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Internet of Things, Home Networking, Smart Cities, and Emerging Services

Metadata/Telemetry Support to Enable Telecom for Healthcare Opportunities

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**VIRTUAL EXPERIENCE
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Telecom for Healthcare (T4H) is a multi-trillion-dollar opportunity for the Cable industry. To capitalize on this opportunity operators must differentiate their services with data management capabilities that meet the needs of T4H stakeholders.

- T4H stakeholder's data needs
 - Quality of experience metrics
 - Telemetry for monitoring patients and adherence to treatments
 - Connectivity state for network devices and applications
 - Service provider accountability metrics
- Analytical framework to manage T4H telemetry and metadata
 - Secure and highly available interface
 - Timely and useful notifications

		T4H Roles		
T4H Service	Basic Responsibilities	Users/Patients (Telehealth and AIP)	Family, Legal Guardian, Trusted Circle, etc.	Doctors, Professional Caregivers, etc.
 <p>Communication</p>	North and Southbound Connections, Unified Communications	<ul style="list-style-type: none"> ▪ <i>Reliable</i> connection ▪ Better <i>Quality of Experience</i> ▪ Ease of use 	<ul style="list-style-type: none"> ▪ <i>Access anywhere</i> ▪ Better Quality of Experience ▪ Ease of use 	<ul style="list-style-type: none"> ▪ Reliable access to customers ▪ Capability to <i>service remotely</i> ▪ Fool proof <i>billing capability</i>
 <p>Monitoring</p>	Remote Patient Monitoring, Behavioral Monitoring, Convenience	<ul style="list-style-type: none"> ▪ <i>Healthcare</i> support ▪ <i>Independent living</i> ▪ <i>Problem solving</i> 	<ul style="list-style-type: none"> ▪ Assist family ▪ Assist independent living ▪ <i>Remote support</i> capabilities 	<ul style="list-style-type: none"> ▪ <i>Monitor the problem</i> remotely ▪ Assist the users ▪ <i>Increase</i> relevant <i>follow-ups</i>
 <p>Management</p>	Notification and Governance	<ul style="list-style-type: none"> ▪ Inform the right stakeholder ▪ <i>Govern the problem</i> ▪ <i>Reduce costs</i> 	<ul style="list-style-type: none"> ▪ Get <i>timely notifications</i> ▪ <i>Reduce costs</i> ▪ <i>Demonstrable improvement</i> 	<ul style="list-style-type: none"> ▪ <i>Manage the user status</i> ▪ Demonstrable improvements ▪ <i>Billability governance</i>

T4H Data Needs

We need to clearly understand the incentives for the users of the Telecom for Healthcare platform to analyze the data to be collected

Quality of Experience

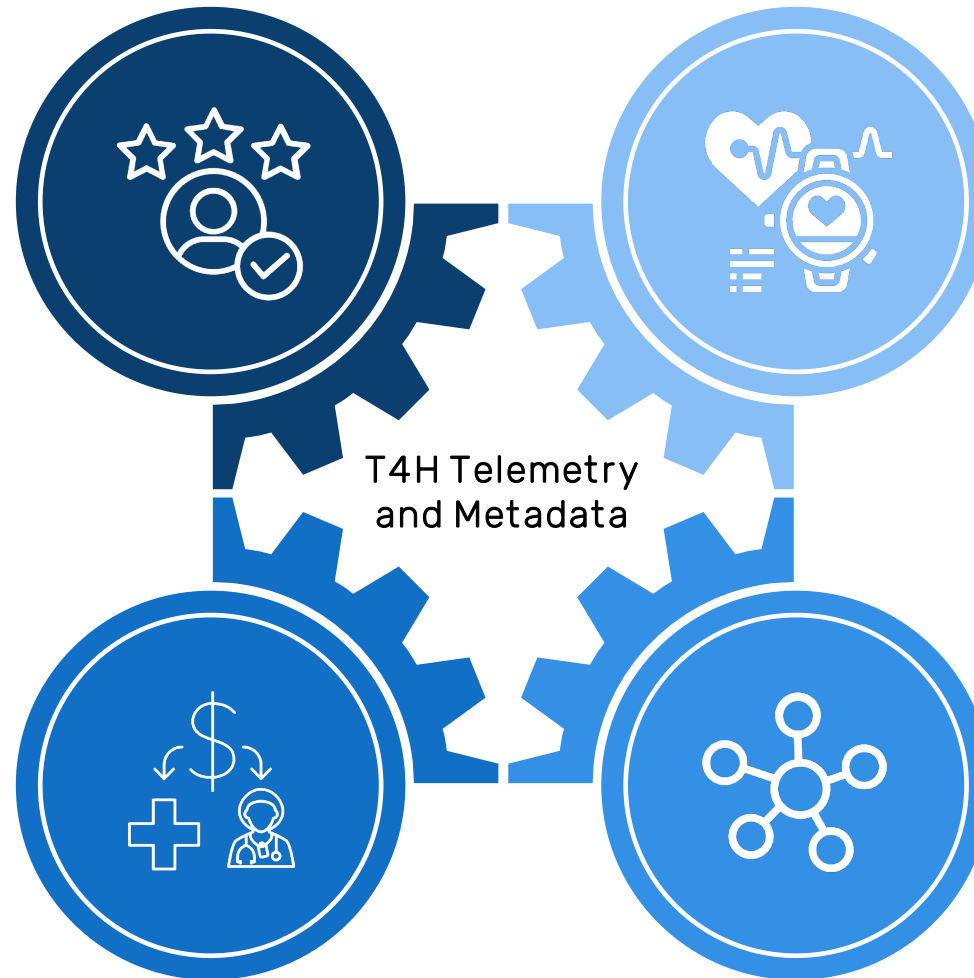
Are T4H services meeting stakeholder needs?
Are users engaging with services?

