



# Sync in an NFV World

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## Panelists

*Tim Frost, Strategic Marketing Manager, Calnex*

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## Moderator

*Andrew White, VP Technology & Standards, ATIS*



# NFV Overview

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*Andrew White*  
*Vice President, Technology and Standards*  
*ATIS*

# Environment

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## Hardware Optimization

- Tight Integration
- Purpose Built
- Custom Software
- Proprietary Hardware

## Software Optimization

- Loose Coupling
- Designed for Reuse
- Abstracted Software
- COTS Hardware

NFV is part of the mass migration of information and communications technology to software-centric frameworks.

# NFV Business Drivers

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## Reduction of Infrastructure Cost

- Higher initial investment results in long term savings
- Improved resource utilization increases efficiency of service provider core
- Provides a basis to simplify operational environments through the automation of the network and its functions

## Creation of New Revenue

- Systematic exposure of software functions through APIs
- Framework of service enablers allows increased customization of service offerings
- Provides new revenue opportunities for operators who productize these internal functions for external integration by enterprises and other service providers

# NFV Forum – Objectives

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1. Define priority use cases such as “virtual network operator” that emphasize the benefits of NFV in a multi-provider environment.

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2. Establish a common catalog of service descriptions that can be instantiated between service providers: runtime, network, and supporting functions.

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3. Specify the service advertising and discovery mechanisms that allow companies to find and incorporate these services.

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4. Incorporate service creation tools such as service chaining for construction of new, aggregate business applications and models.



# ATIS NFV Use Cases

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1. Virtual Network Operator (VNO)
2. Cooperative, Cloud-based CDN
3. Roaming
4. Efficient Home-Routed VoLTE Roaming
5. Enterprise Voice/Collaboration Arrangements
6. Enabling Service Function Chains with Third Party VNF
7. Enabling Third Party VNF Applications



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***Tim Frost***  
***Strategic Marketing Manager***  
***Calnex***



