



# Detecting Ephemeral Optical Events with OpTel

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**Tencent** 腾讯

**UC SANTA BARBARA**



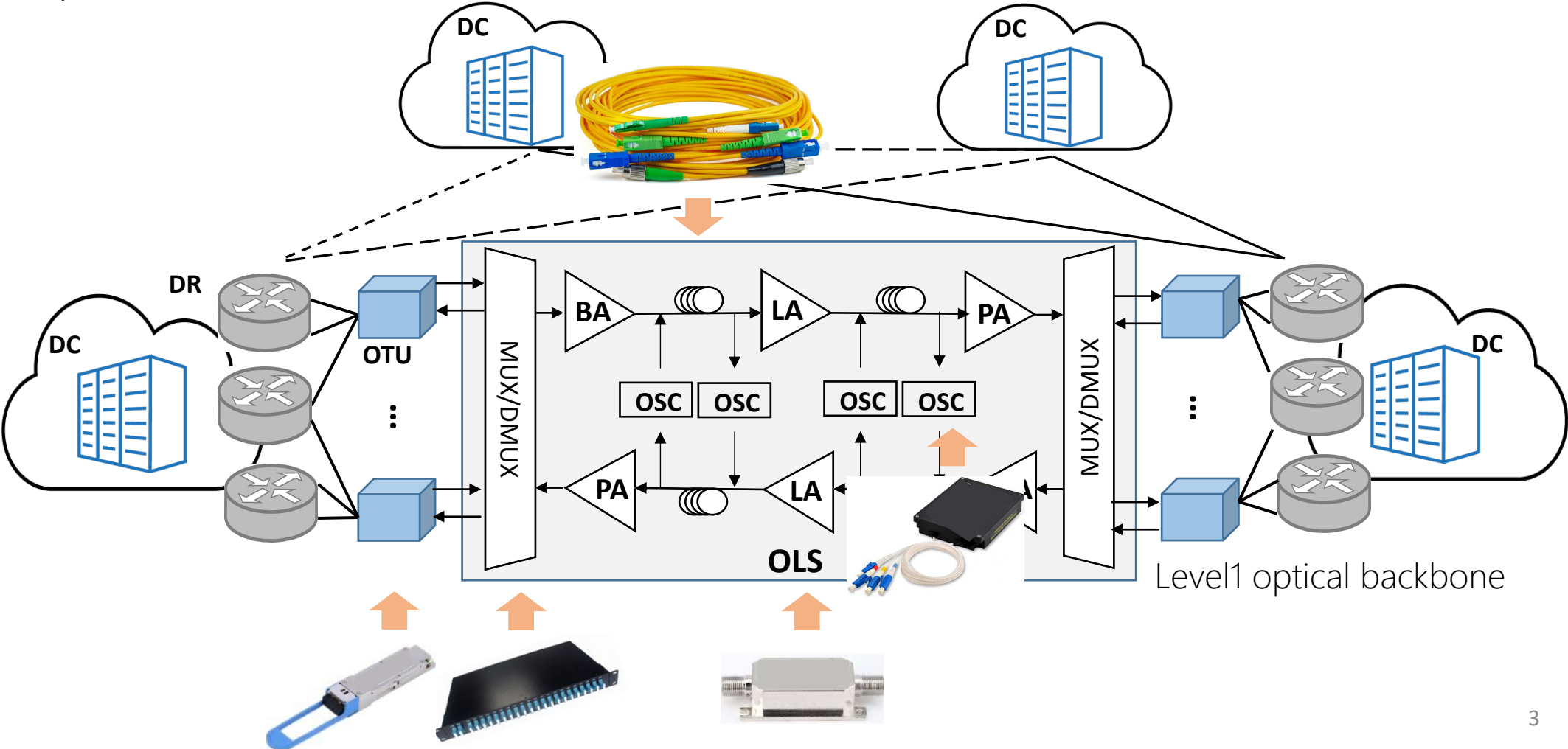
# Wide-Area Networks (WANs)

- The workhorses of cloud services
- Exchange of TBs of data every day.

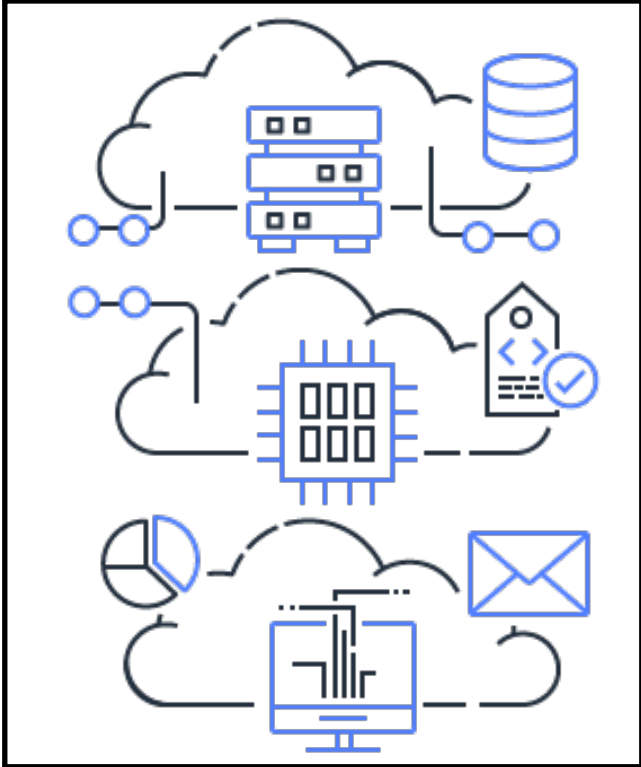
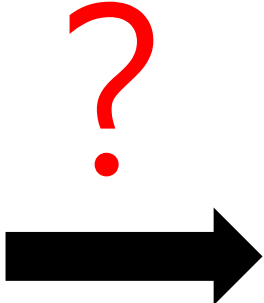


# Optical Backbone Networks

- Optical hardware and fiber cable.



# Optical Failures



Degradation or fail

SLAs



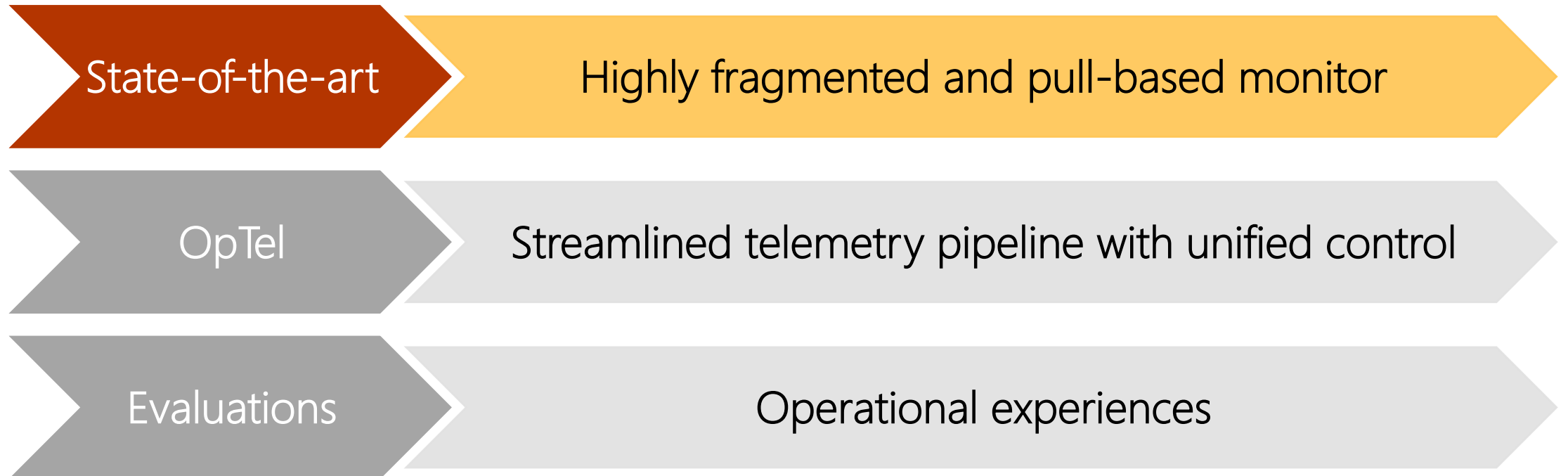
Average cost of downtime is \$8,000 per minute.



This talk: OpTel

Troubleshoot optical events in a few seconds, which is orders of magnitude faster than the state-of-the-art.