Bandwidth, latency, platform experience for
back office and individual connections

Accountability

Are providers delivering expected services?
Are patients adhering to treatment plans?

Quality of care, timely resolutions, problem
resolution rate, timely status notifications



Monitoring

Are we capturing the right Telemetry and
metadata to provide useful T4H services?

Healthcare and non-healthcare related streams,
sensor and UCC flows, network and device
status

Connectivity

Are we providing a reliable and highly available
platform across all interfaces?
Do we support a robust set of network protocols?

Platform availability, SLA guarantees, service up
times, zero touch network provisioning

Based on our analysis we recommend to classify the T4H metadata/Telemetry data into QoE, Monitoring, Connectivity, and Accountability

The intuition

Quality of Experience (QoE) is measured for the applications that the users are using the platform for. These applications for the T4H environment are *sensor* and *interactive applications*. These application's QoE are measured **at in-home for individual usage** and **at back-office** service infrastructure that hosts the applications for **aggregate usage**.

Class of applications*	Throughput sensitive	Loss sensitive	Delay sensitive
Onetime measurements	X	X	
Video monitoring	X		X
Sensor monitoring	X	X	
Video communications	X		X

(*). Refer to white paper [here](#) for details on the application QoE characteristics

Generic application metadata

Generic Metadata

Sensor metadata: Sensor id, type, group, priority (critical, high, medium, low), location in the house, vendor information etc.

Interactive applications metadata: UCC id, type, location (home, care giver, provider, family), vendor information, application experience (e.g., 5-star scale) etc.

QoE relevant data

Bandwidth data: Bits/second (Peak, Min, Average); Monitoring Location: Sensor hub, Back-office hosting; Granularity: Per session, per aggregate (per sensor or UCC id)

Latency data: One way delay (Peak, Min, Average); Monitoring Location: Back-office hosting; Granularity: Per session; Relevant information: Timestamp the data

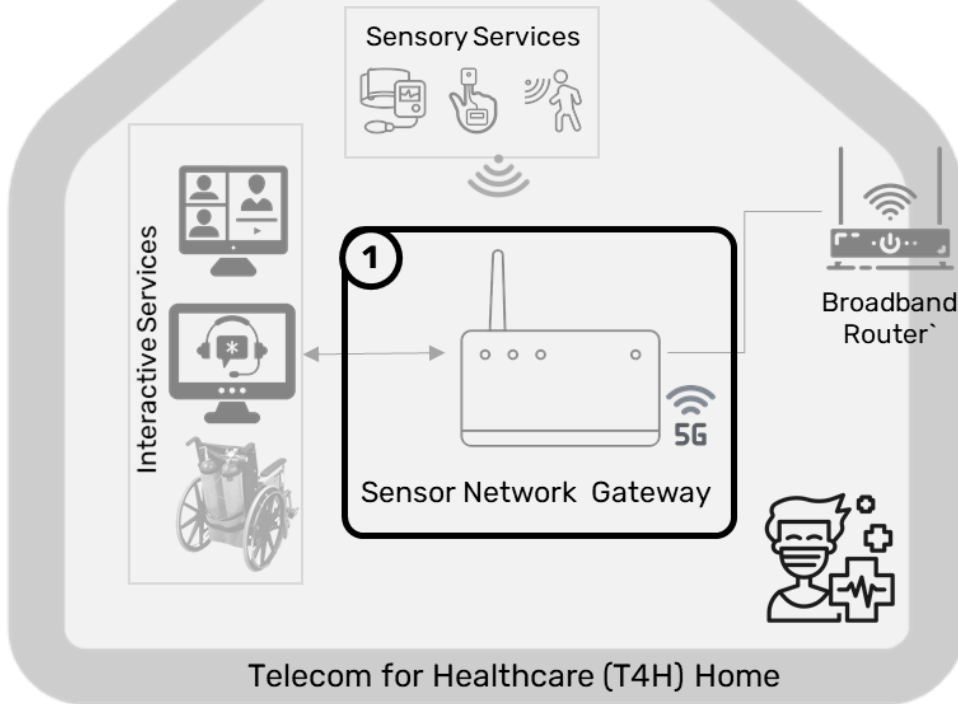
Loss related data: Data points lost per minute (Peak, Min, Average); Monitoring Location: Back-office hosting; Granularity: Per session; Relevant information: Time sequence the data

