



Synchronization for Next Generation Network Equipment

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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

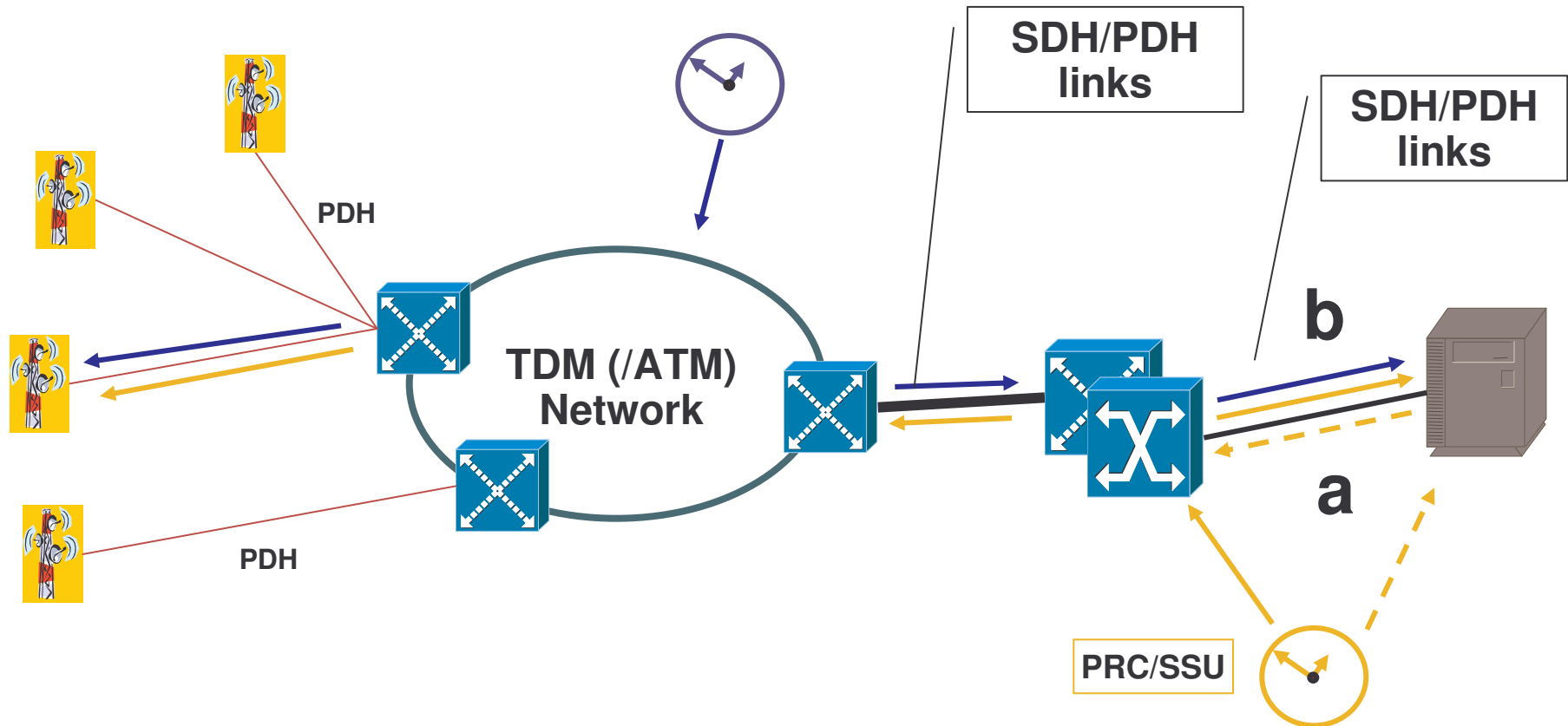
- **Certain applications need an accurate clock**
- **Examples of current applications that potentially require synchronization**
 - Cellular base station
 - Legacy services: E1, fax, modem...
 - Media gateways
 - Video equipments
- **PSN with synchronization transmission should enable introduction of 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

