Synchronization in an NFV World

Calnex

Tim Frost,
WSTS, March 2015

www.calnexsol.com

Synchronization in an NFV World

Calnex

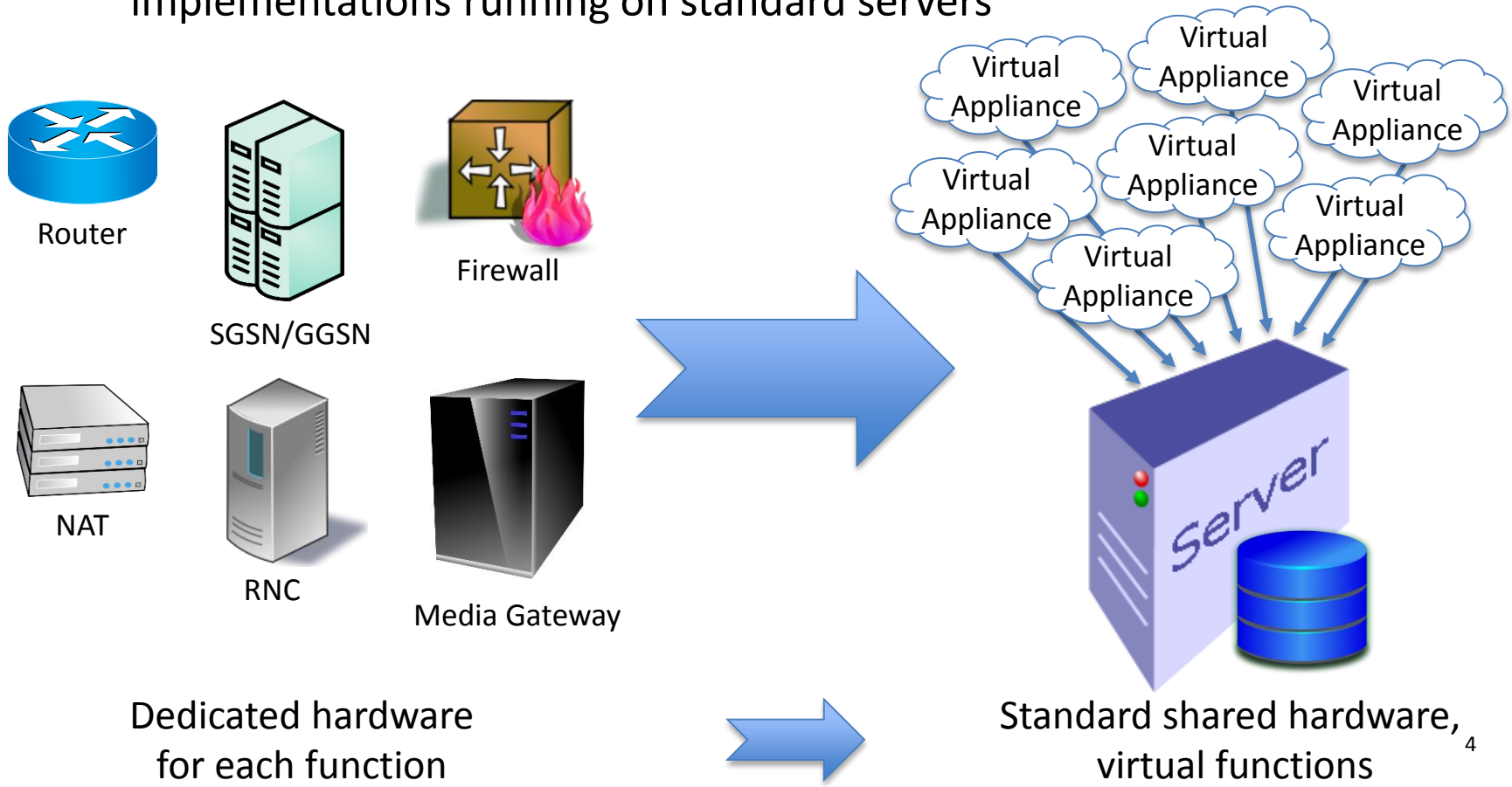
- What is NFV?
- Why does it affect synchronization?
- Standards for synchronization in NFV
- Opportunities for synchronization
- Summary

Calnex

What is NFV?

