Leveraging PCE
For Deterministic
Networking
(DetNet)

https://tools.ietf.org/html/draft-finn-detnet-architecture

Time Sensitive Networking

New level of (Deterministic?) guarantees

– A differentiator for high-end forwarding engines

– Sharing physical resources with classical networking

– For traffic known a priori (control loops…)

– Time Synchronization and global Schedule
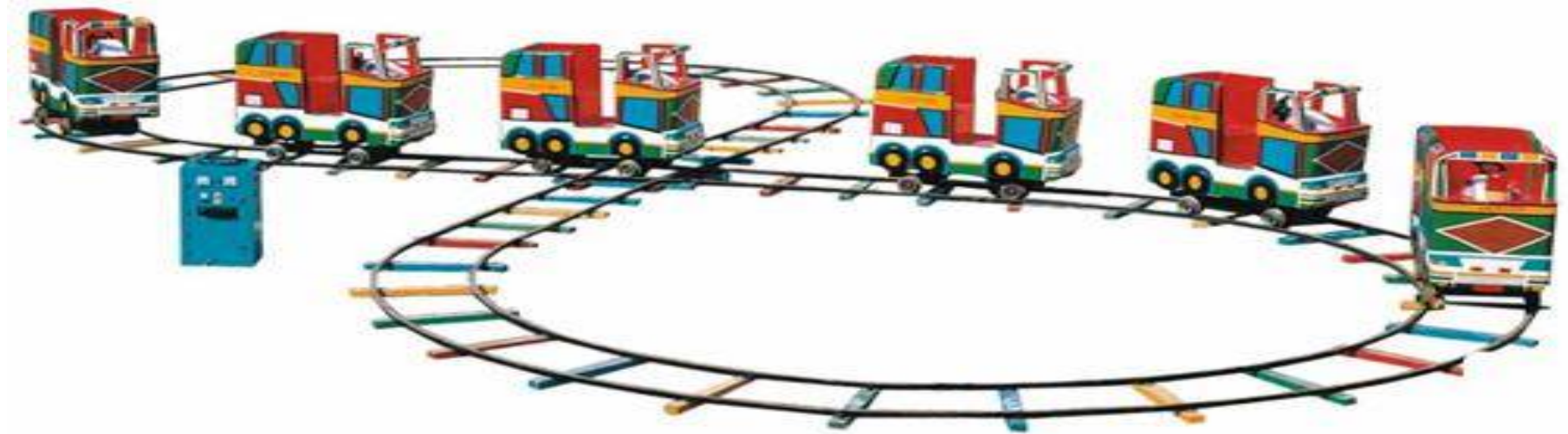
The Train Analogy

End-to-End latency enforced by timed pause at station

Periodic trains along a same path and same schedule

Collision avoidance on the rails guaranteed by schedule

The Bus Analogy

A bus every T. minutes, Stop A to Stop B in X. minutes

Worst end-to-end delivery time < (T + X)

Every packet in an Airbus 380 takes a bus across the fabric

Who needs Deterministic Networking?

Two classes of bleeding-edge customers, Industrial and Audio/Video.

Both have moved into the digital world, and some are using packets, but now they all realize they must move to Ethernet, and most will move to the Internet Protocols.

1. Industrial: process control, machine control, and vehicles.

- On LLNs, this is a Wireless HART, ISA100.11a, WIA-PA/FA, … and **6TiSCH**
- On Ethernet, this is IEEE 802.1 **Time-Sensitive Networking (TSN)**
- Data rate per stream very low, but can be large numbers of streams.
- Latency critical to meeting control loop frequency requirements.

2. Audio/video: streams in live production studios.

- At Layer 2, this is IEEE 802.1 **Audio Video Bridging (AVB)**.
- Not so many flows, but one flow is 3 Gb/s now, 12 Gb/s tomorrow.
- Latency and jitter are important, as buffers are scarce at these speeds.