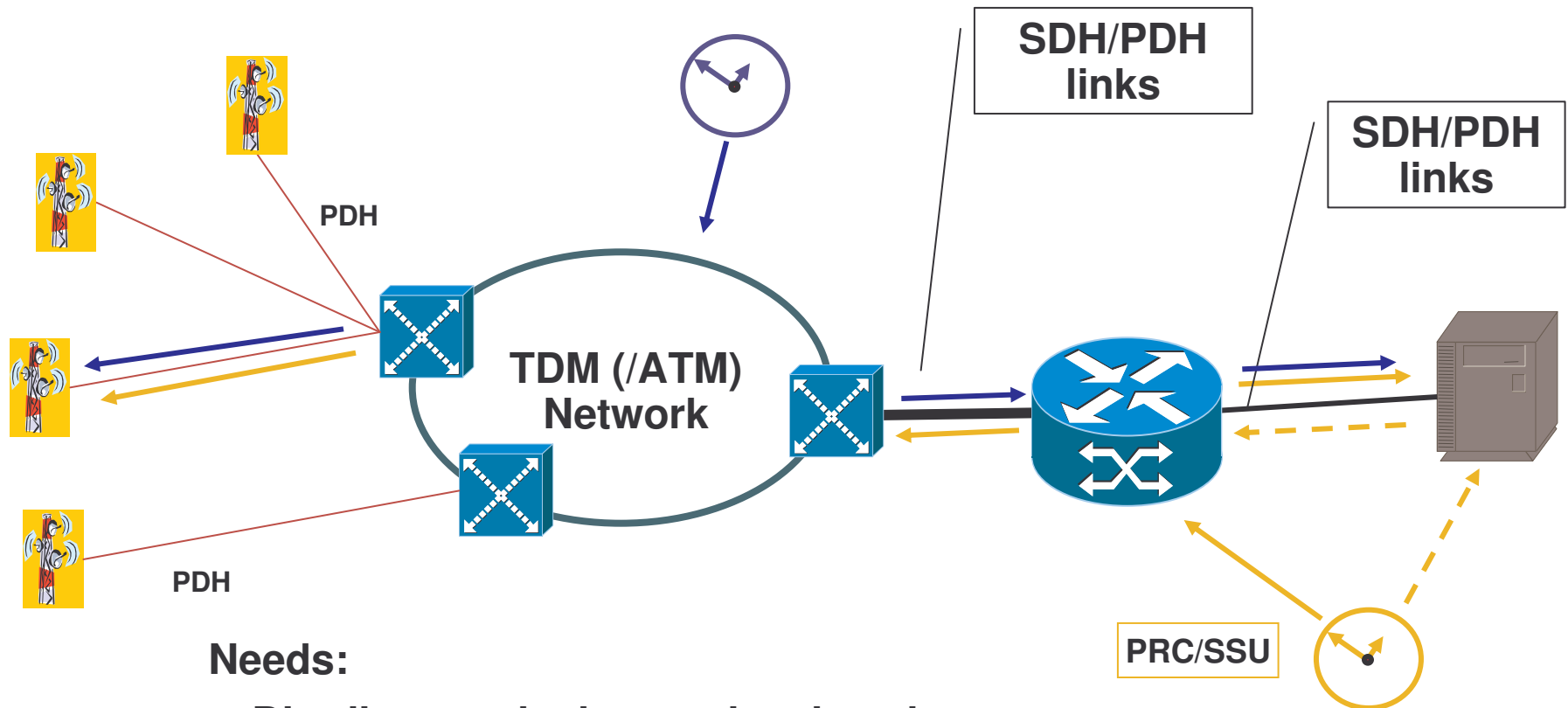
- **Provide a synchronization service to customer**
Operators manage clock source for their customers
- **Transmit synchronization as data**
Customers manage their own clock
- **Service must comply to customer synchronization requirements**
Not getting the right sync can break applications
At least it 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



