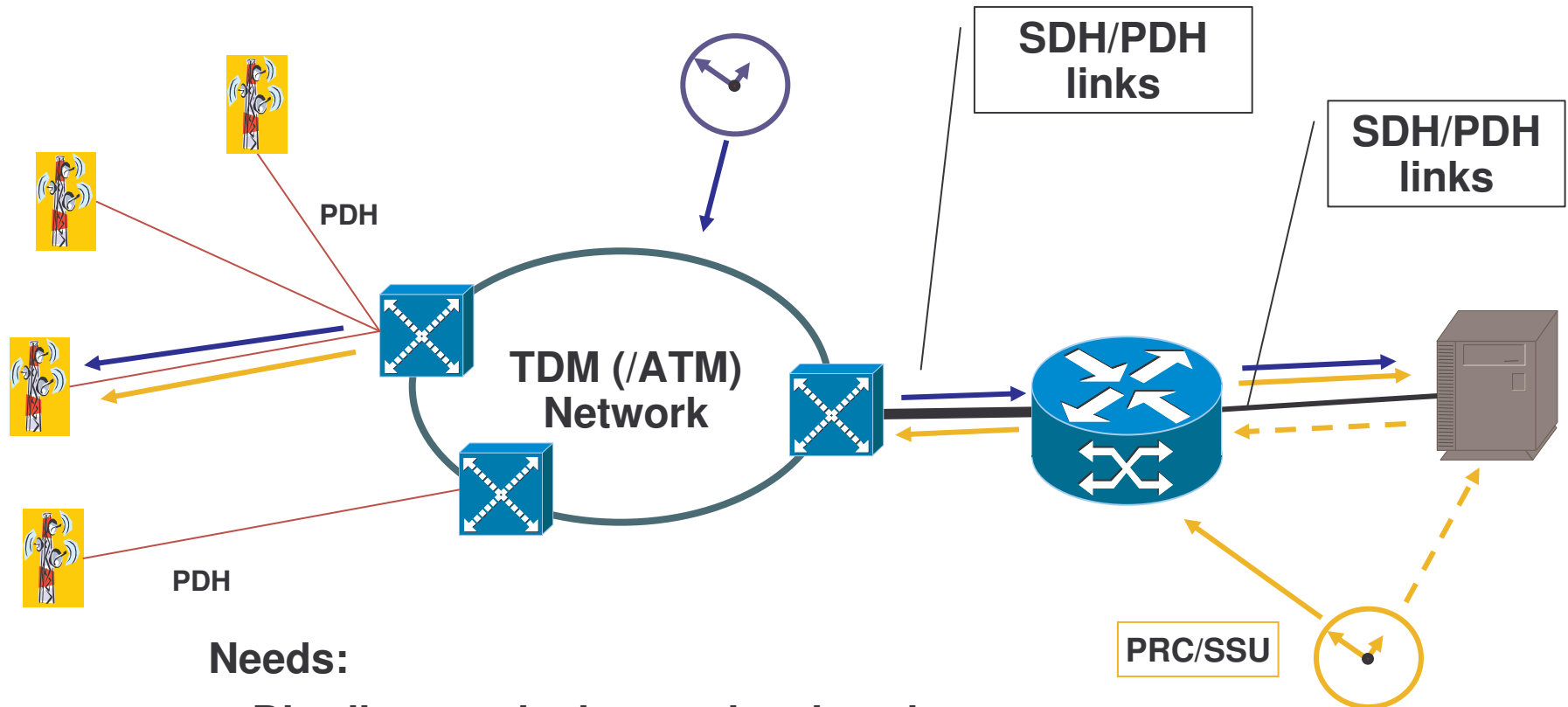
# Network synchronization service

- **Provide a synchronization service to customer**  
Operators manage clock source for their customers
- **Transmit synchronization as data**  
Customers manage their own clock
- **Service must comply to customer synchronization requirements**  
Not getting the right sync can break applications  
At least it would degrade the applications
- **The two synchronization services may demand different network requirements**  
Network equipment design/conception  
Network architecture: design, protocol, algorithm, SLA, ...