3. Vehicule, SmartGrid: streams in live production studios

Determinism: Back to physical

It's **not** about
- Classical Layers
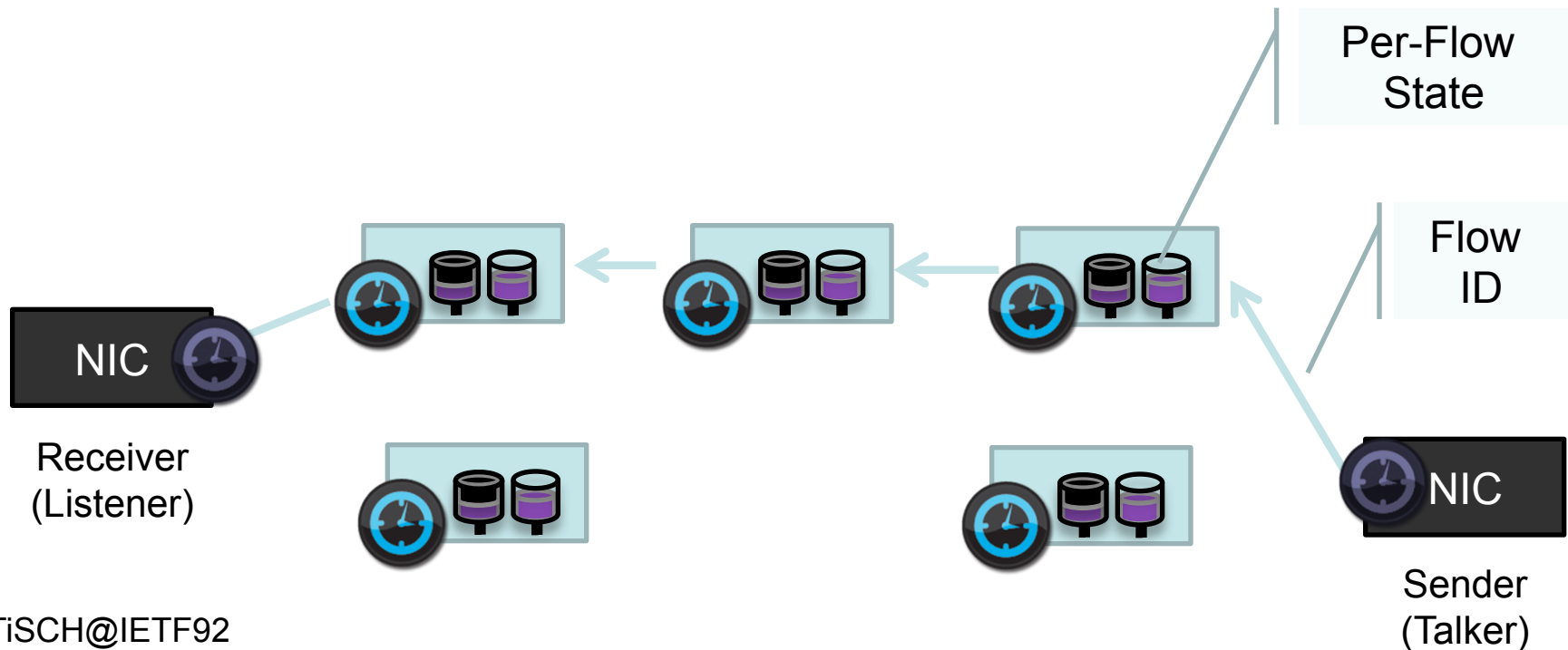- Standard bodies
- QoS and stat mux