# Talk outline





# Traditional Telemetry Pipeline

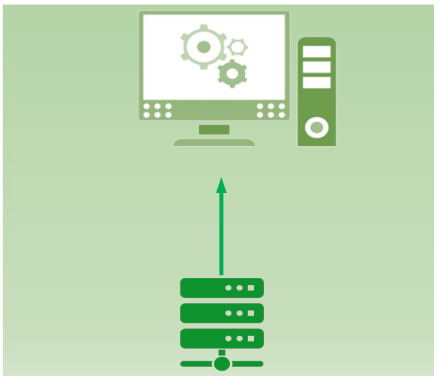
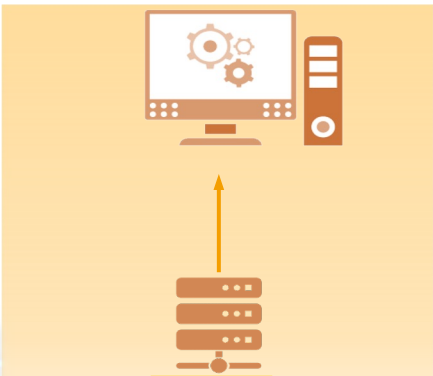


Tencent Operating Support System (OSS)

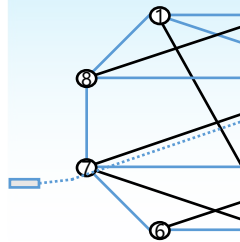
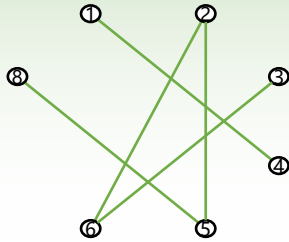
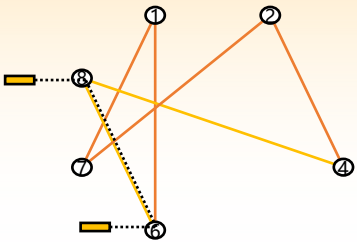
Northbound API



Indirect control of heterogeneous devices



Highly fragmented control plane



Vendor1

Vendor2

Vendors

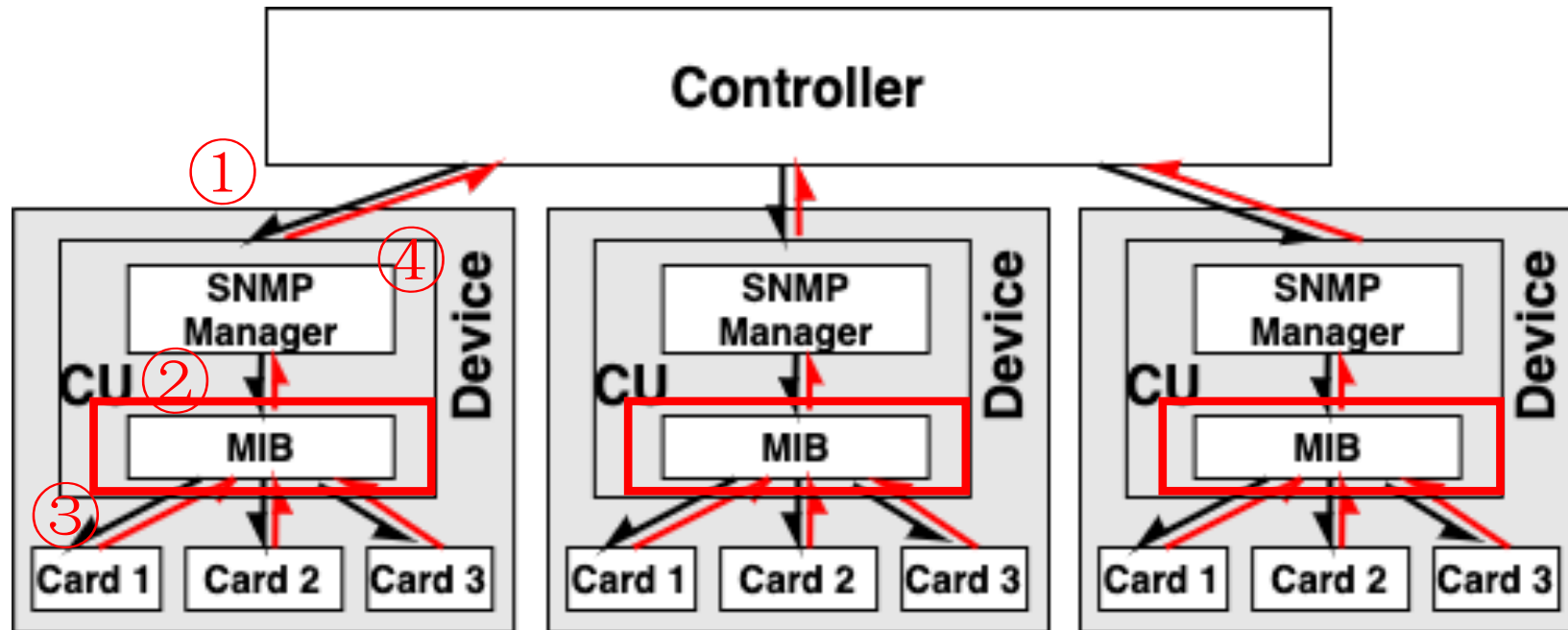
Challenge1: hard to extract a consistent (synchronized) view of the network.

Fragmented

# Traditional Telemetry Pipeline

- Telemetry pipeline
  - Request data **once**
  - Push data **once**

Consume a lot of CPU cycles !



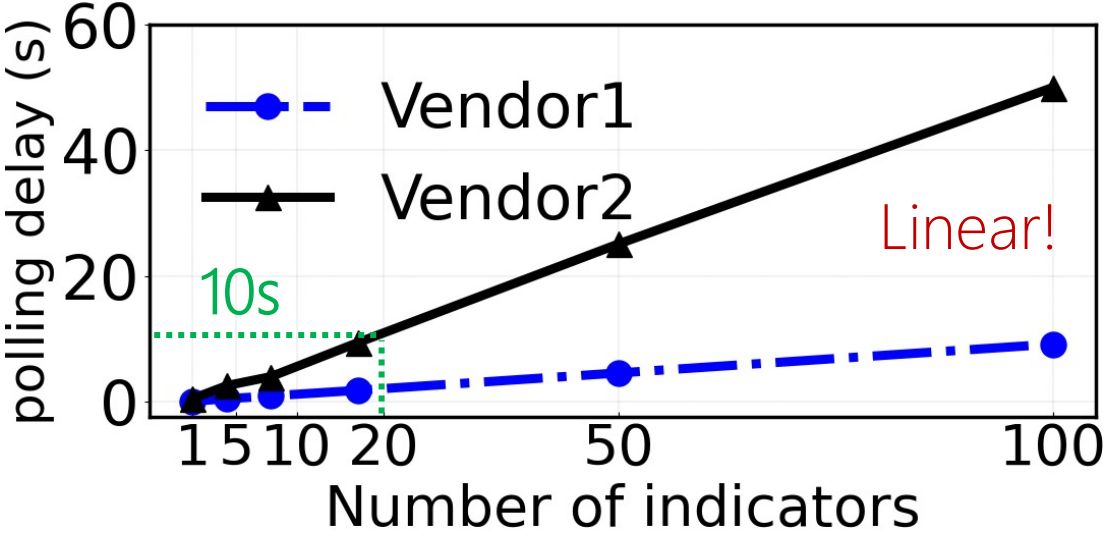
SNMP-based workflow

- ① SNMP GET request.
- ② Traverse MIB database.
- ③ Obtain data by *function*.
- ④ Report data.

→ Control Flow      → Data Flow

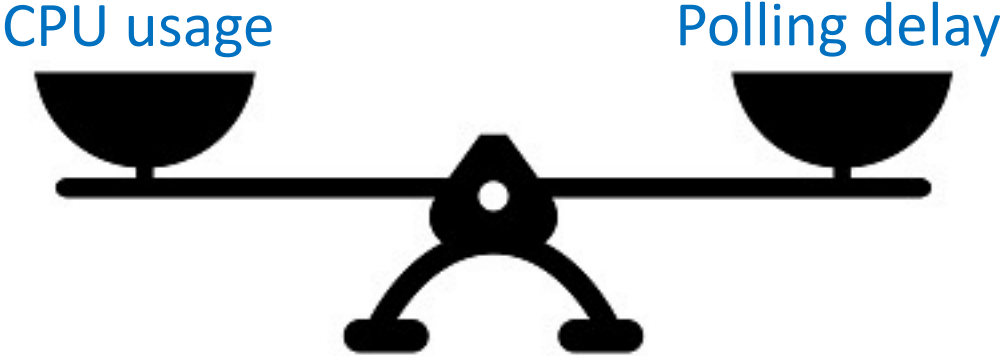


# Traditional Telemetry Pipeline



CPU (time) consuming workflow

Challenge2: improper for high-frequency data collection.