# Case study: Mobile operator *Radio Access Network aggregation*



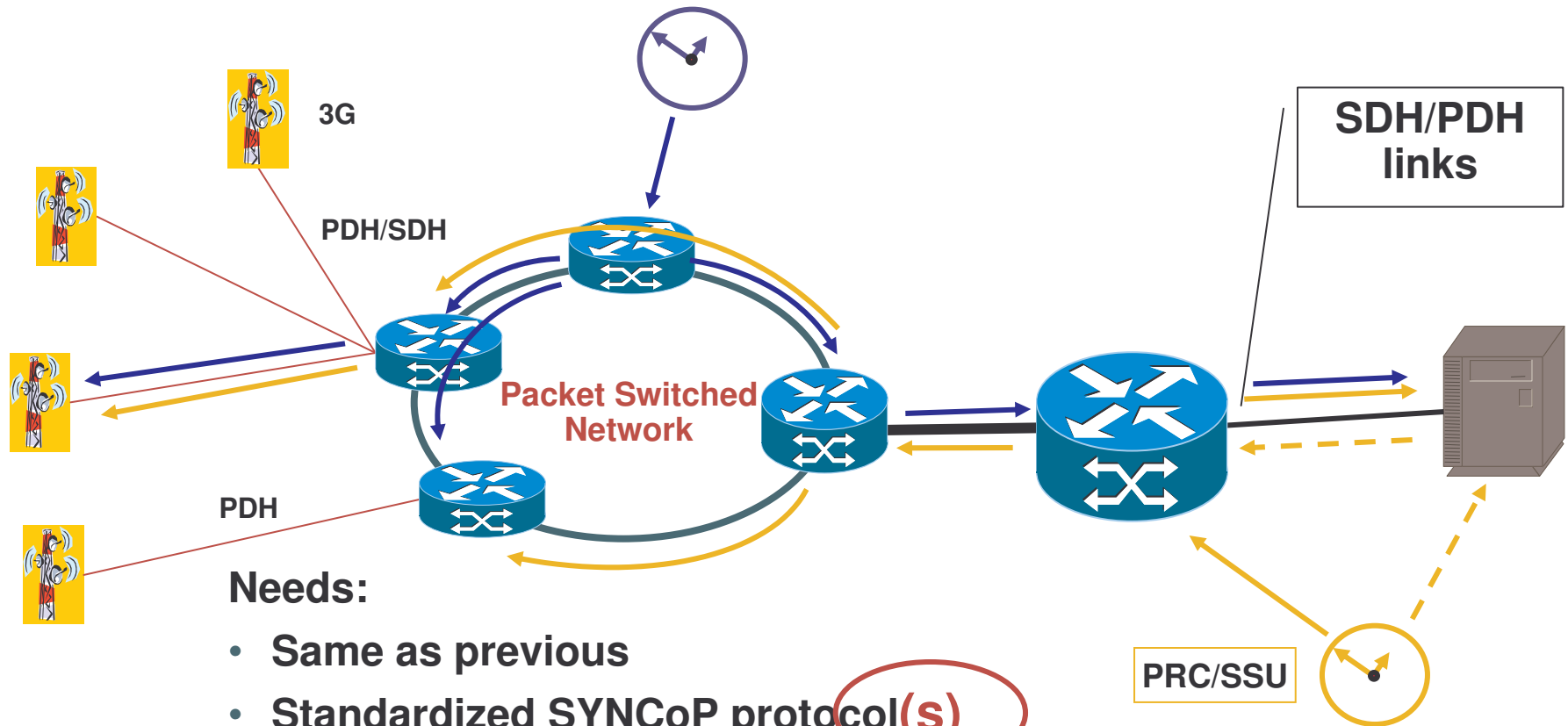
# Case study: Mobile operator Introducing NGN equipment



## Needs:

- Distribute a clock over the chassis
- Introduce an input clock interface (chassis wide)
- Have redundant clock source(s)