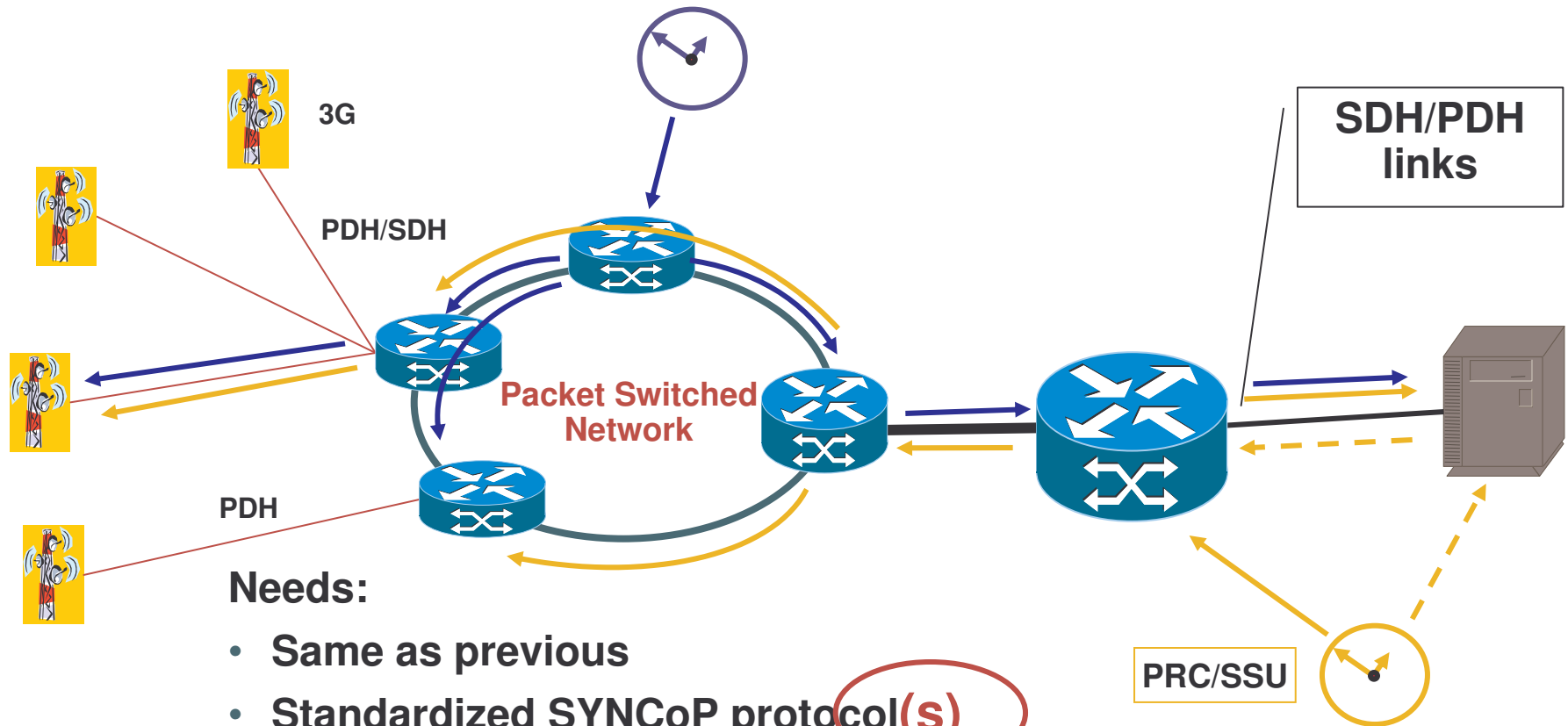
Case study: Mobile operator Introducing NGN equipment



Needs:

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

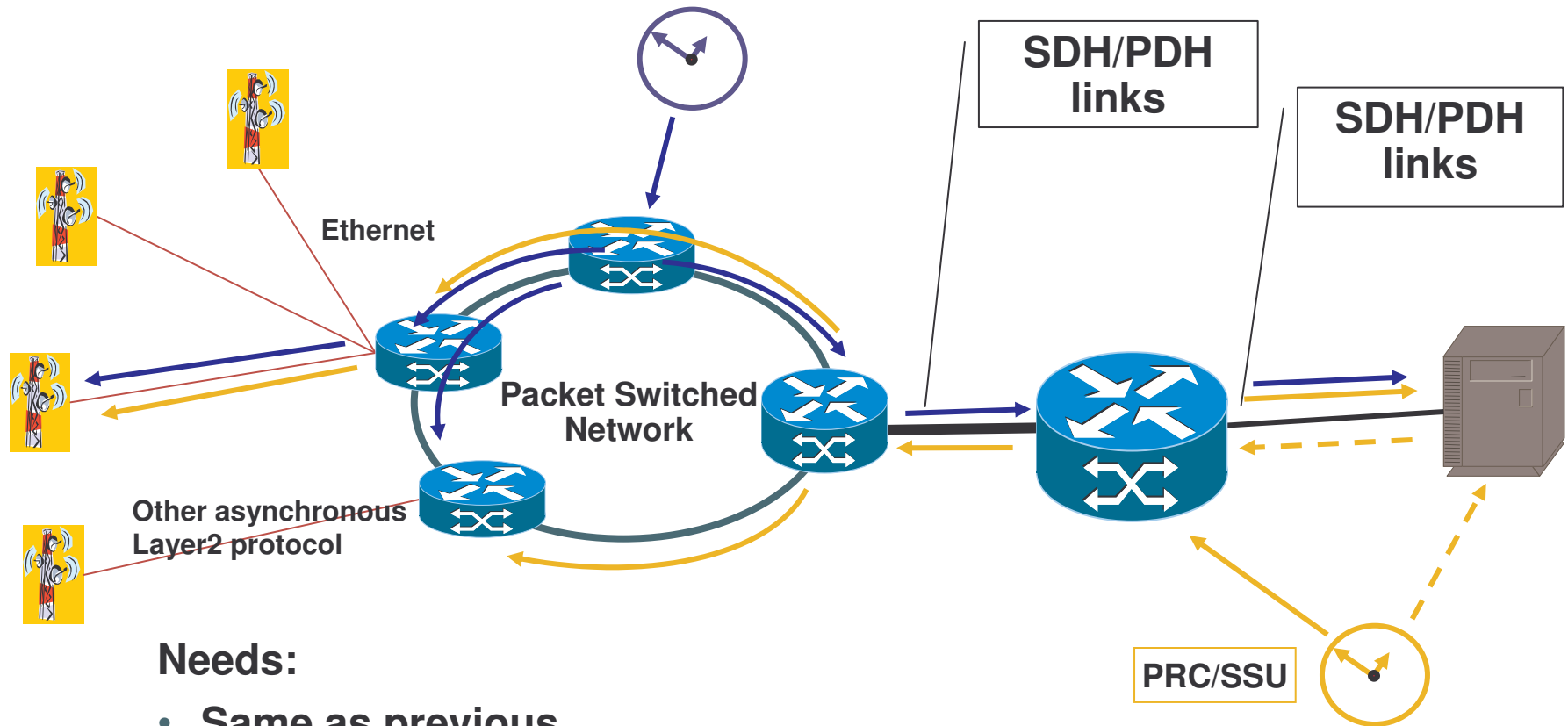
Case study: Mobile operator *Migration to NGN based RAN*