Experience related data: Experience rating per service

Quality of experience measures the fidelity of the communication of the sensor and interactive data to the satisfaction of the players

The intuition

The applications that are offered and hence are monitored are again *sensor* and *interactive applications*. They can be supporting *healthcare* and *non-healthcare* applications. The idea of these data needs does not include the core data streams such as the temperature from a thermometer, but the additional data that supports the players.



Generic application metadata

Metadata

Additional Sensor metadata: Status (up or down), start time, healthcare or non-healthcare related, etc.

Additional Interactive applications metadata: Start and end times of the sessions, type of session interaction (video, audio, video +audio), number of sessions, etc.

Monitoring relevant data

Sensor monitoring data: Priority of the sensor, privacy level of the data (Generic, provider specific, stakeholder, user alone etc.), urgency level of the notification (such as threshold crossing alarms)

Interactive services monitoring data: Session related (number of legs, number of streams, etc.), stream related (QoE measures, transcriptions, metadata, etc.)

Monitoring locations: The data can be monitored at the aggregation point at the home (sensor network hub) and some of them at the hosted service back office.

Monitoring the direct and indirect information from T4H streams is the core function of the end-to-end platform

The intuition

Connectivity focuses on providing a *highly available* service platform with *five 9s reliability*. These measures are very important to support highly emotional and sensitive subjects of healthcare and elderly care. In addition, providing ease of configuration (zero touch configuration) is essential for T4H adoption.



Reliability

Reliability of the devices, connections and the platform is essential for these critical services



Availability

Availability of the end-to-end services is another measure for these time sensitive T4H services



Ease of configuration

Many devices and solutions will be integrated with the T4H services, leading to paying attention to the ease of configuration

Generic application metadata

Metadata

Additional sensor metadata: Sensor uptime, sensor loss of connectivity, sensor reliability

Connectivity relevant data

Reliability data: Device reliability metrics, service reliability metrics

Availability data: User device uptime (Primary connection, secondary connection), server uptime, percentage availability, service availability

Zero touch configuration assessment: Service call during installation, failed self-installs, in-home installation percentage and average installation duration per service offering

Other connectivity data: Availability SLA adherence

Reliable and highly available connectivity services with the attention to the ease of configuration is essential for the successful adoption of T4H

The intuition

The accountability of the T4H environment is measure on the *Quality of Care* provided by the service providers, the *timely notifications* that can be provided by the platform and the *billability of the services* offered by the platform (and hence the provider).



Measure QoC to assist the T4H service providers and platform providers to assess the improvement

Quality of Care



Showcase how the cable infrastructure can improve notifications to different stakeholders and hence assist the providers with their accountability goals

Notifications



Billing

Providing corroborative information to bill appropriately is an essential service that Cable operator T4H should offer to make this solution attractive

Generic application metadata

Metadata

Analytical platform metadata: Efficacy of the algorithms (problem resolutions rate), speed of analysis

Notification infrastructure metadata: Notification statistics, notifications per type of problem

Accountability relevant data

Quality of care data: Time take to resolve the issue, condition improvement, reduce number of missed appointments, cost reduction (for user, stake holder, provider)