It's all about

- Real boxes and links
- Real buffers and queues
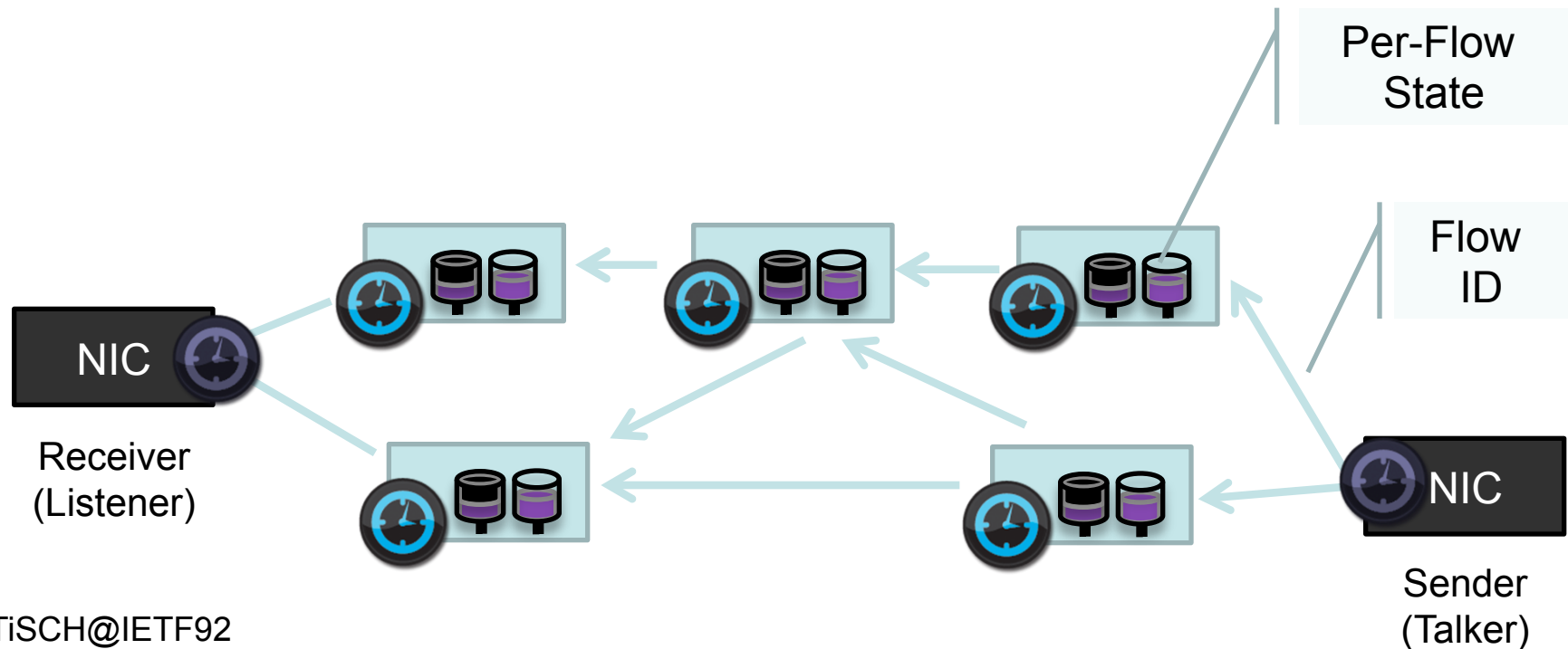- Real packets
- Real Time

VIRTUAL/REAL

Basic Dataplane Model

- Single nailed-up path

Adding seamless redundancy

Replication & Elimination of individual packets

Receiver (Listener)

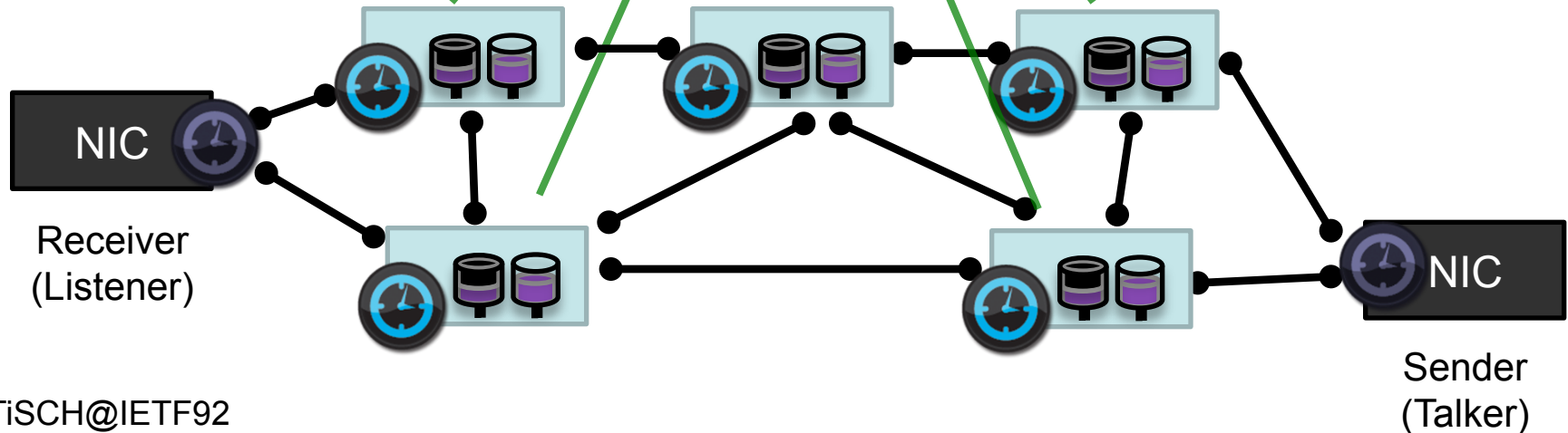Sender (Talker)