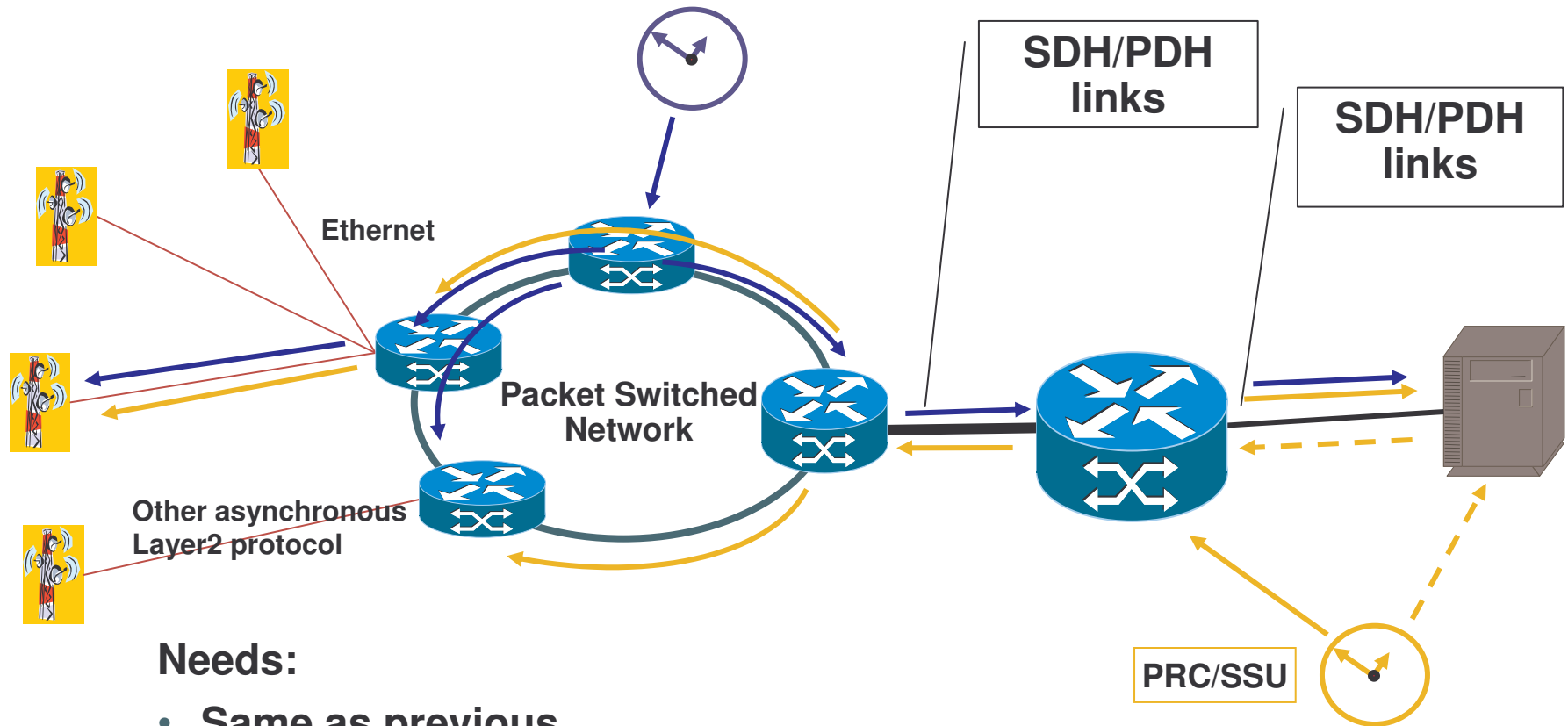
# Case study: Mobile operator *Migration to NGN based RAN*



## Needs:

- Same as previous
- Standardized SYNCop protocol(s)
- SYNCop protocol SHOULD be media independent
- Transmit clock over packet (SYNCop)
- Recover clock from SYNCop and use as a source