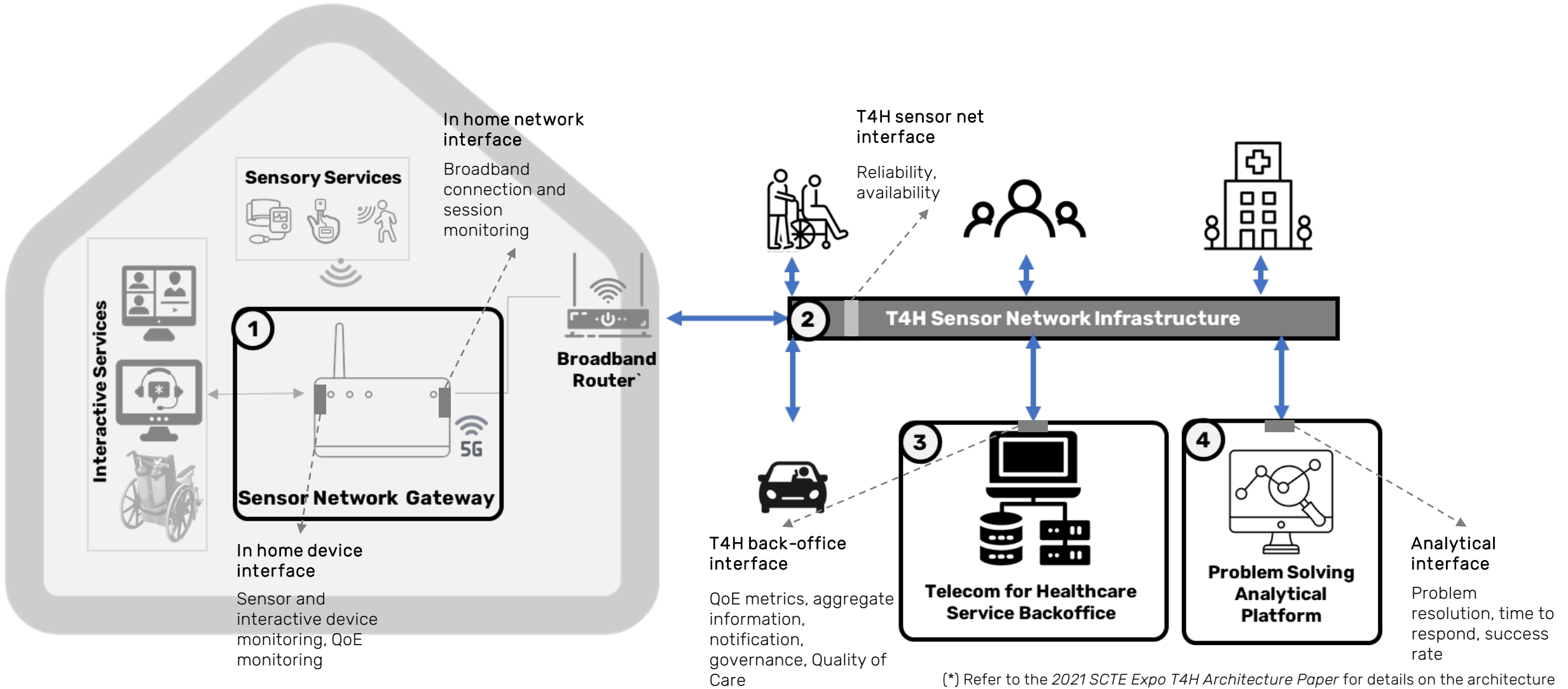
Notifications related data: Response time (Average, peak, minimum), per problem, per provider,

Billability related data: Session context (duration, reason, parties involved, provider information etc.), stream context (devices, device performance, potential transcription, additional notes)

Other related data: Other stakeholder accountability, payor accountability measure