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

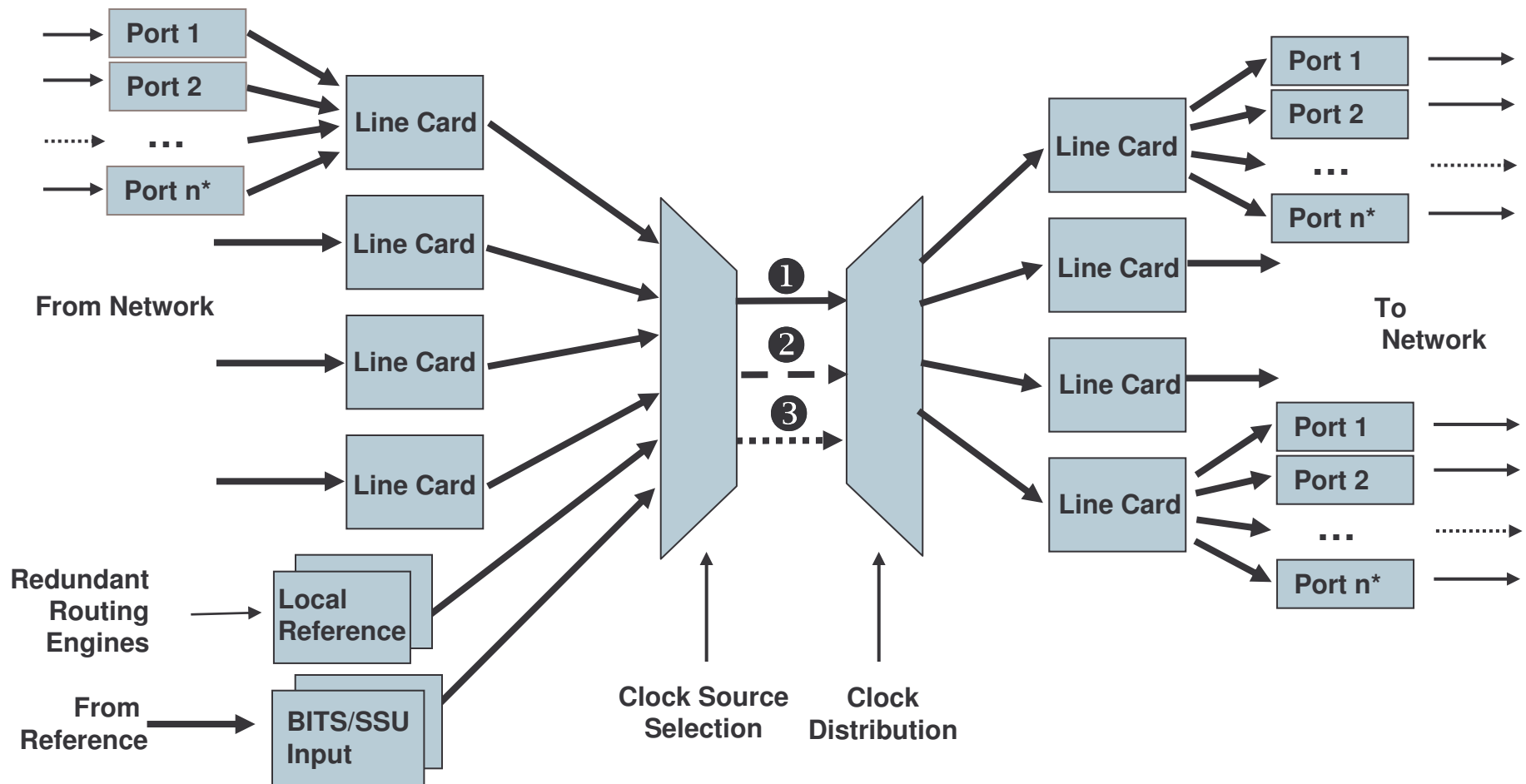
Case study: Mobile operator IP RAN



Needs:

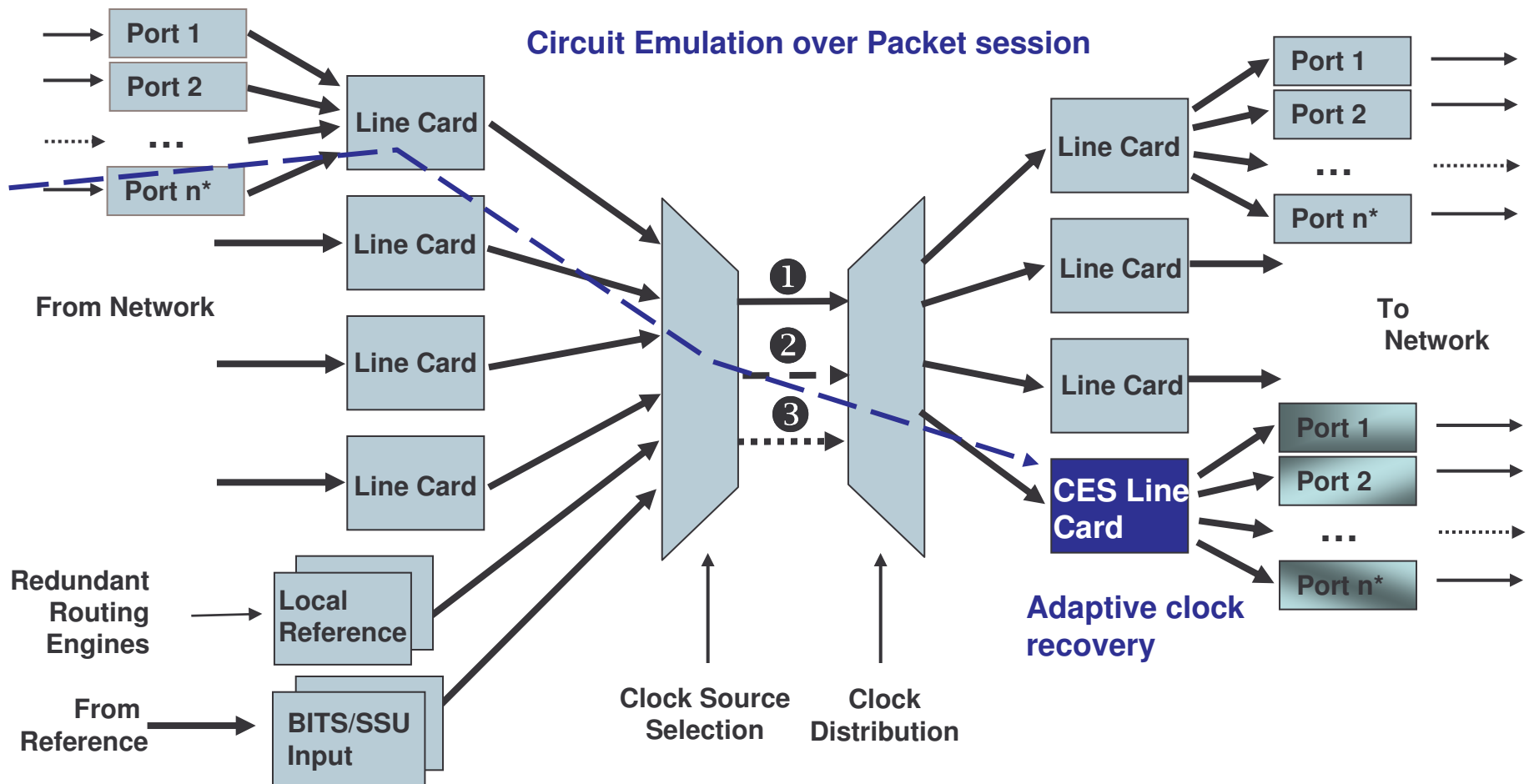
- Same as previous
- Either SYNCoP protocol **MUST** be media independent
- Or need inter-working functions for SYNCoP protocols