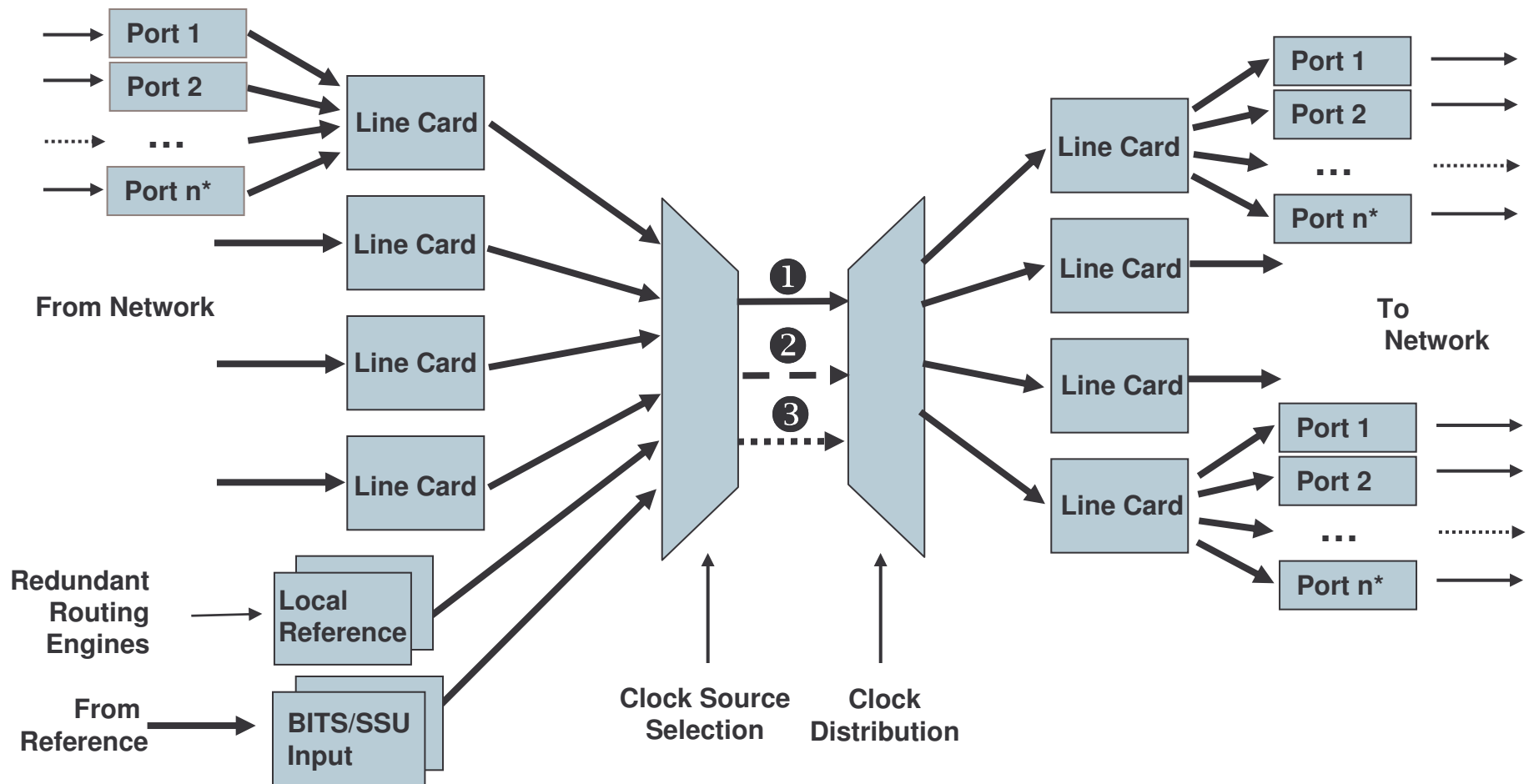
# Case study: Mobile operator IP RAN



## Needs:

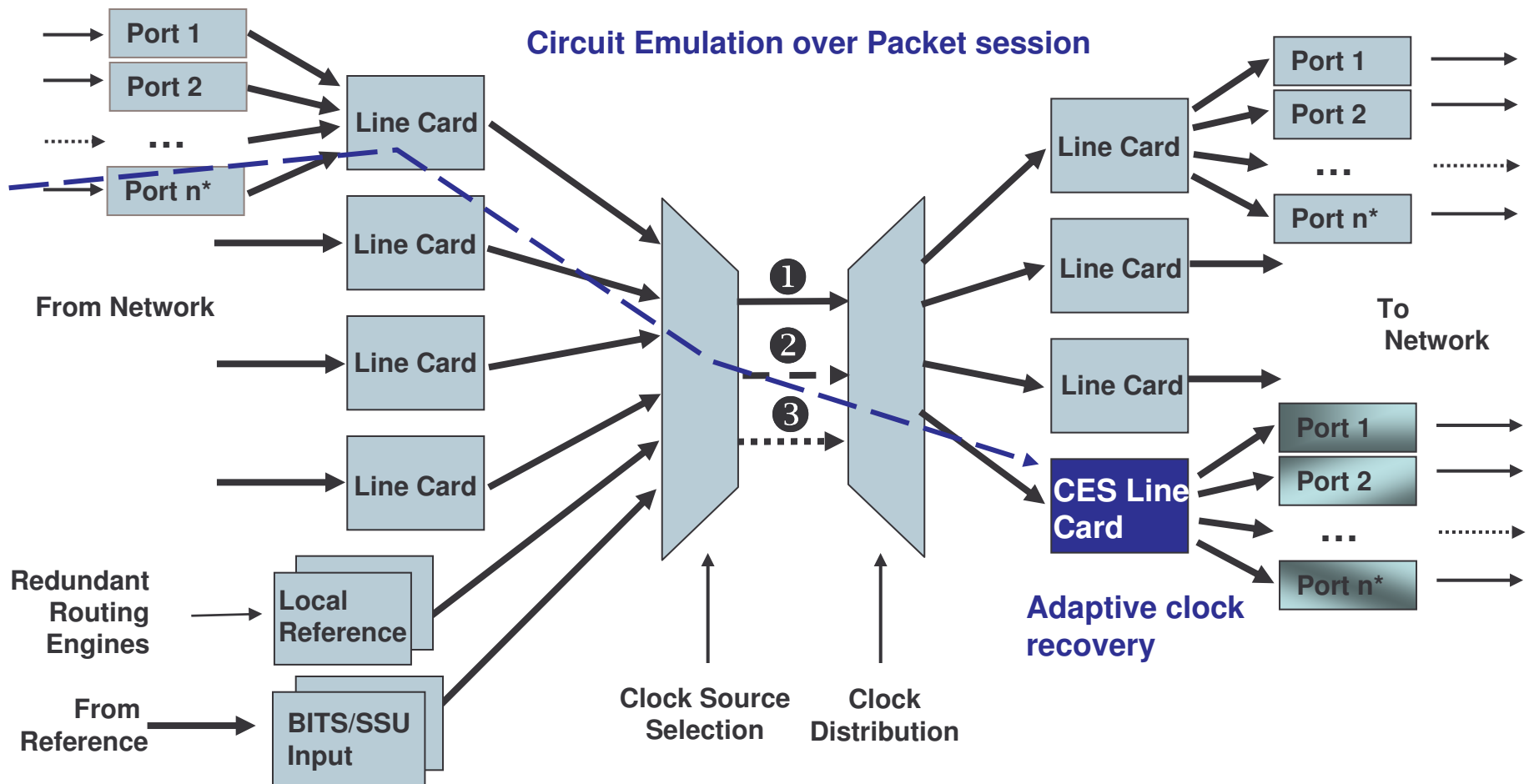
- Same as previous
- Either SYNCoP protocol MUST be media independent
- Or need inter-working functions for SYNCoP protocols