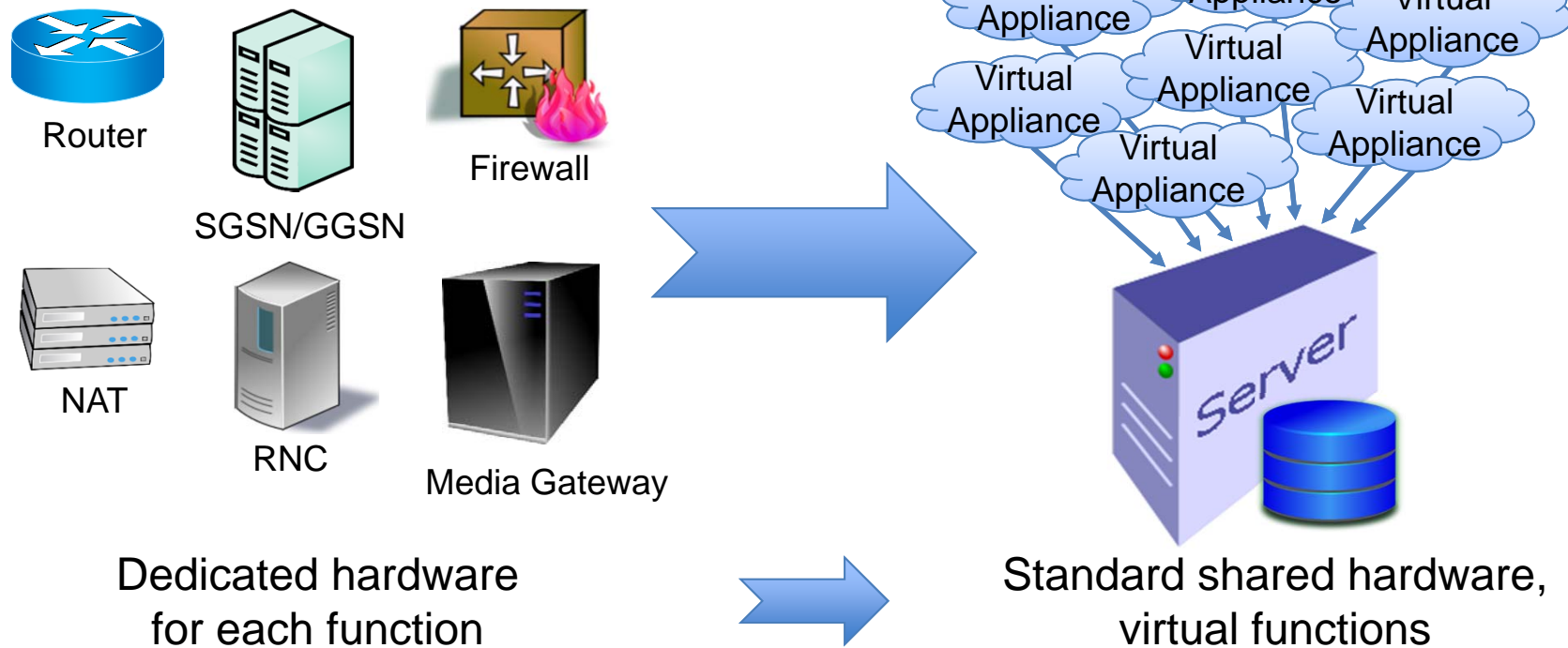
# Synchronization in an NFV World

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- What is NFV?
- Why does it affect synchronization?
- Opportunities for synchronization
- Examples

# What is NFV?

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



# Why Adopt NFV?

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- 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 innovation

# How does this affect Synchronization?

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- Synchronization chain requires dedicated hardware
- Boundary clocks are a hardware function
  - Oscillator, physical layer timestamping, PLL
- Software-based routers have less deterministic delay
- How do you get accurate time in a server environment?
  - Procedure calls inherently slow
  - Less accurate than a hardware time signal

# Financial Data Centers

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- 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 1 $\mu$ s 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***

# Standard Server Approach

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Standard high-volume network server – L3 upwards  
OS support for high-speed procedure calls (“gettime”)

Timestamping  
NIC (L1, L2)

Timestamping  
NIC (L1, L2)

Timestamping  
NIC (L1, L2)

Timestamping  
NIC (L1, L2)

Timestamping  
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NIC (L1, L2)