A Network Timing Clock Generation and Distribution



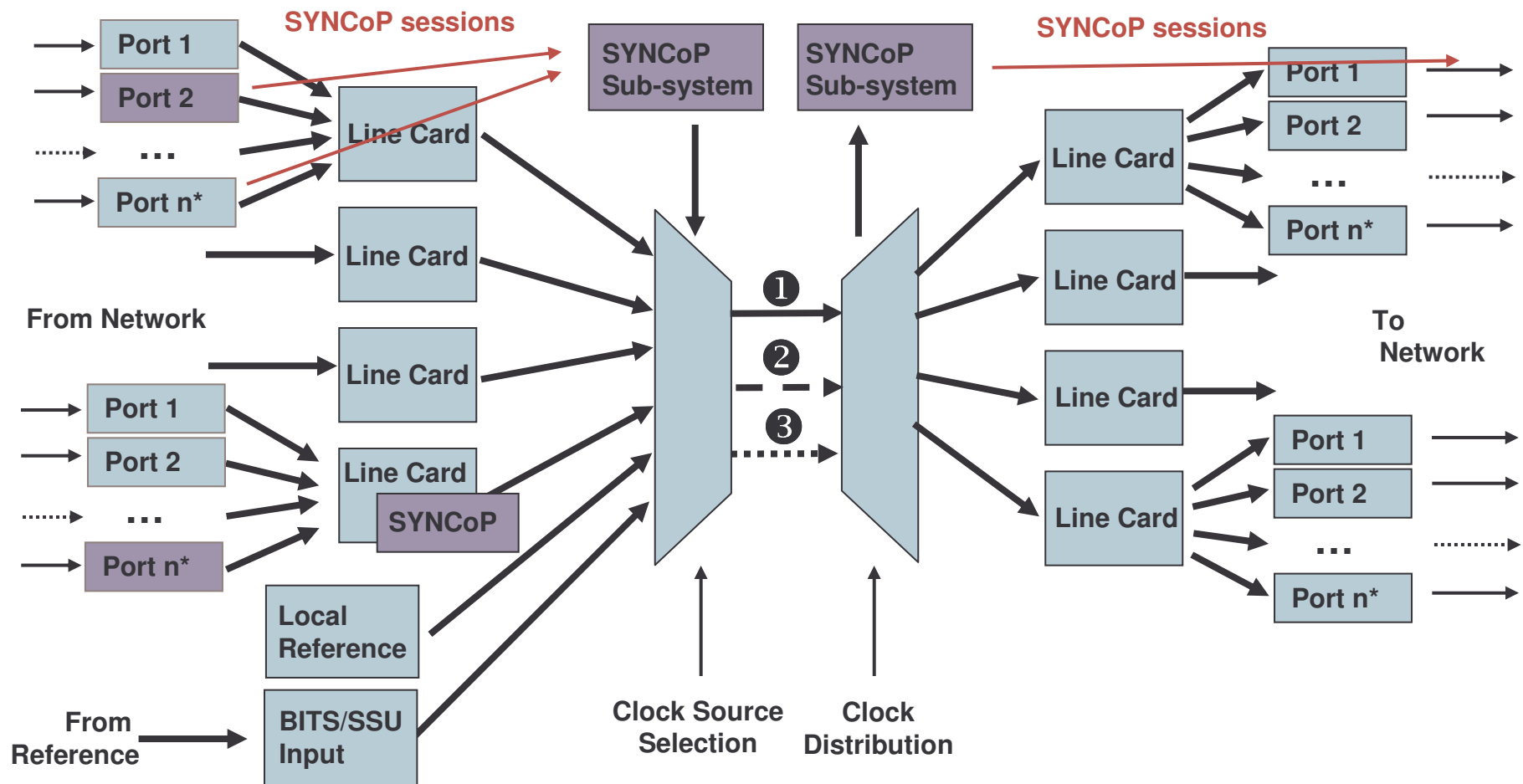
Single clock domain

A Network Timing Clock