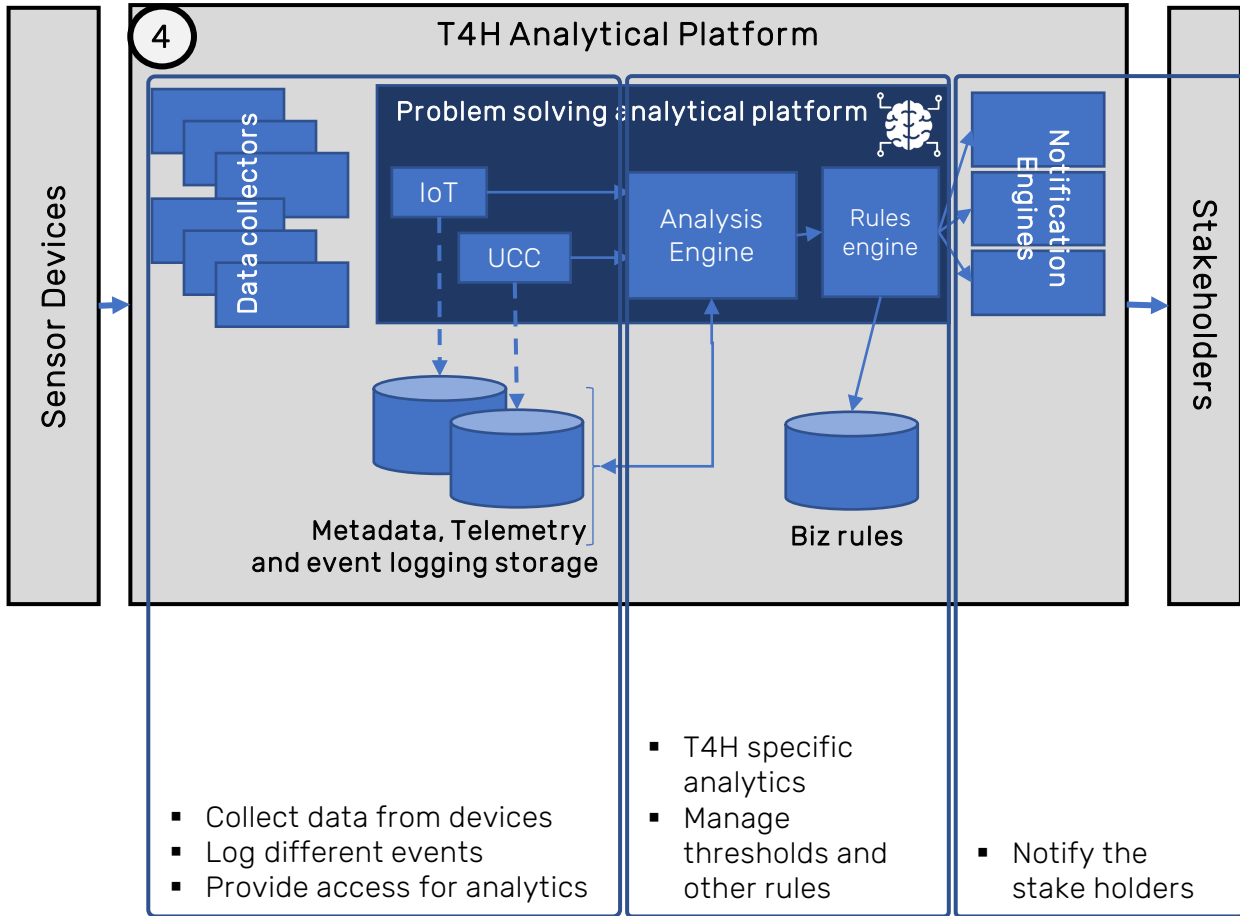
Accountability of the providers and the end-to-end systems is an essential feature for the success of a T4H platform

End to End Data Collection Points and Their Information Scope



The metadata and the telemetry information gathered on the T4H platform shall understand the players and their incentives

Analytical platform architecture



What is different for T4H?

Component	Status in MSO	Comments
Data collectors	Existing for IoT and other service info.	Need to repurpose for T4H data
Analysis engine	Existing for IoT engines	Need additional development for T4H
Rules engine	Potentially new function	Need solutioning
Notification engines	Existing with service assurance tools	Need to extend to T4H
Data privacy	Existing for PII	Need to extend to PHI*
Performance	Status in MSO	Comments
Scalability	Device level alarms	Need to extend to per sub per stream
Security	SNMPv3 based	Need to validate if this is enough
Privacy	PII after collection	Need to validate if we need to anonymize at the collection points
Reliability	Reliable communication	No additional changes in our opinion
Responsiveness	Good for current use	Crucial for the success

(*) PHI - Patient Health Information

Cable operators are already implementing many of the T4H analytical platform components, but they need to make some subtle changes



Understand the T4H players, and their incentives to develop relevant data architecture

- Know the **players** in T4H space – users, stakeholders, and T4H service providers
- Understand their **incentives** –Quality of experience, monitoring, connectivity, accountability
- Develop **purpose driven analytical infrastructure**

Use the cable operator's data collection capability to their T4H opportunity

- Provide **quality of experience** measures for the sensor and interactive applications
- **Monitor** healthcare and non-healthcare applications
- Offer a reliable, highly available, and easy to configure **connectivity** services
- Develop QoC, notification, and billing **accountability** metrics

Scale up to the needs of T4H players

- Most of the required T4H data platform is already developed for operator's current use
- Meeting the needs of scalability, security and privacy is essential to gain T4H share
- Developing a responsive and T4H problem-relevant platform is essential for the success

Take appropriate next steps for T4H opportunity

- Review the **business cases and market analysis**
- **Start building the architectural components** for the T4H needs
- Build relations with the **inter-industry partners for launches**



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Thank You!

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