Per-Flow State

Flow ID

NIC

NIC

Network Capabilities (TEAS-like)

Service (northbound)
interface

Topology,
resources

Controller
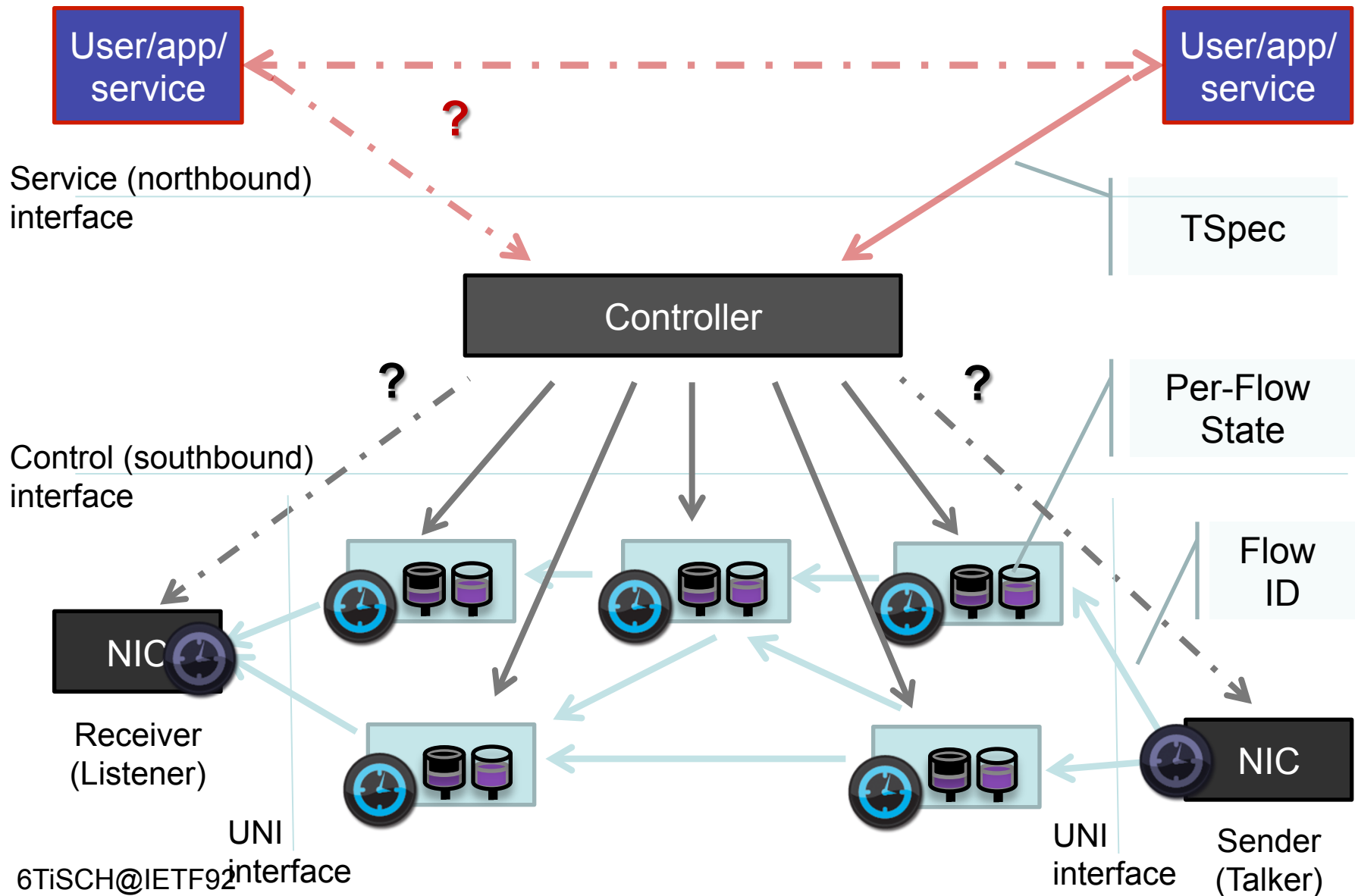
Control (southbound)
interface

NIC

Receiver
(Listener)

NIC

Sender
(Talker)