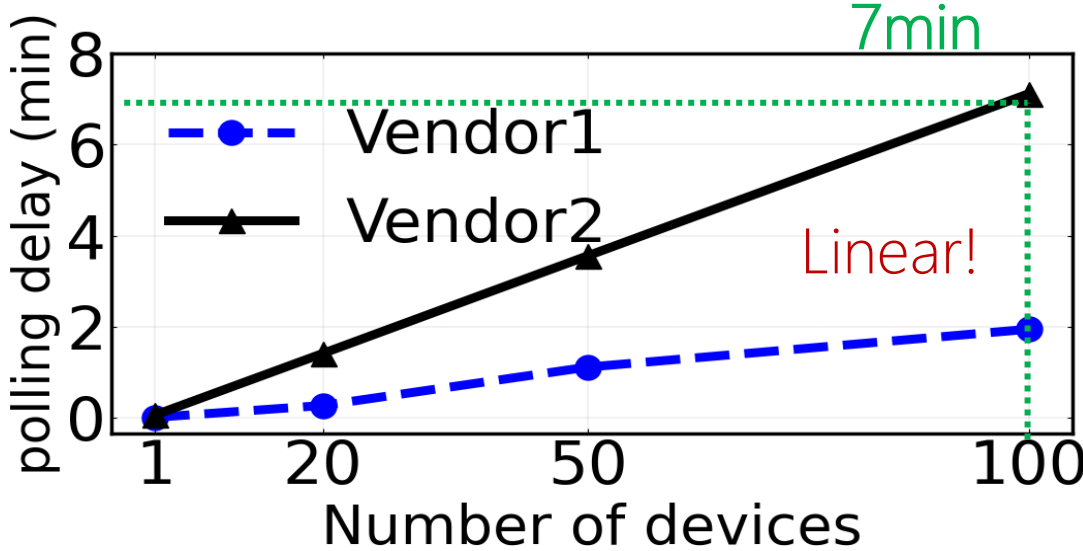
Serialized request for multiple indicators at device

# Traditional Telemetry Pipeline



Fixed resources

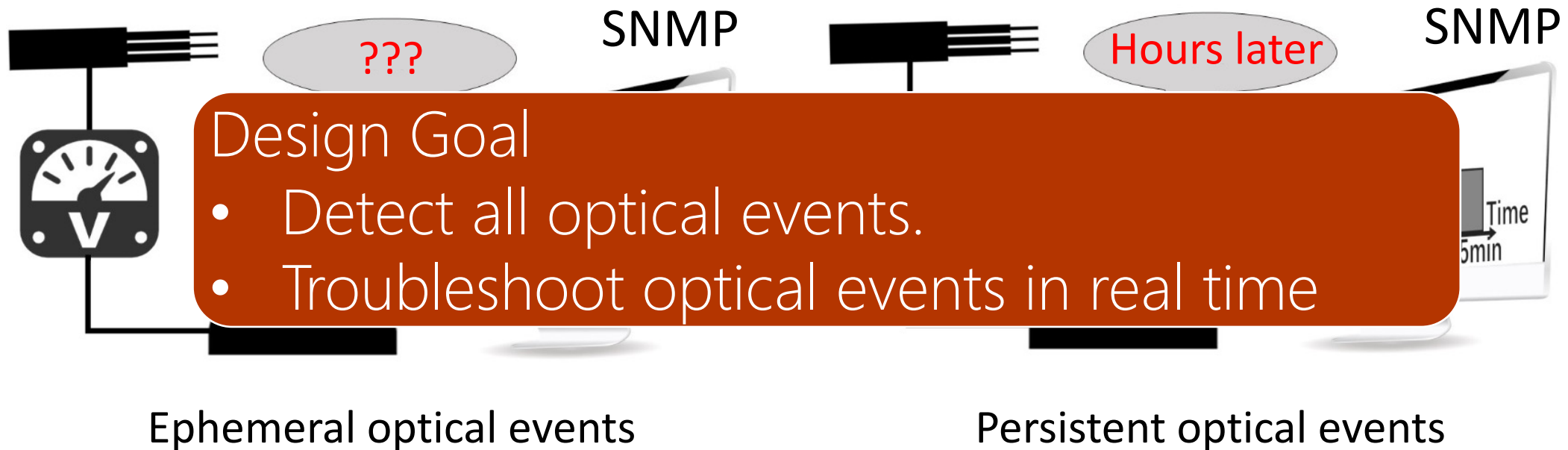
Inelastic computing resources



Challenge3: impossible to correlated data across devices on a short time scale.

Serialized request for multiple devices at controller side

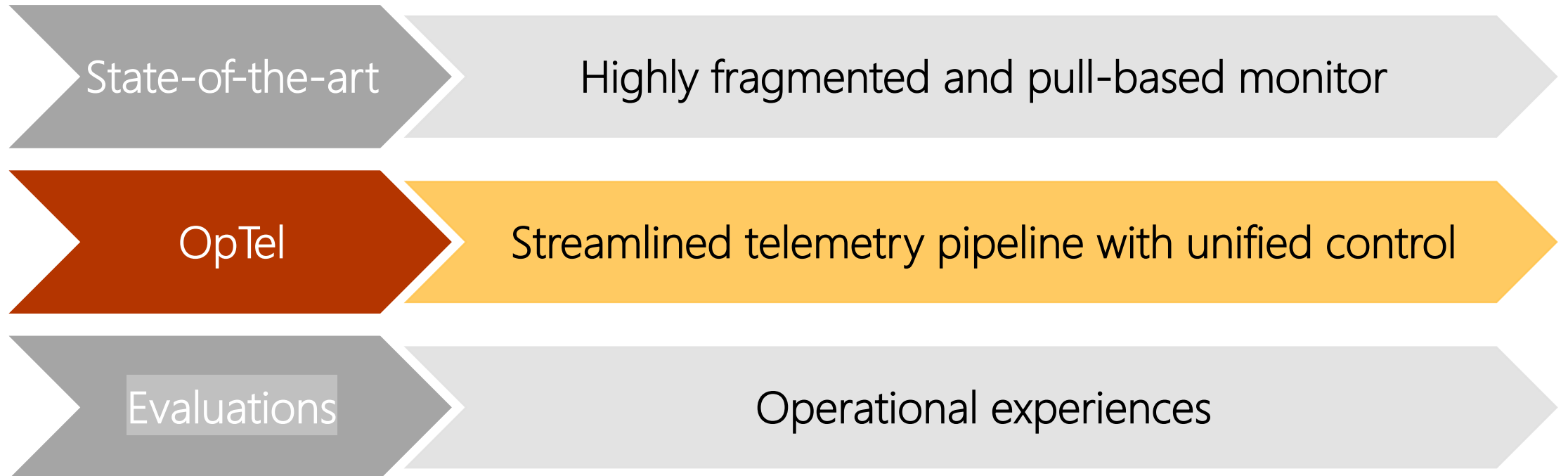
# Existing Telemetry System



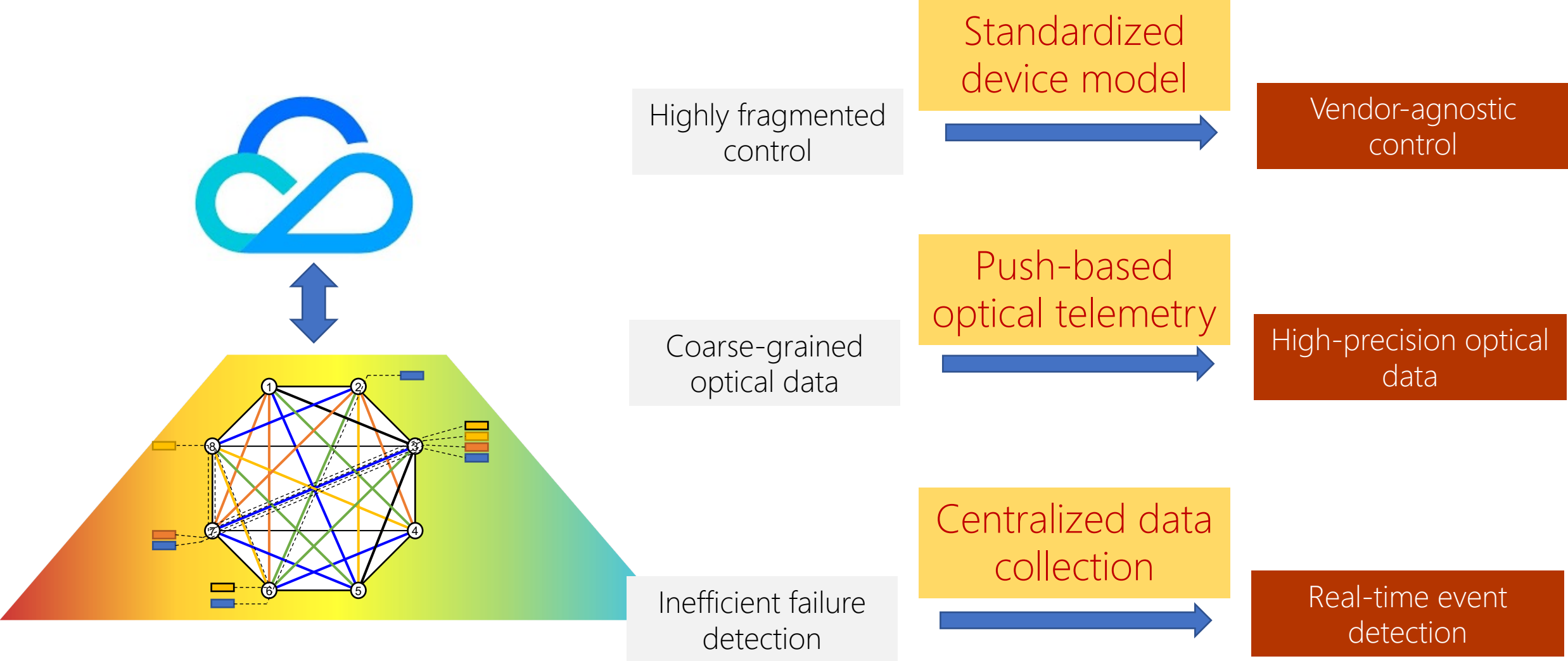
State-of-the-art approach

- Unable to detect ephemeral optical events.
- Slow in detecting and troubleshooting the more disruptive persistent events.