What is NFV?

- Network Functions Virtualization
  - The replacement of dedicated network elements with software implementations running on standard servers



Why adopt NFV?

Calnex

- Sharing of hardware resources
- Economies of scale
- Reduced CAPEX, OPEX
- Faster deployment of services
- Flexibility of approach
- Reduced cost of deploying new functions
- Reduced barriers of entry for independent software vendors
- Increased competition for suppliers

Why does it affect Synchronization?

How does this affect Synchronization?

- Synchronization chain requires dedicated hardware
- Boundary clocks are a hardware function
  - Oscillator, physical layer timestamping, PLL
- Software-based functions have less deterministic delay
  - De-couples the upper layers from the physical layer timing systems
- How do you get accurate time in a software implementation?
  - Procedure calls inherently slow
  - Less accurate than a hardware time signal


SENTINEL BOWL
OPEN

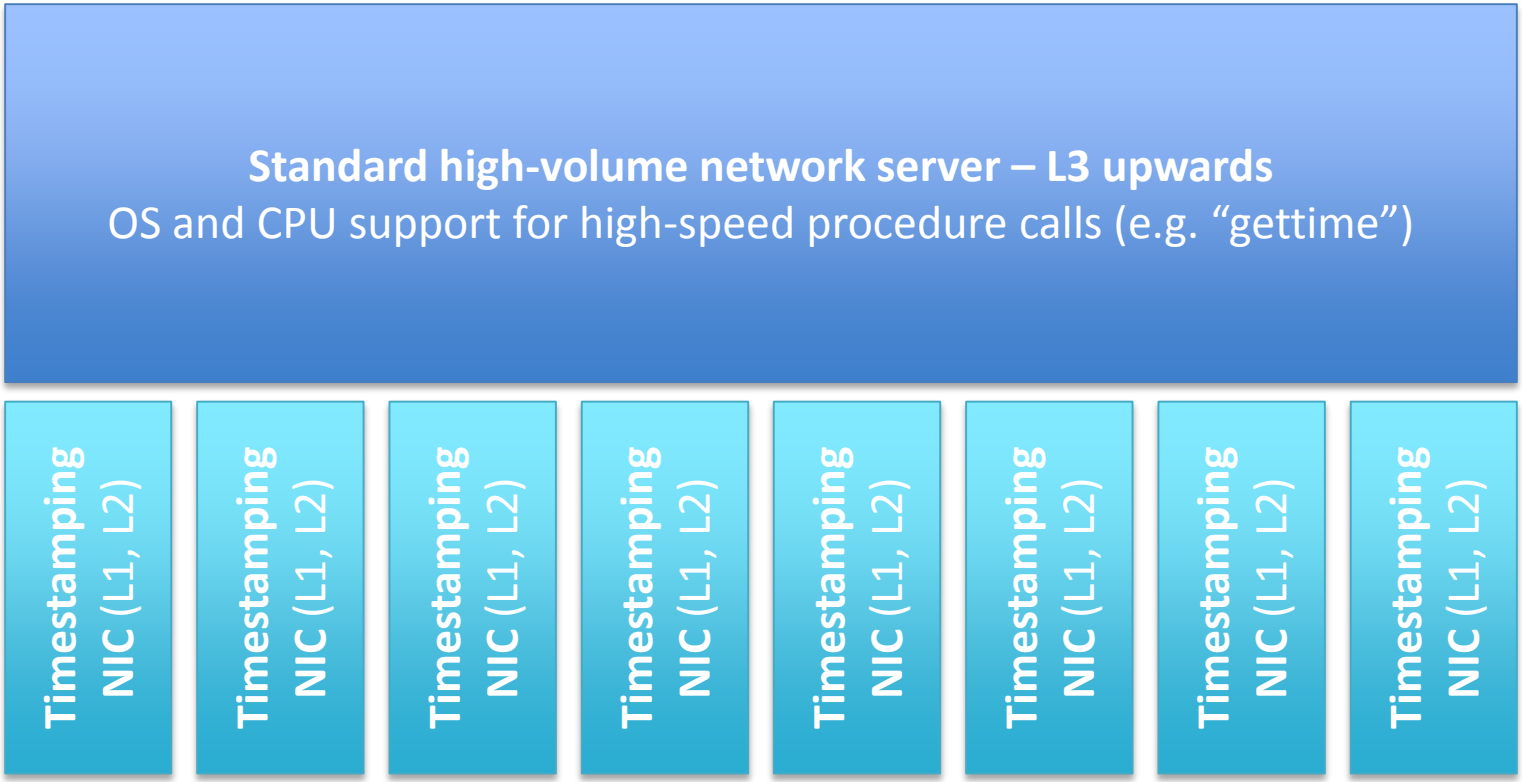
Financial data centers

Calnex

- High-Frequency Trading requires higher and higher timestamp accuracy for trades
  - SEC currently requires 1ms accuracy for trades – Rule 613 (d)(3)
  - ESMA (European Securities and Markets Authority) is considering mandating 1μs accuracy
- Financial data centers use high volume data servers
  - How do they achieve accurate timestamps?
- Combined approach:
  - PTP hardware timestamping at the NIC (Network Interface Card)
  - Software support to bypass procedure call latency

Standard server, timestamping NICs, OS support

Server-based Approach



Calnex

Standards for Synchronization in NFV

Standards for NFV Synchronization

Calnex

- ETSI recently finalized 17 Standards, Recommendations and Use Cases for NFV.
  - http://www.etsi.org/technologies-clusters/technologies/nfv
- Virtualization Requirements document, Section 5.8:
  - Service Assurance calls for the use of IEEE 1588 timestamps
  - Implemented on the NIC to establish a common time base for physical layer and upper layer processes
  - Timestamps to be used as precise time labels for all event processes

Application to Mobile Networks

Calnex

- How does NFV impact the overall synchronization requirement of an LTE network?
  - 3GPP has established air interface frequency and time synchronization offset limits for the RAN.
- NFV upper layer control plane functions schedule the execution time of time-sensitive actions
- Latency from software to hardware a key issue
  - Interrupt time of virtual machine OS is a major issue in time synchronization between air interfaces and control plane processes
  - Physical delays (cable delays, packetization delays) have to be measured and accounted for
- All layers need to share a common precise timebase for accurate scheduling