In-band reservations (CCAMP-type)
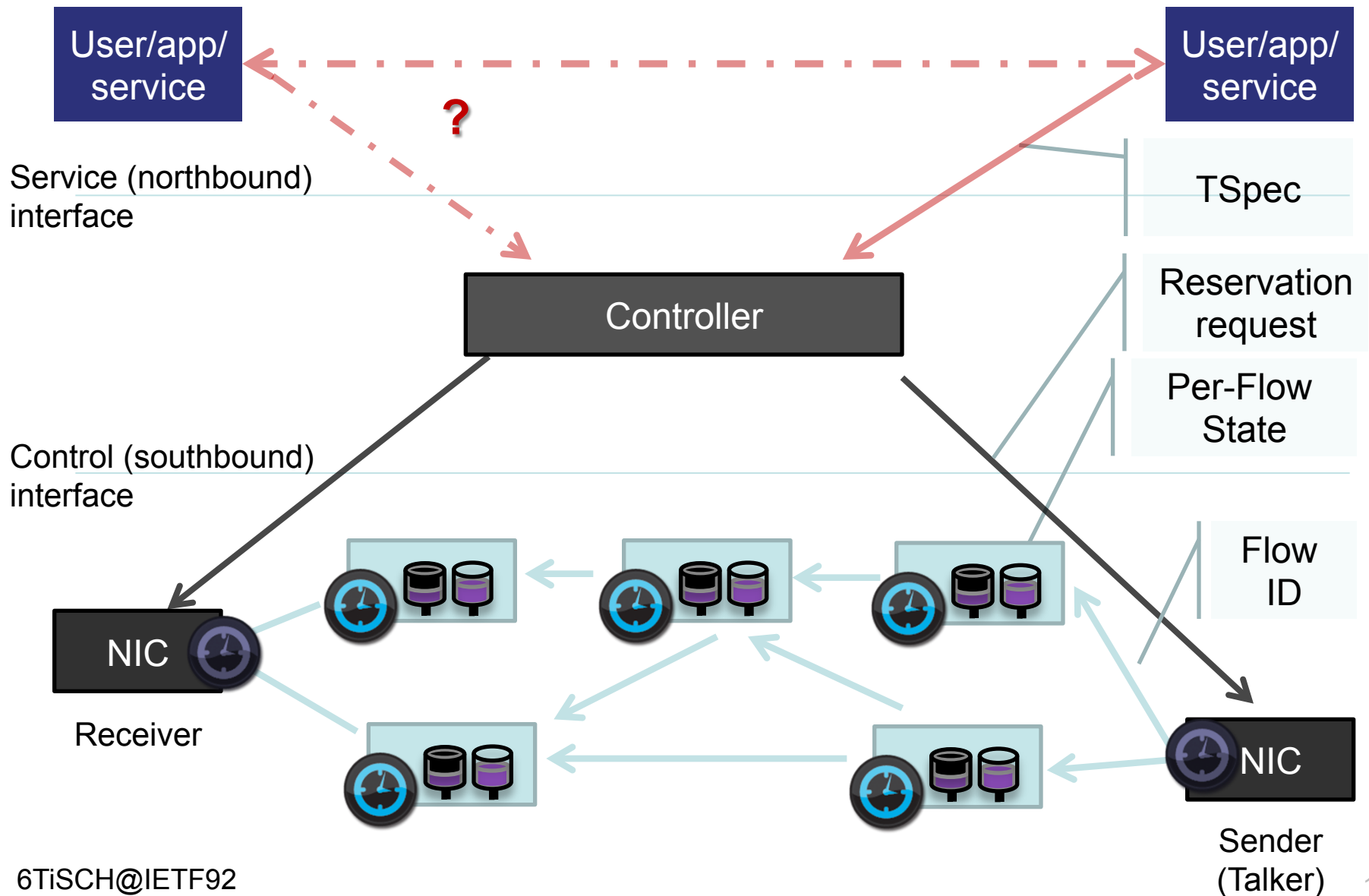
Direct Reservations from Controller

Expanding the Controller view

Service (northbound)
interface

Command and
Configuration
(CLI-type
operation)

Track
Computation
And
Maintenance
(PCE)

Measurement
and
Fault
Management
(ops
management)