# Talk outline

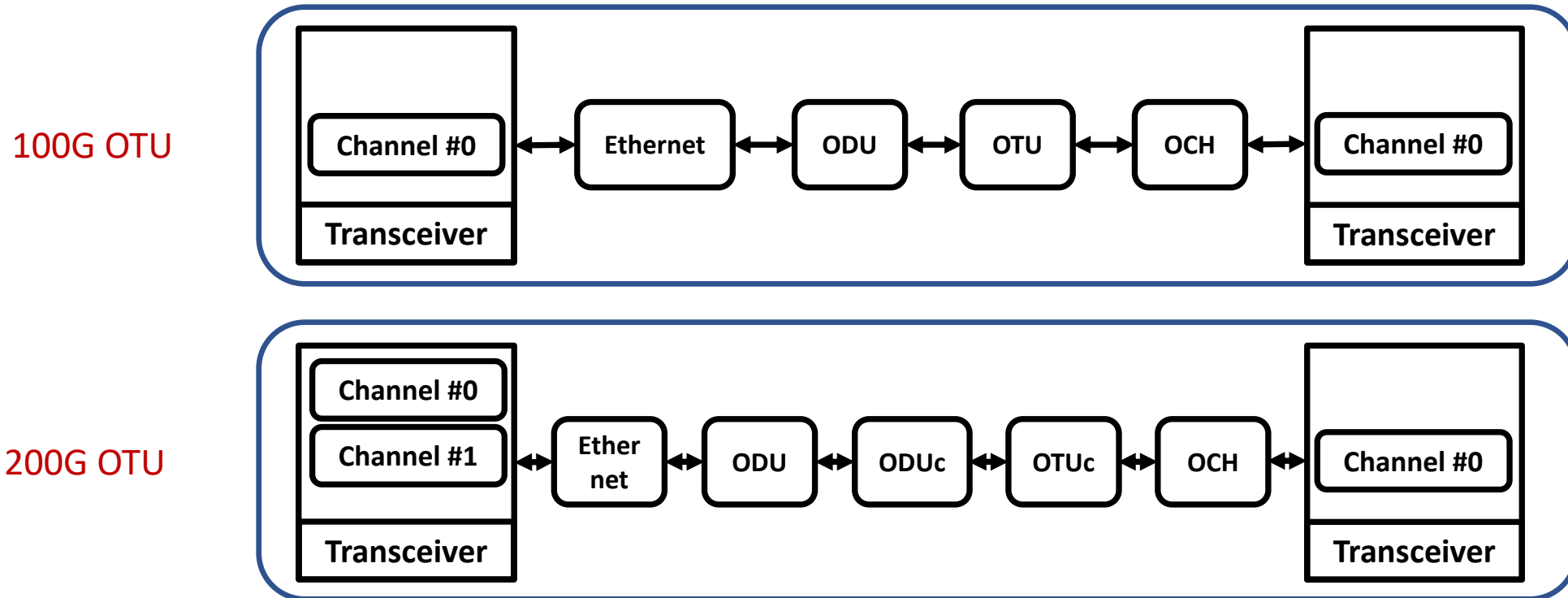


# OpTel high-level design



# Design and implementation

- Standardized device model



Logic model

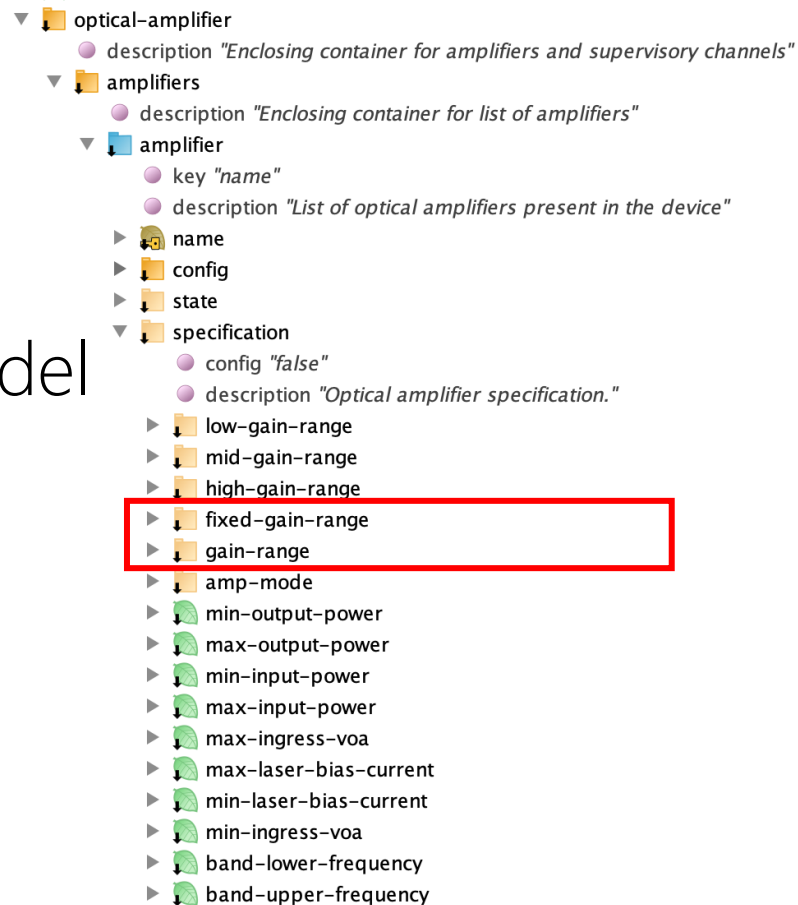
- Abstraction of logical components
- Workflow between components