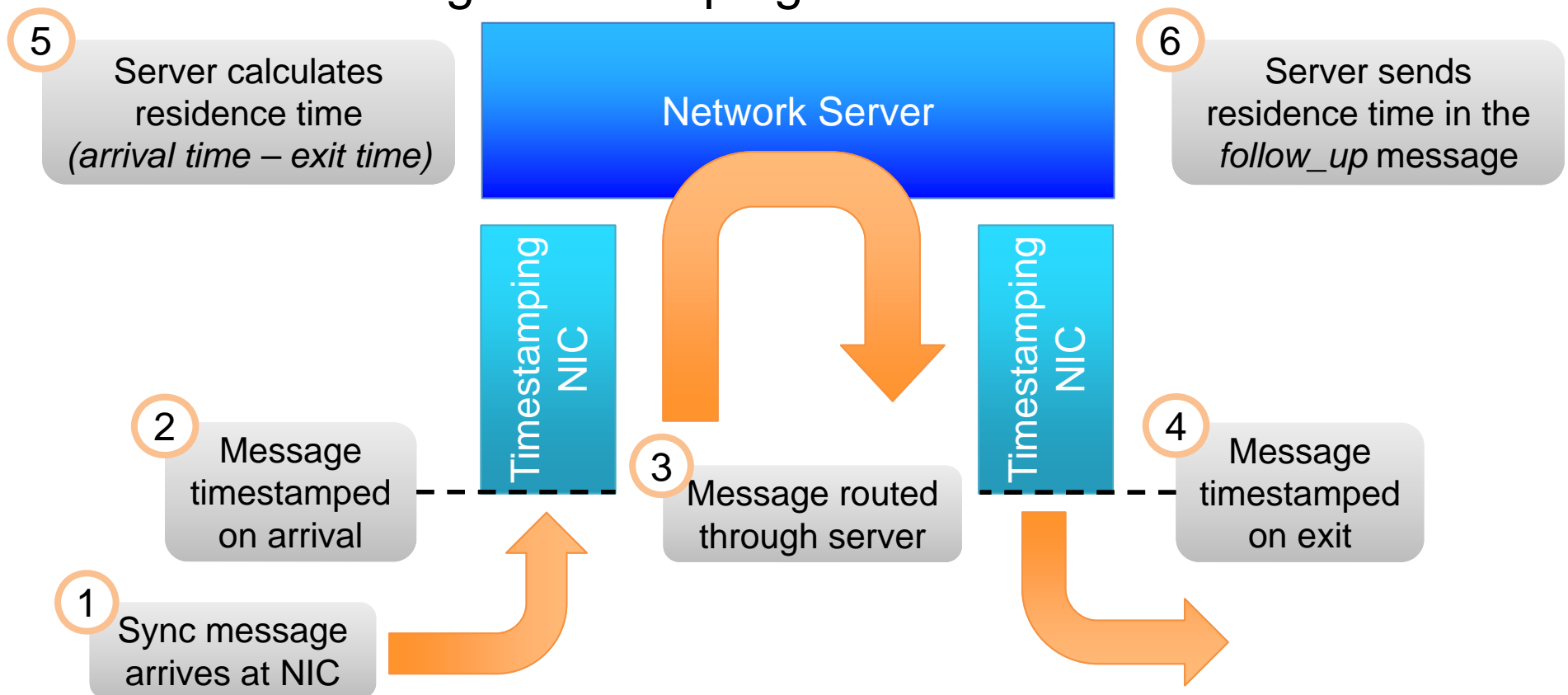
# Opportunities for Synchronization

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- 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

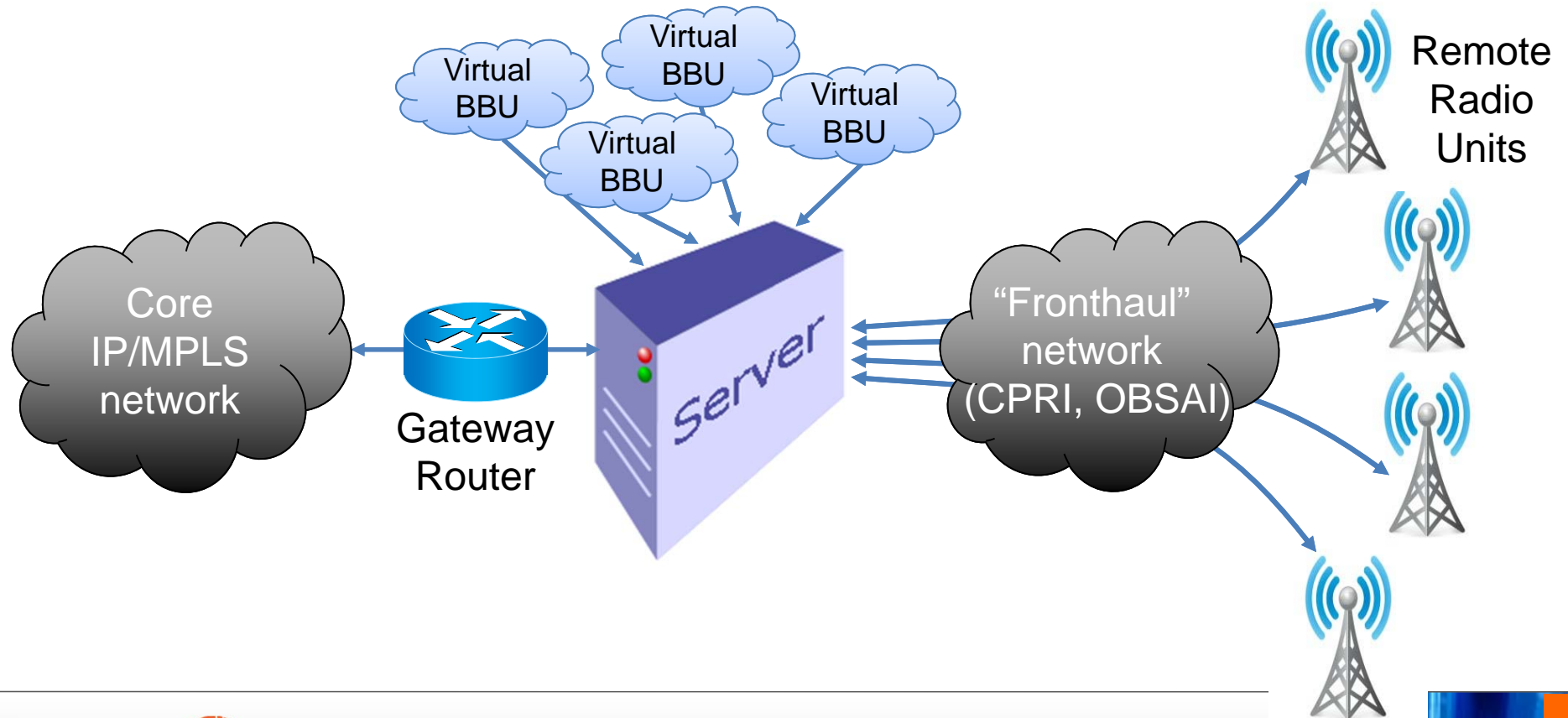
- Enables deployment of full timing support on standard servers using timestamping NICs