Push
update

Controller

Trigger
recompute
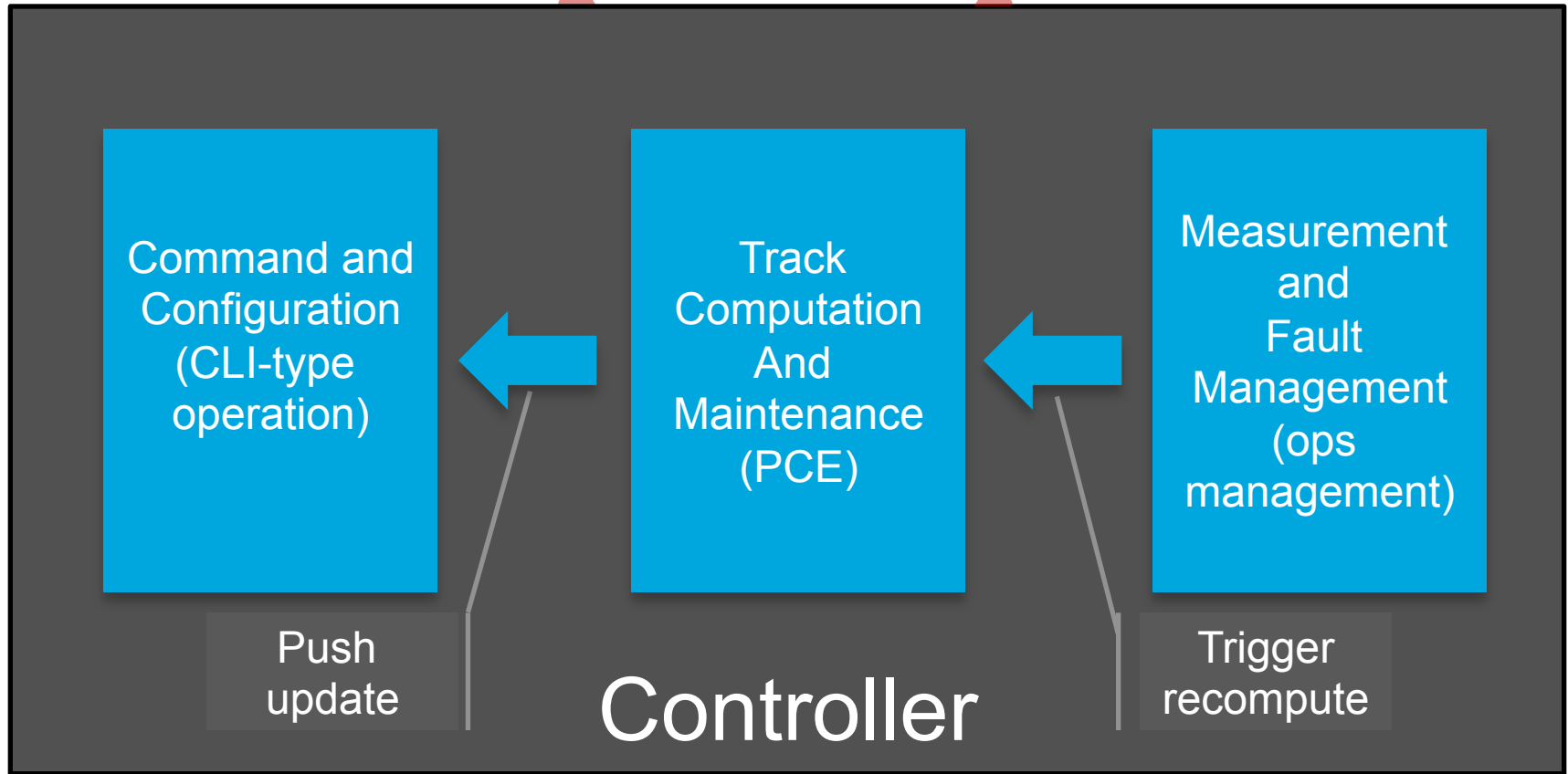
Control (southbound)
interface

Key take-aways on 6TiSCH

- **Time synchronization** for network nodes and hosts to order of (10s of) μs.

- Software for **resource reservation** for critical data streams (buffers and schedulers in network nodes and bandwidth on links), via configuration, management, and/or protocol action. PCE/CCAMP/TEAS connections.

- Ensure **extraordinarily low packet loss ratios**, order of 10^{-5} or better, and a **guaranteed end-to-end latency** for a reserved flow along track.

- Also optimized battery life by synchronizing wakeup

- **Convergence** of critical data streams and other QoS features, including best-effort RPL, on a single scheduled network.

6TiSCH@IETF92

Thanks!