# Design and implementation

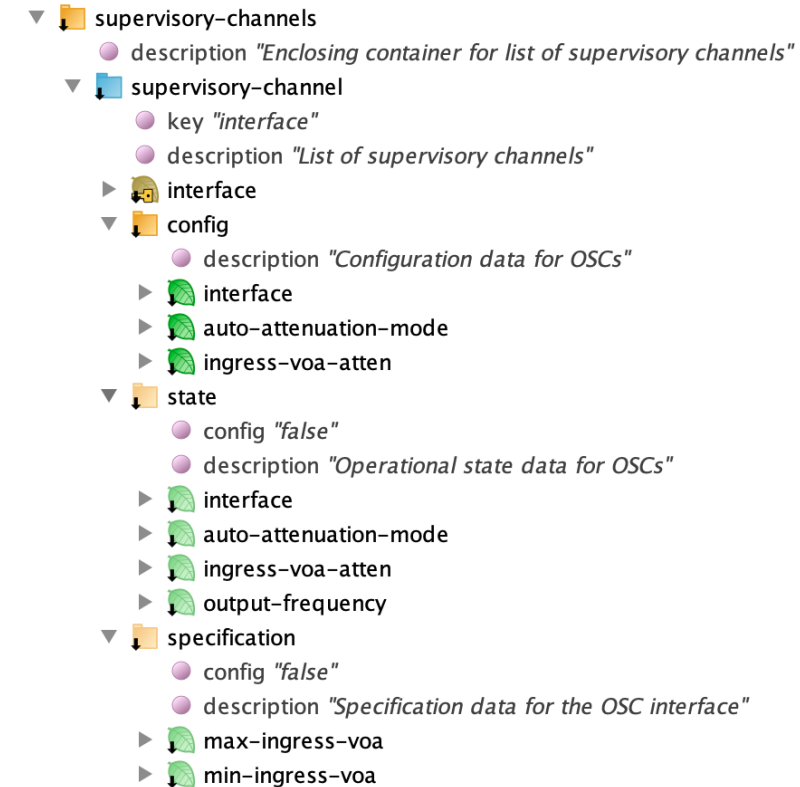
- Standardized device model

## Optical amplifier



Data model

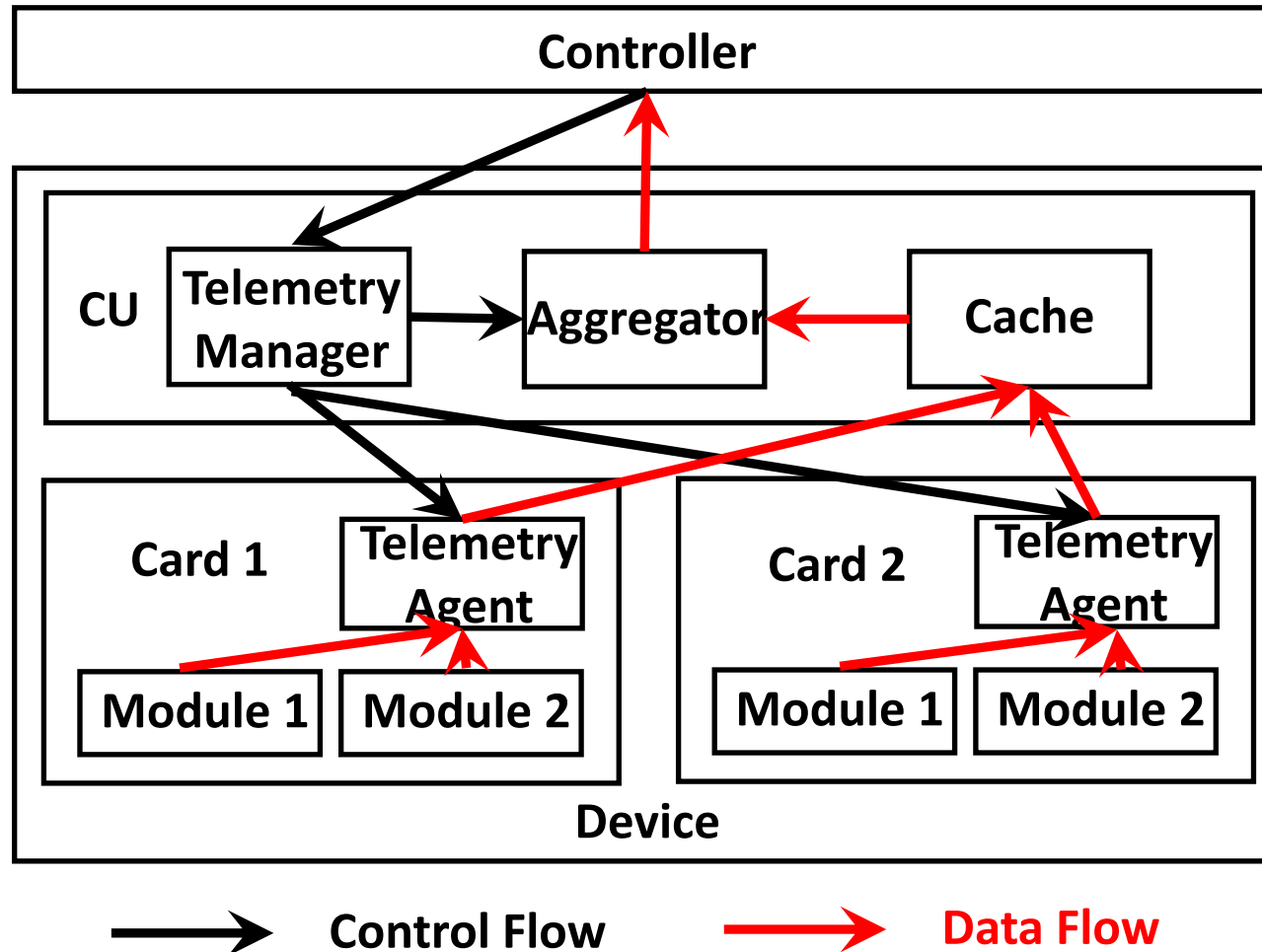
## Optical supervisory channel



# Design and implementation

- Push-based optical telemetry

Configured once!



Data pushed periodically!

# Design and implementation

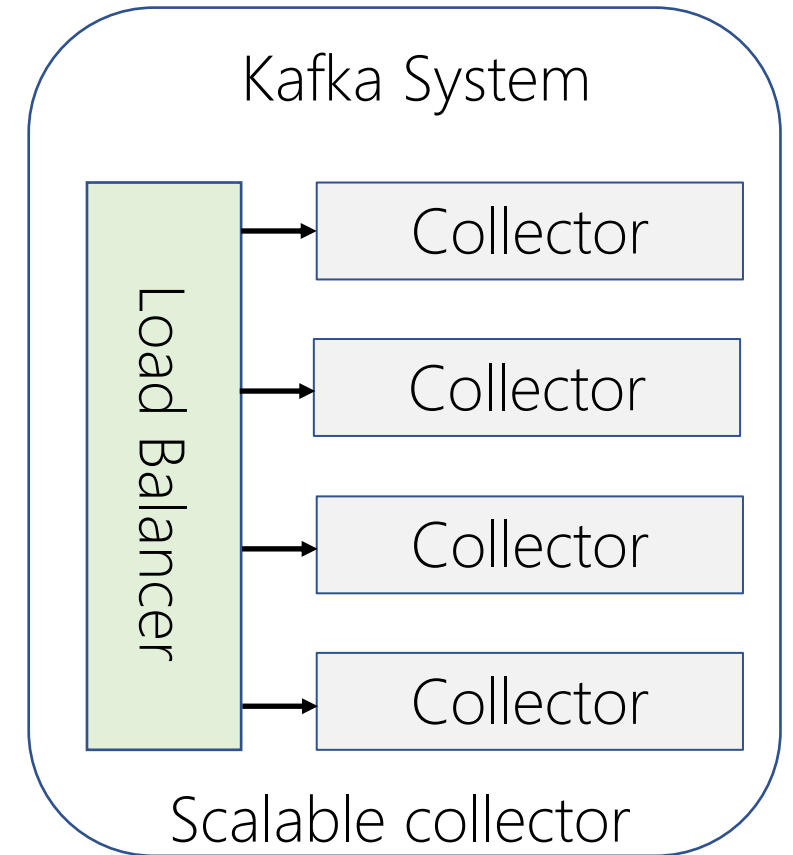
- Centralized data collection



PUSH

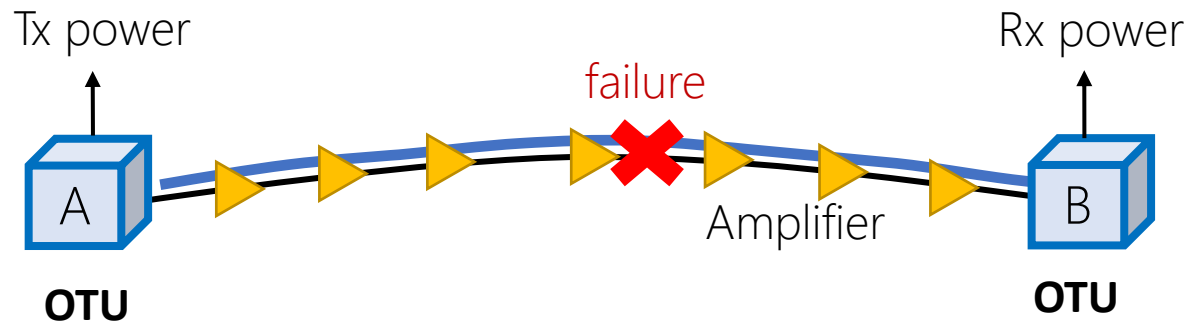
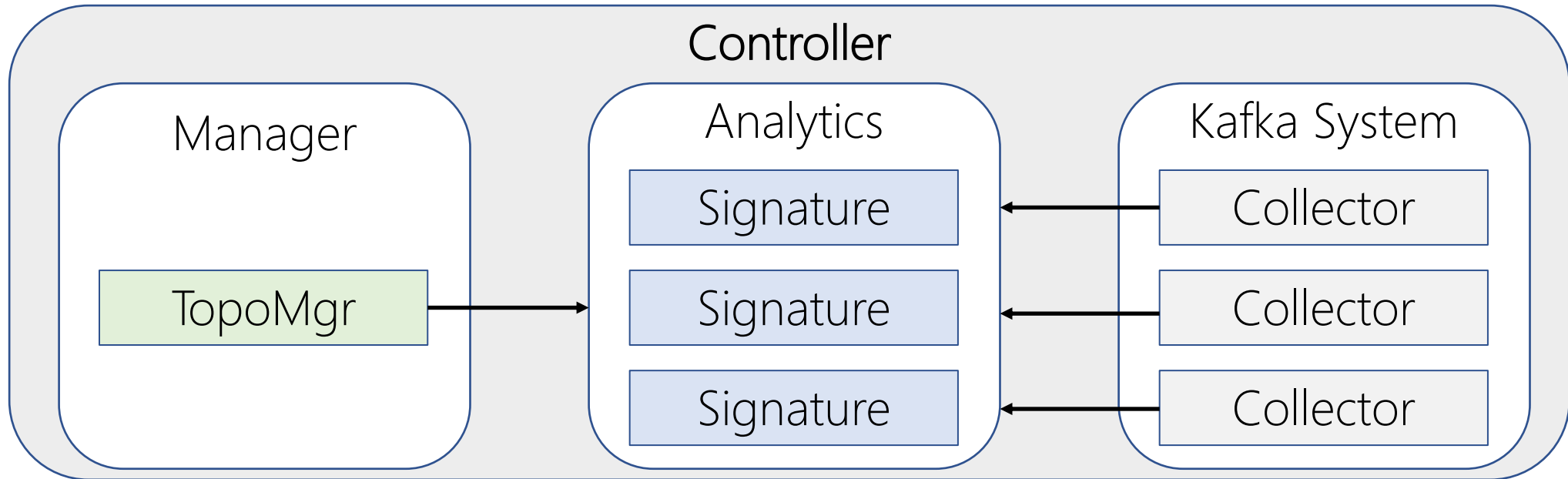
Data Stream