## Example 2: Centralized RAN Architecture

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





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***Pat Diamond***  
***Principal***  
***Diamond Consulting***

# Synchronization in an NFV World

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- Network Functions Virtualization, NFV, in this example is a process of moving mobile wireless network applications from dedicated hardware to merchant servers and cloud based data centers.
- This is NOT a change to 3GPP RAN standards or operational processes.
- Many organizations are involved in this standardizing process with ETSI taking the lead.

# Synchronization in an NFV World

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- ETSI recently finalized 17 Standards, Recommendations and Use Cases for NFV.
- The Link to these is:  
<http://www.etsi.org/technologies-clusters/technologies/nfv>
- The Virtualization Requirements document in Section 5.8.
  - Service Assurance calls for the use of IEEE 1588 timestamps.
  - These time stamps are to be used as the precise time labels for any and all event processes.

# Synchronization in an NFV World

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- NFV is an upper layer application suite generally running in a Virtual Machine environment.
  - This sits on top of a multi-threaded OS, Linux.
- NFV applications are in a broad state of definition and implementation.
  - Some applications without control plane or management plane implications can be rolled out today.
  - Many of the ETSI defined processes are in Proof of Concept stages of development.
  - Proof of Concept completion and demonstrations are planned for mid to late 2015 and early 2016.

# Synchronization in an NFV World

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- How does NFV impact the overall synchronization requirement of an LTE network?
  - The de-coupling of the upper layers from the physical layer timing systems can be a serious problem.
  - ETSI has specified the use of IEEE 1588 precise time stamps on NFV hosting server NIC and NID devices to utilize the same time stamp generation for physical layer and upper layer time bases.
  - 3GPP has established air interface frequency and time synchronization offset limits for the RAN.
- Don't these requirements solve the upper layer to physical layer synchronization issues? - NO

# Synchronization in an NFV World

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- NFV upper layer control plane functions will “tell” RAN physical layer function “what time” to execute commands – actions.
  - With Air interface alignment requirements having a total phase error margin across air interfaces of  $1.5\mu\text{s}$  and signal propagation of  $1\text{ns}$  per foot “execute then” commands could be an issue.
  - The interrupt cost time of virtual machine OS is a major issue in time synchronization between air interfaces and control plane processes.
  - The answer may lie in the establishment of an over the top control plane for time sensitive commands between entities.

# Synchronization in an NFV World

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- The following is a list of the Standards, Recommendations and Use Cases ETSI has published:
  - Infrastructure Overview
  - Hypervisor Domain
  - Resiliency Requirements
  - **Architectural Framework**
  - Terminology for Main Concepts in NFV
  - Infrastructure; Compute Domain
  - Infrastructure; Network Domain
  - **Service Quality Metrics**



# Synchronization in an NFV World

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- ETSI-published NFV documents continued:
  - Management and Orchestration
  - Virtual Network Functions Architecture
  - Security; Security and Trust Guidance
  - Performance & Portability Best Practices
  - Proofs of Concept; Framework
  - Infrastructure; Methodology to describe Interfaces and Abstractions
  - Security; Problem Statement
  - Use Cases
  - **Virtualization Requirements**

# Learn More About Sync-Related Issues at WSTS 2015

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