# A Network Timing Clock Generation and Distribution



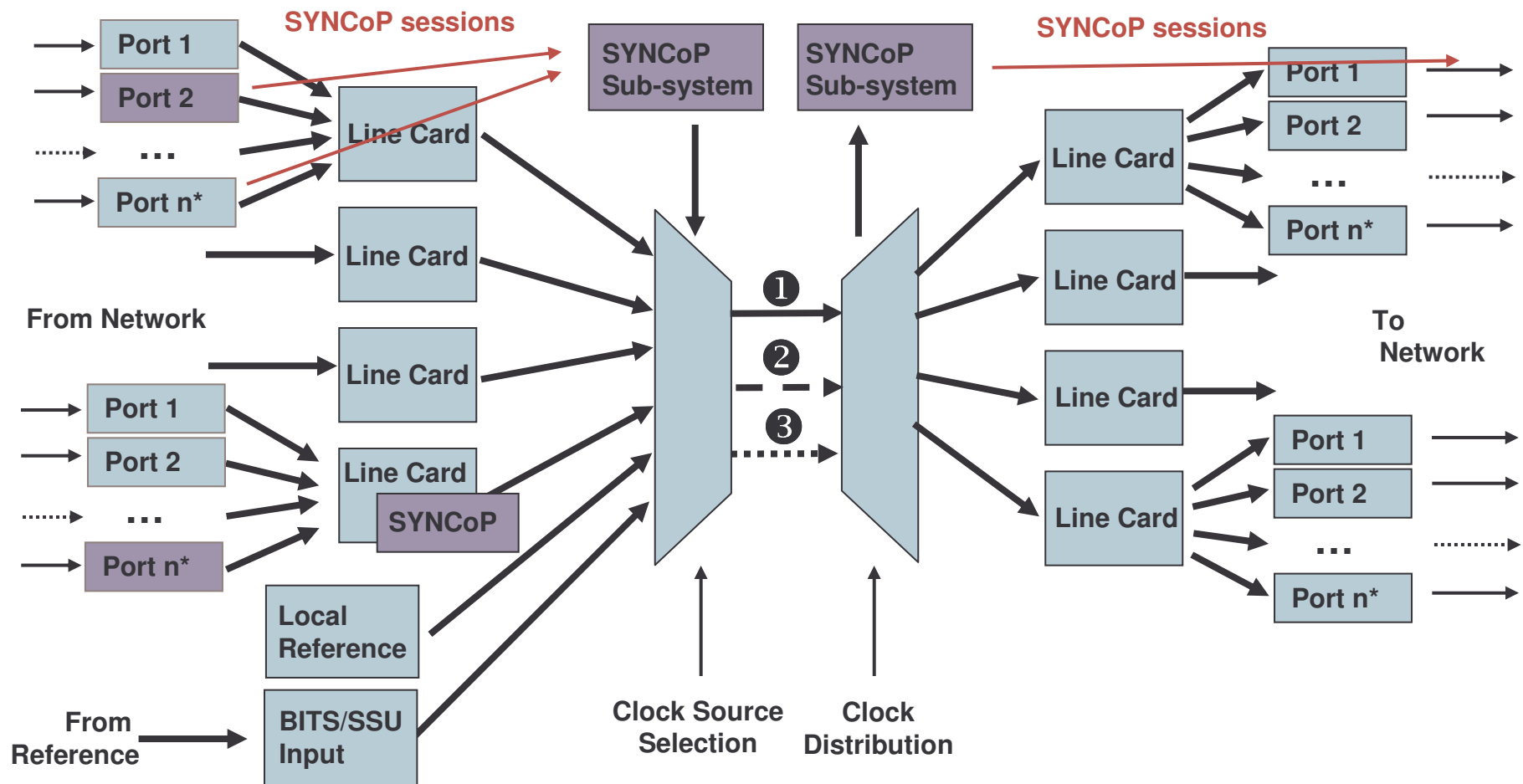
*Single clock domain*

# A Network Timing Clock Generation and Distribution



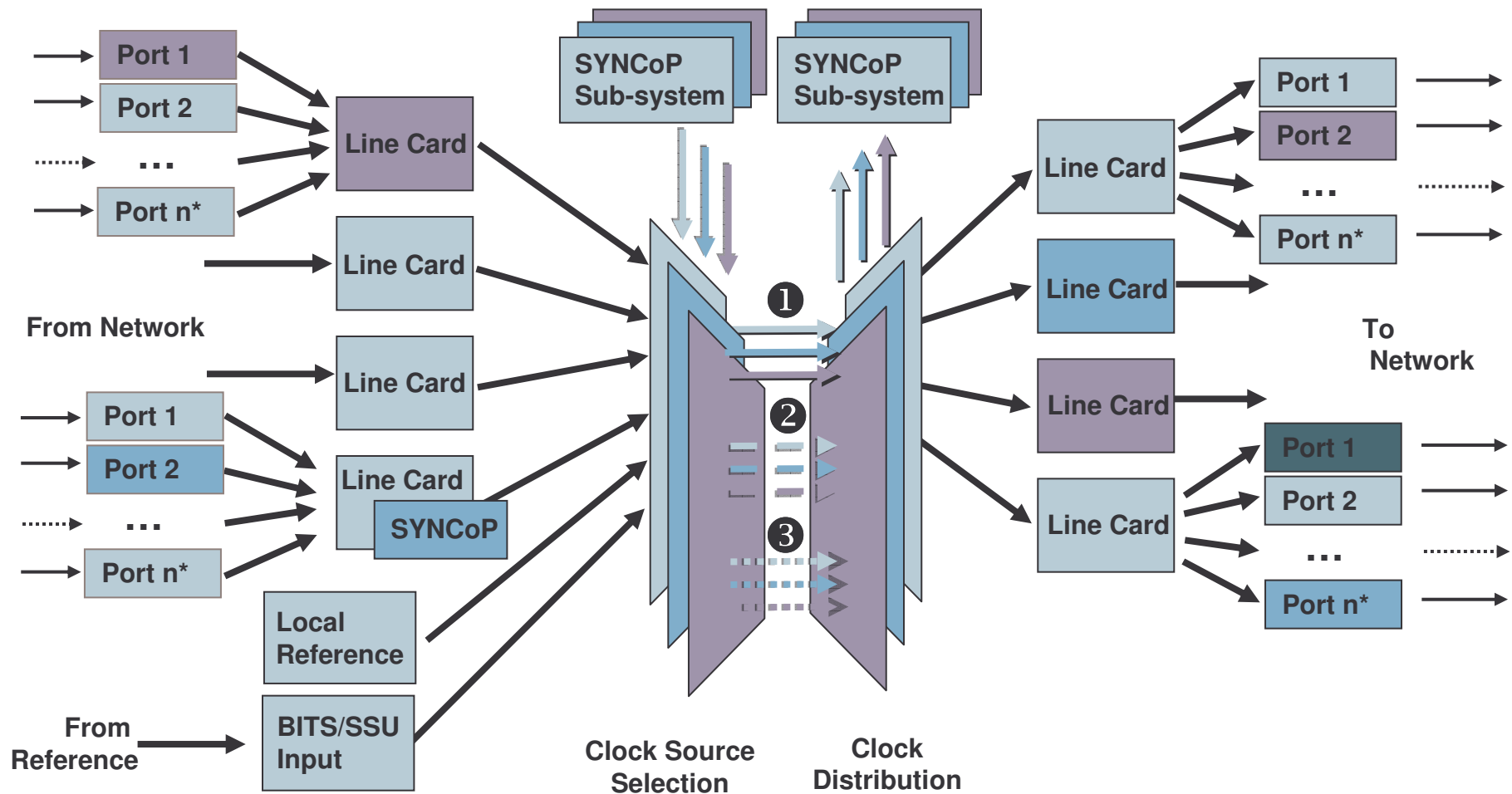
*Single clock domain*

# SYNCoP as new clock source



*Single clock domain*

# Multiple clock domains support



*Need different clock domains?*

# Needs for enhanced/new network equipment

## Summary

- **Clock distribution across the equipment**
  - To/from synchronous and/or serial interfaces
  - From dedicated clock source interface (e.g. BITS)
- **Synchronization transmission over non-synchronous interfaces need a new protocol**
  - Equipment need new hardware and software to initiate/terminate such protocol
  - Can be unicast / multicast, end-to-end / hop-by-hop
  - Protocol design will impact the network design
- **Clock distribution logic**
  - Single clock domain
  - Are multiple clock domains required?

# Impact of synchronization on network design

- **Some or all nodes of the PSN need to transmit the synchronization information**
- **Service Provider nodes participate in the synchronization architecture**
  - Support a SYNCOP protocol
  - Either only edge nodes participate (connected to application)
  - Or edge and some core nodes
  - Or all nodes must participate
- **Synchronization between customer nodes**
  - PSN just forward the SYNCOP session
- **Telecom network design and SLA are key**
  - Already low latency queuing for voice
  - Will SYNCOP protocol be OK with same QoS?
  - Or will QoS need to be better?

# Telecom architecture requirements for synchronization network

- **Media independent standard protocol**
  - Or multiple protocols with IWFs
- **Redundancy and resiliency**
  - Multiple clock sources
  - Multiple clock locations
  - Reachable via alternate paths
- **Operator designed and managed**
  - Performance is more important than plug & play
  - Must have control and monitoring mechanisms
- **Security: trusted or non-trusted domain**
  - A trusted domain will ease design for better accuracy

# Summary

- **Network ability to transmit appropriately SYNCoP sessions**
  - To continue the support of existing non-packet services
  - To enable new services and applications
- **Platform ability to support synchronization requires:**
  - Local clock distribution
  - Participation in SYNCoP architecture
- **Protocol providing the ability to transmit an accurate clock over a packet based network will depend on:**
  - Telecoms requirements
  - Media independency or IWF
- **Each of these elements will influence the design of the others**

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# CISCO SYSTEMS