- Hundreds indicators
- Thousands devices
- One-second granularity

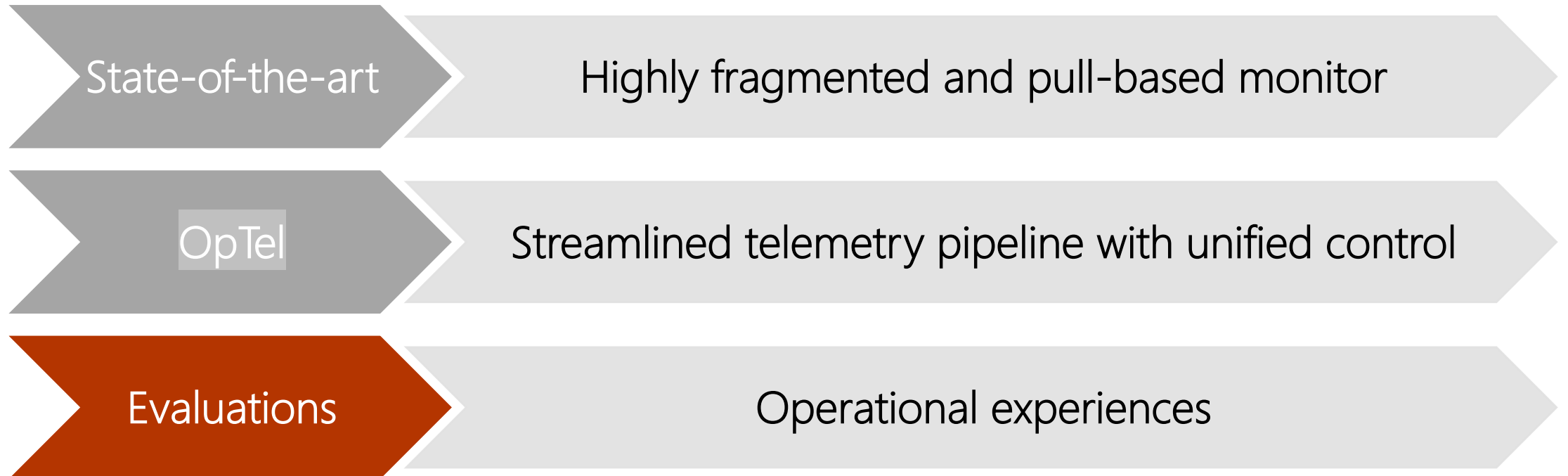


# Centralized data collection

- Real-time analytics

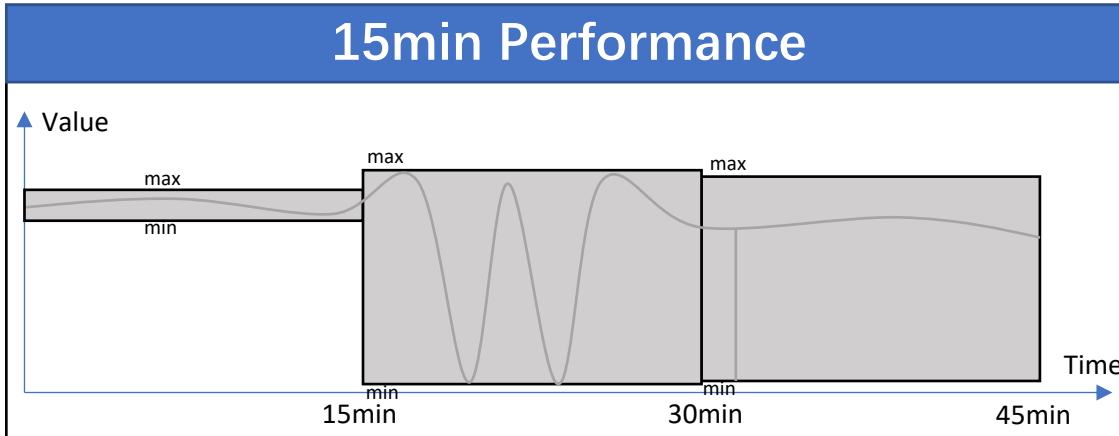


# Talk outline



# Dataset

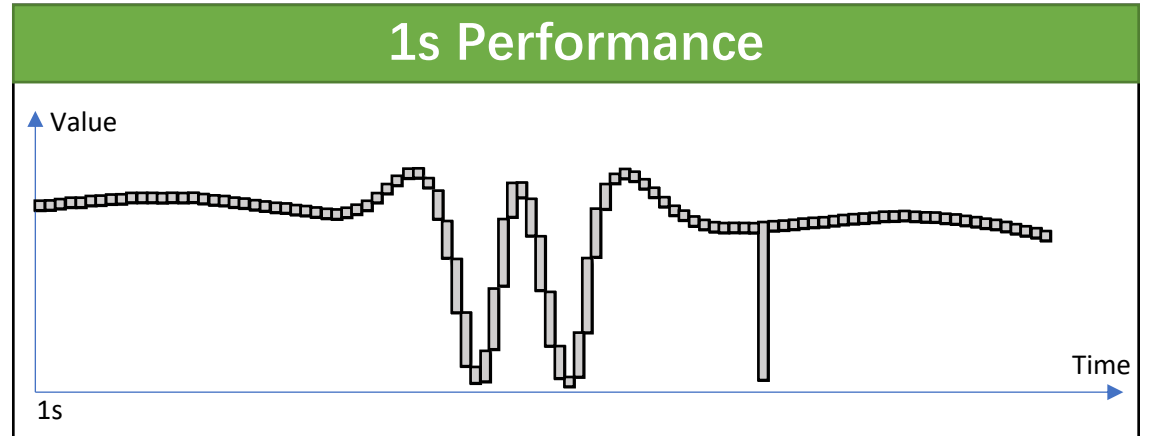
- Optical telemetry dataset (1-second granularity data)



Data : four tuples (max, min, avg, current)  
Time resolution : 15min (900s)