Generation and Distribution



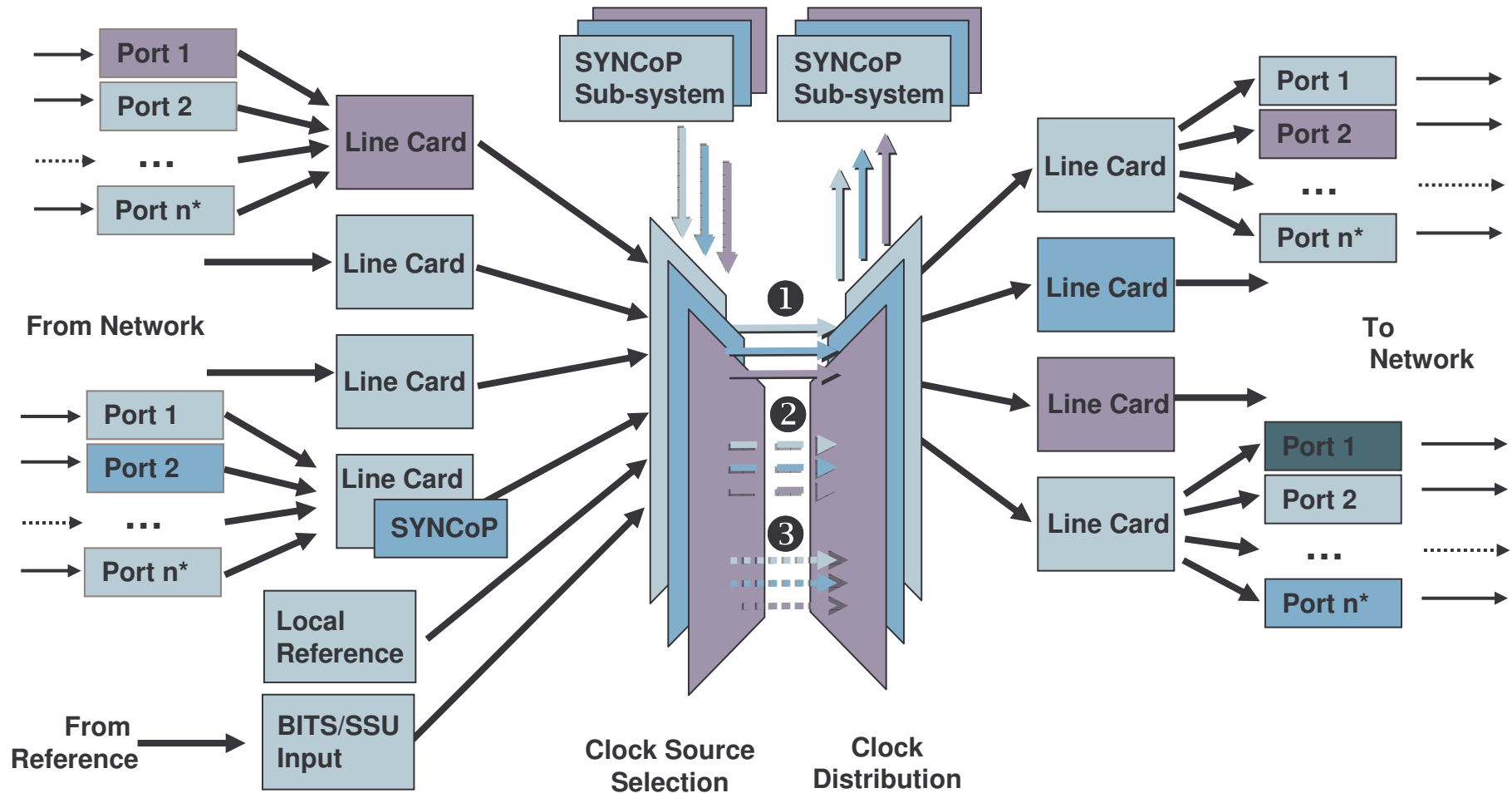
Single clock domain

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**