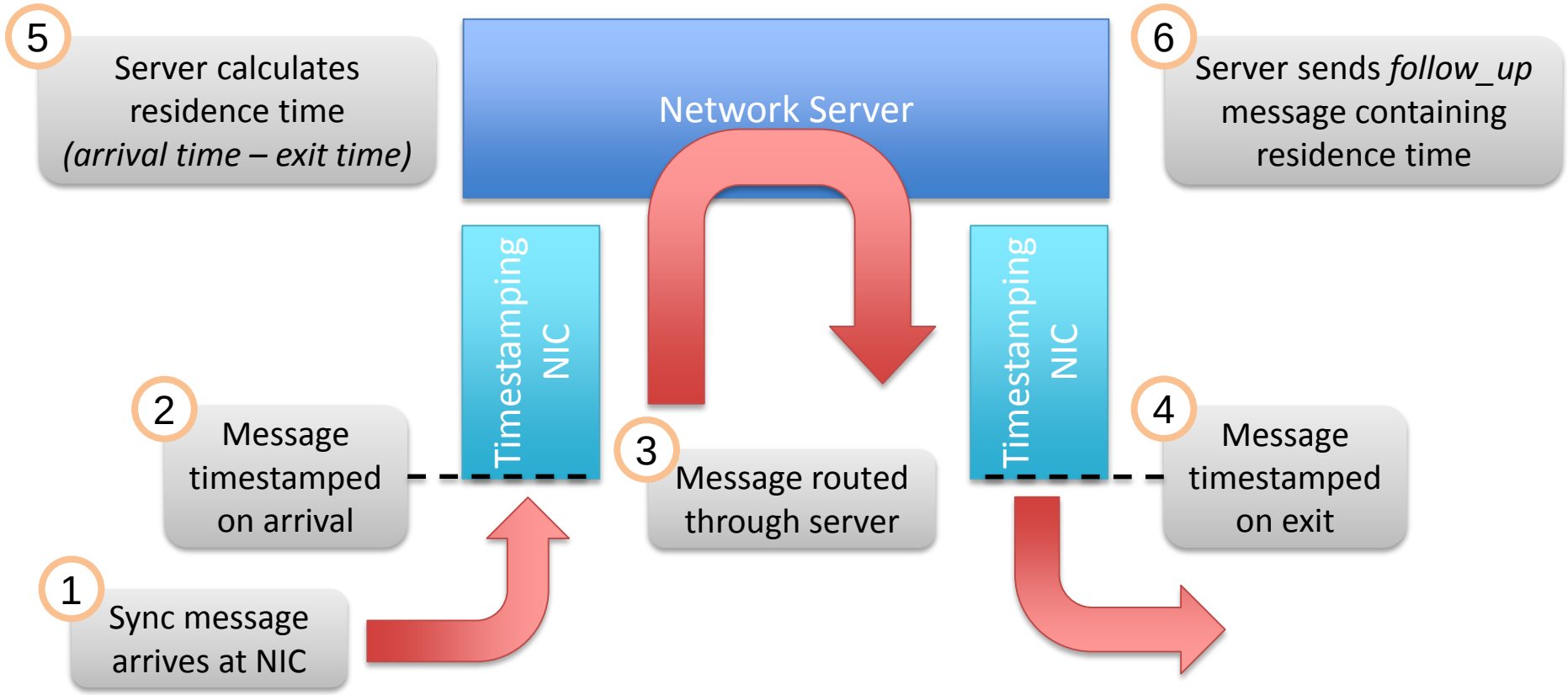
Opportunities for Synchronization

Opportunities for Synchronization

Calnex

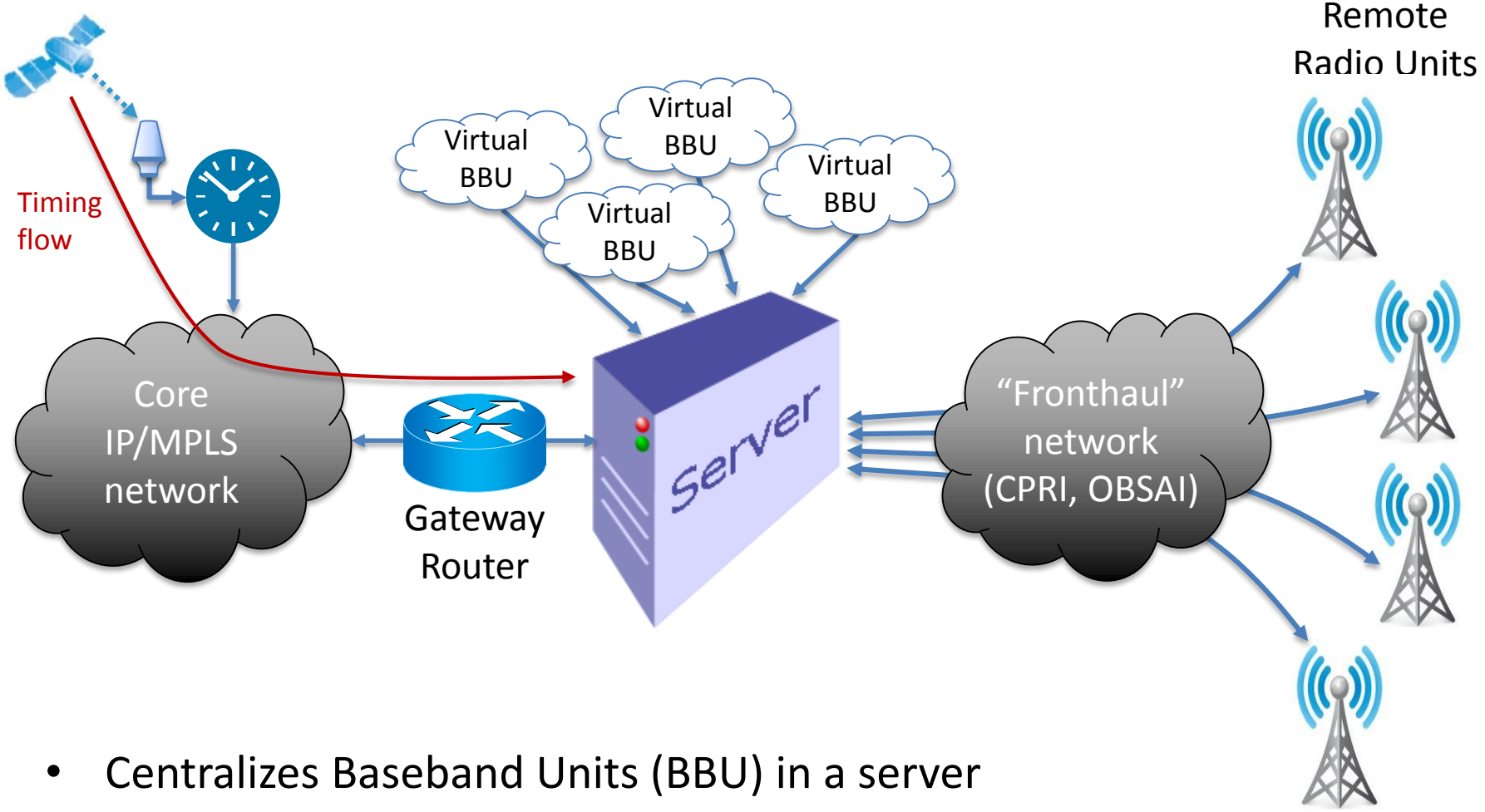
- ITU has developed PTP profiles based on “full timing support”
  - PTP-aware functions (Boundary Clock, Transparent Clock) at every node in the network
  - Highly accurate, deterministic timing
- In standard network functions, requires dedicated hardware support in every node
  - Not practical for most American operators to deploy
- In server-based hardware with timestamping NICs, PTP support can be provided in software
  - Easier to deploy PTP support where required
  - Increases accuracy and reliability of network delivered synchronization
- Co-located virtual functions can be synchronized more efficiently than separate hardware units

Example 1: Two-step Transparent Clock



- Enables deployment of full timing support on standard servers using timestamping NICSs

Example 2: Cloud RAN Architecture



- Centralizes Baseband Units (BBU) in a server
- BBUs all co-located, simplifying synchronization for eICIC and CoMP

Summary

Summary

Calnex

- NFV is coming, like it or not
  - Most major operators are considering it, if not actively planning for it
  - Probably the biggest shake-up of telecoms networks since voice-data convergence 10 years ago
- Synchronization will be affected
  - Synchronization methods will change
  - New models of operation will be established
  - New opportunities will be created
- Synchronization needs to be built into the fabric of NFV
  - Physical layer functions on the NIC or NID
  - OS support for precise time
- NFV could enable a more tightly synchronized network by making precise time a generic function available everywhere

Wednesday Night is Whisky Night

Calnex

Before Whisky . . .

. . . after Whisky

(It’ll make your head spin)