Traditional system



Data : four tuples (max, min, avg, current)  
Time resolution : 1s

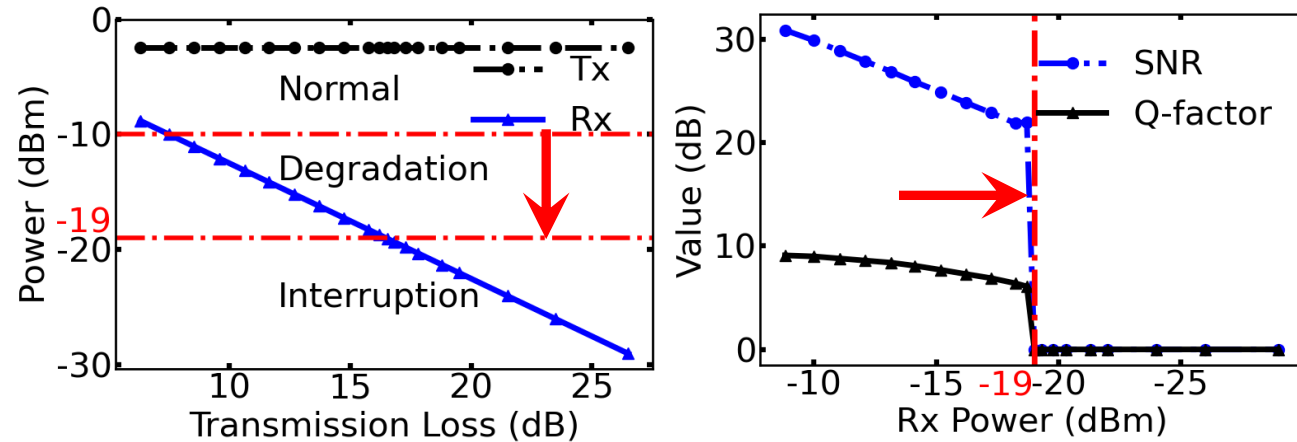


OpTel

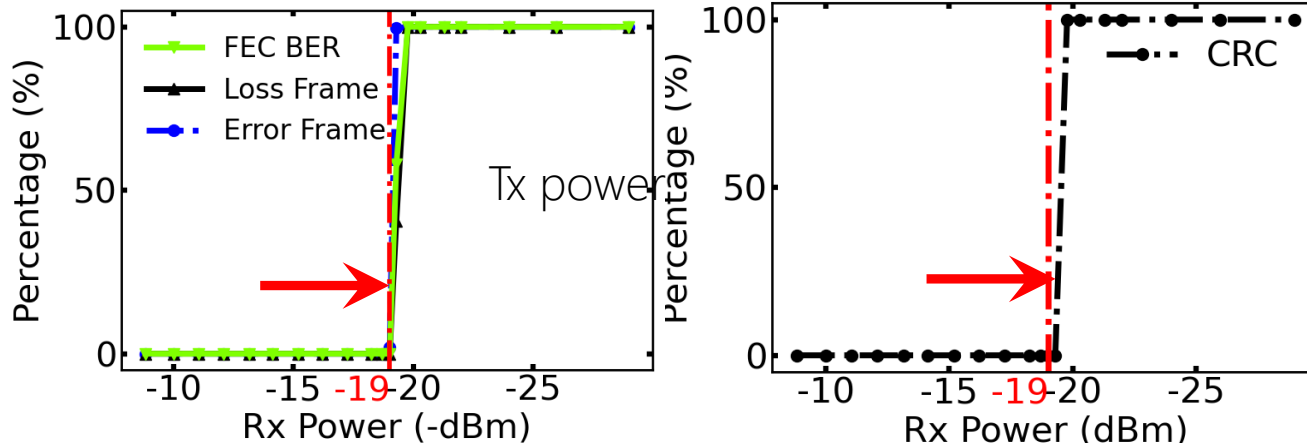


# Optical events

- Interruption vs. Degradation



**Physical layer**



**Data link layer**

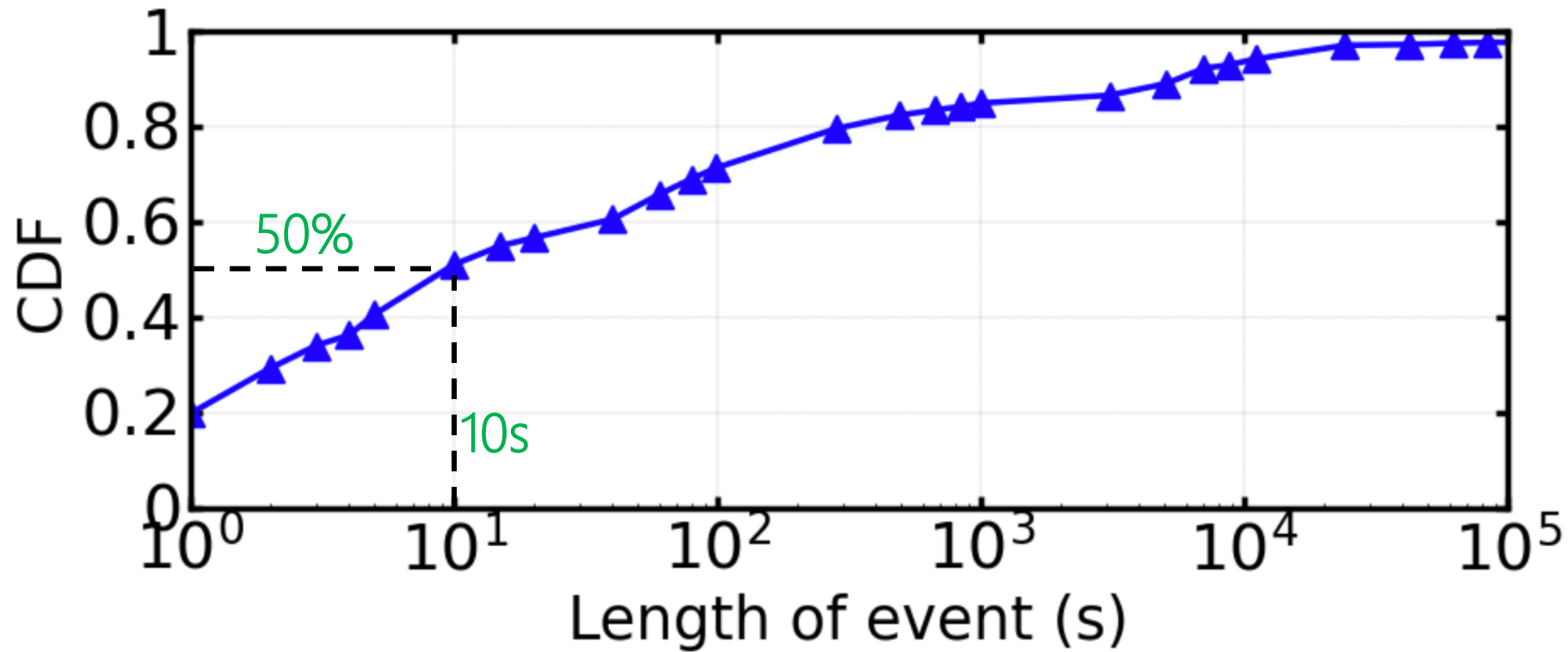
**Network layer**

Fiber Degradation

Affect physical layer indicators, but do not affect data transmission in the data link/ network layer

# Optical events

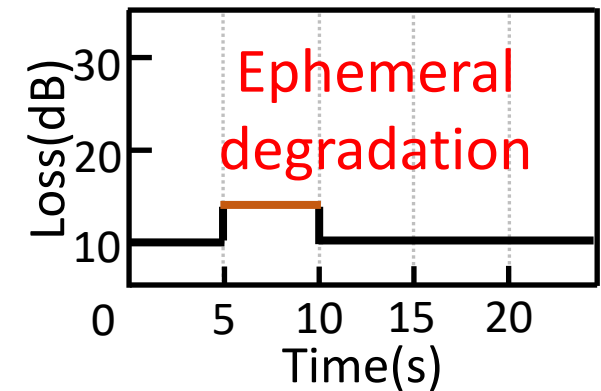
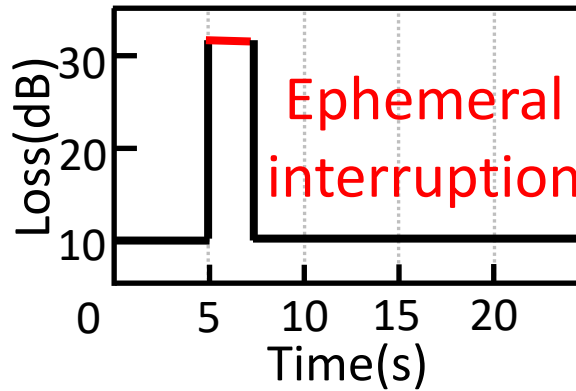
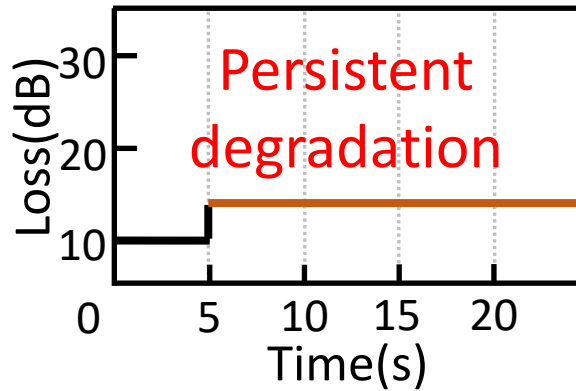
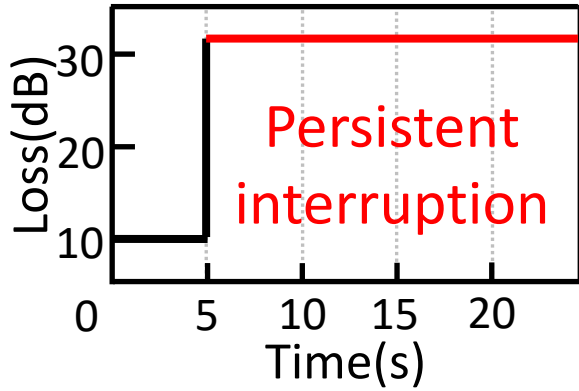
- Ephemeral vs. Persistent events



Ephemeral event

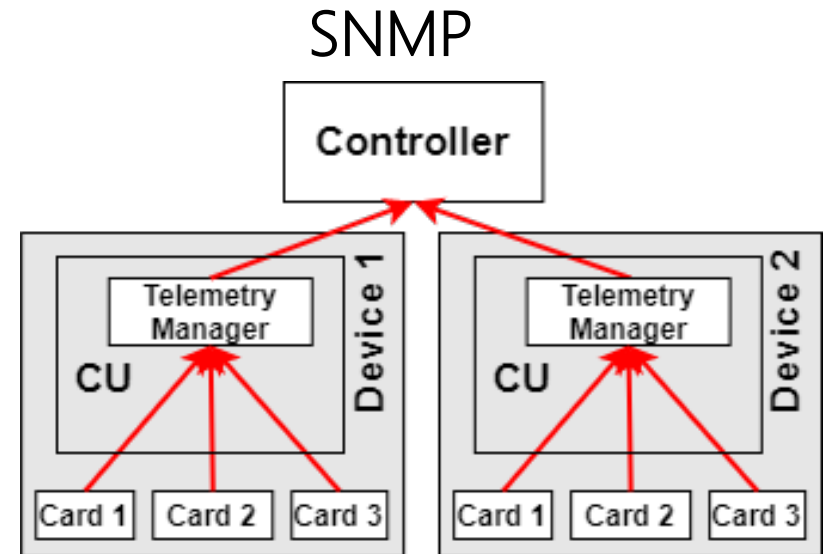
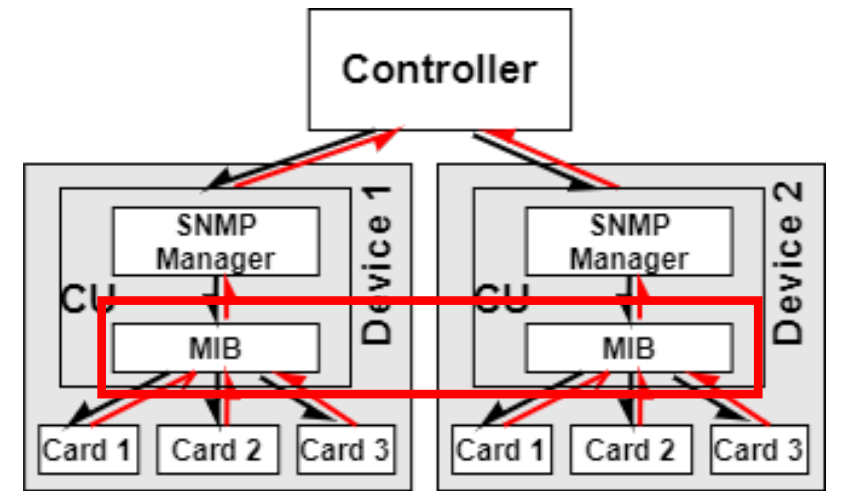
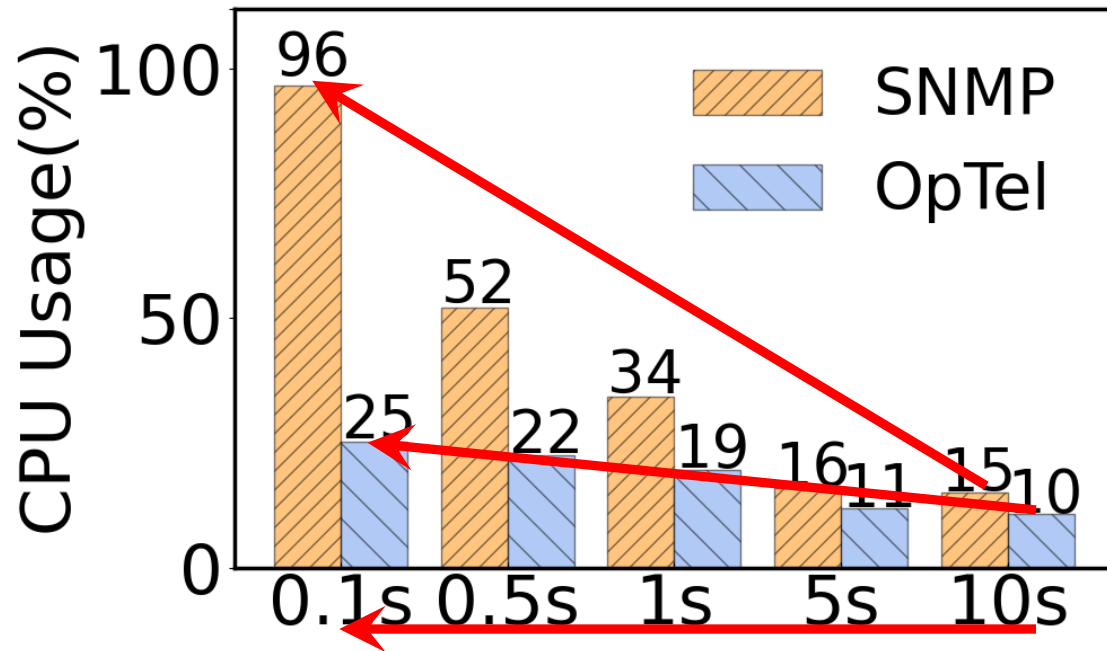
Less than 10 seconds

# Optical events



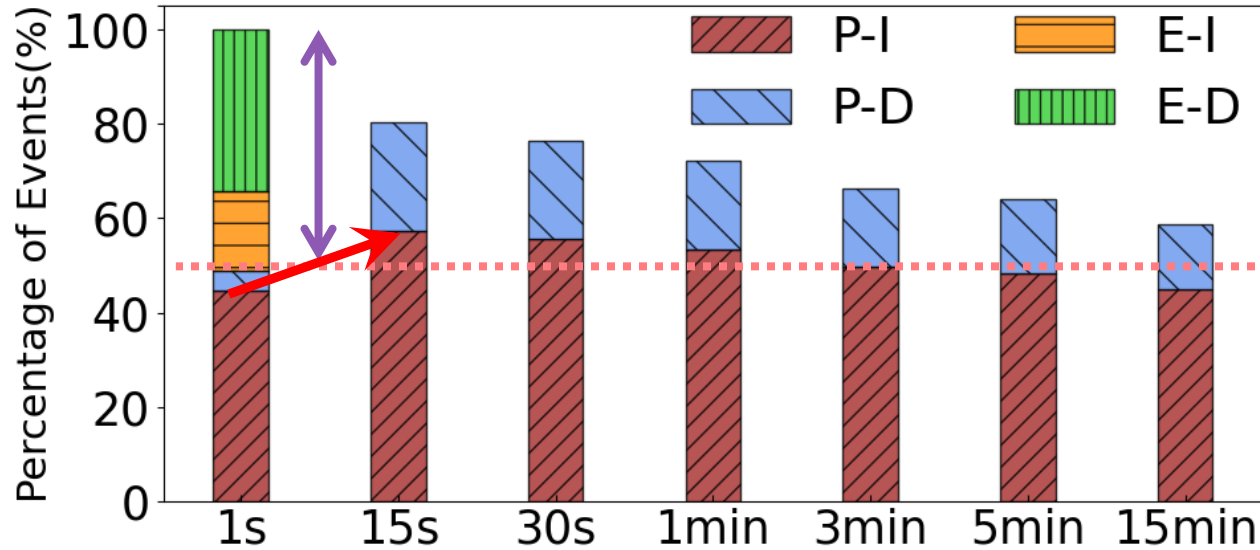
Type	Percentage	Degradation	Ephemeral
Persistent Interruption (P-I)	44.63%		
Persistent Degradation (P-D)	4.28%	✓	
Ephemeral Interruption (E-I)	16.85%		✓
Ephemeral Degradation (E-D)	34.24%	✓	✓
Total	100%	38.52%	51.09%

# Data collection overheads

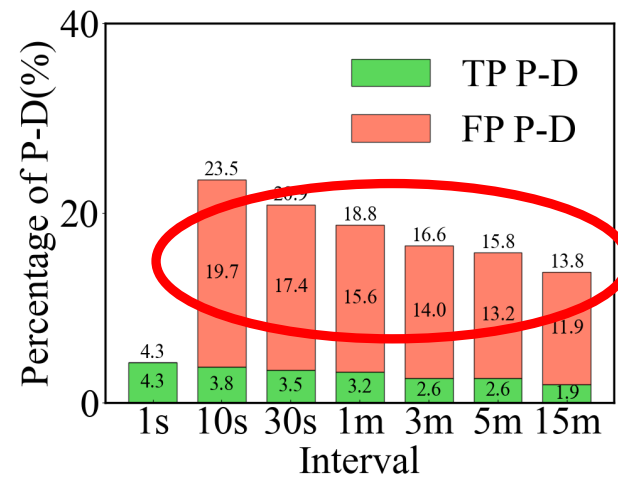
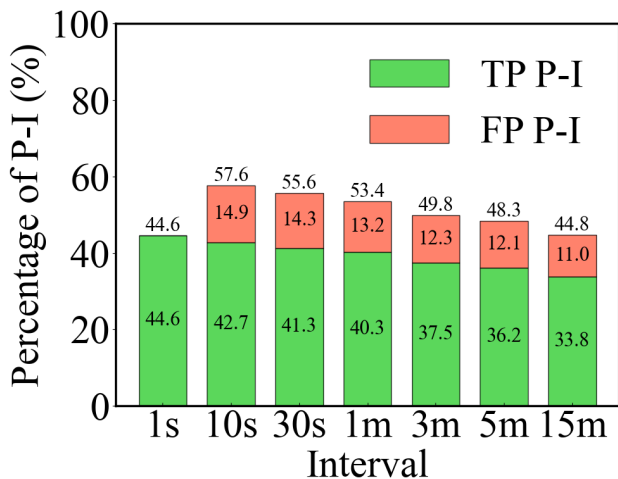


OpTel

# Detecting optical events



Not detect ephemeral events



Wrongly identify ephemeral events as persistent events

# Troubleshooting optical events

Category	Troubleshoot	Existing system	OpTel
Fiber	Fiber cut	5min~10min	10s
	Fiber jitter	Unknown	3s
	Fiber degradation	Unknown	10s

Our OpTel Troubleshoots optical events in a few seconds, which is orders of magnitude faster in production networks.



# Concluding summary

- OpTel uses standardized device model for vendor-agnostic control
- OpTel introduces optical telemetry for high-precision data collection.
- OpTel takes advantage of Tencent cloud for large-scale data collection and real-time data analysis.
- OpTel detects ephemeral events and enables troubleshooting optical events in a few seconds.

Q&A

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