

10th
UCAAT

**User Conference on
Advanced Automated Testing**

ETSI 
The Standards People

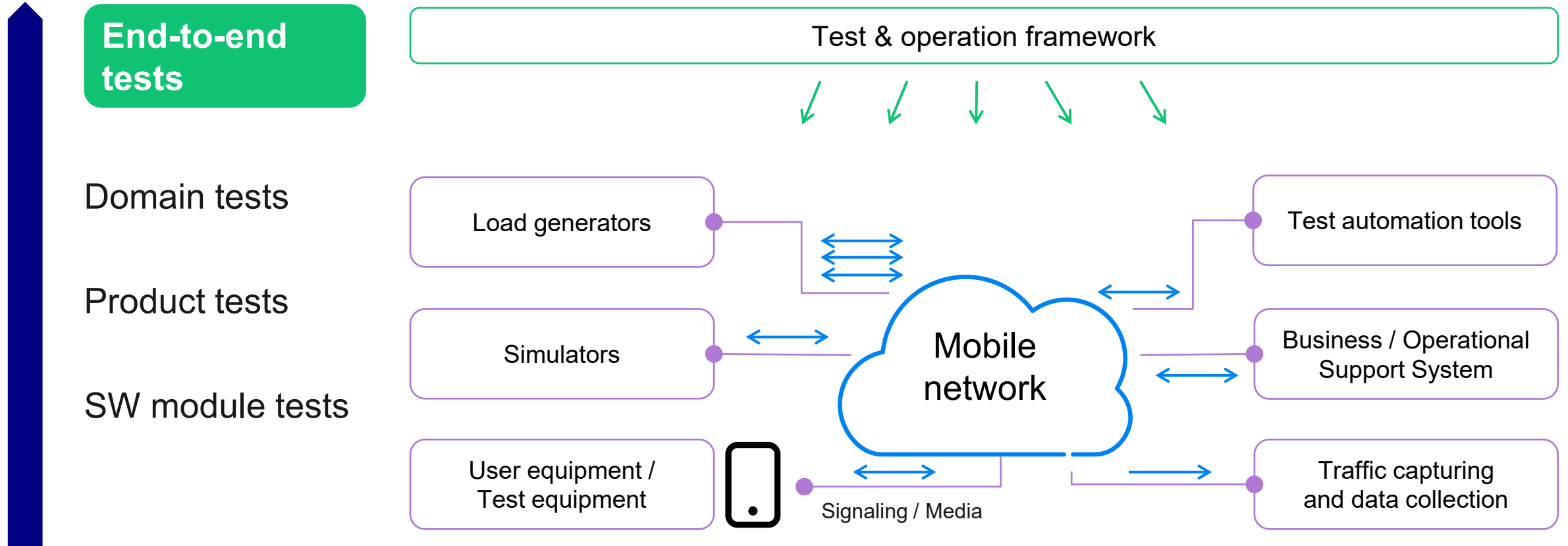
Troubleshooting of telecommunication networks with event-based monitoring

Presented by: **Zoltán Elzer, Ericsson**

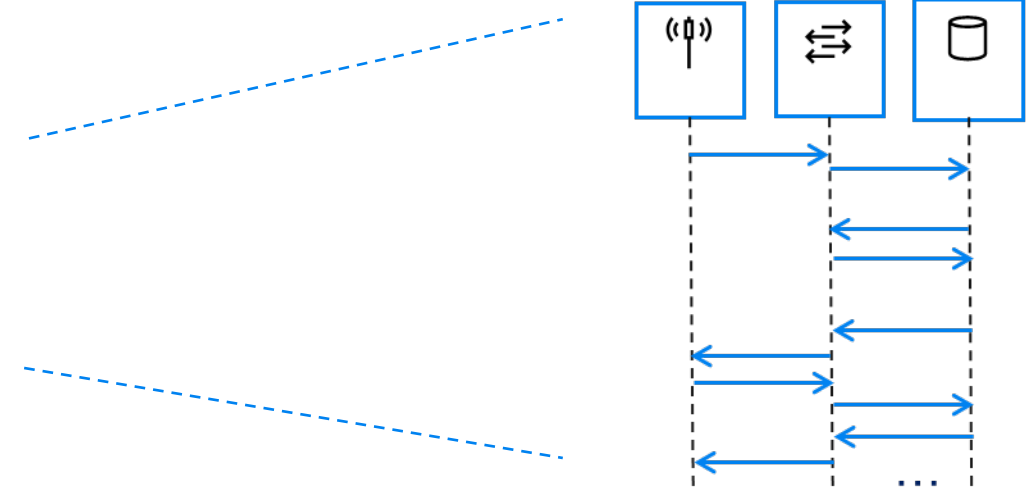
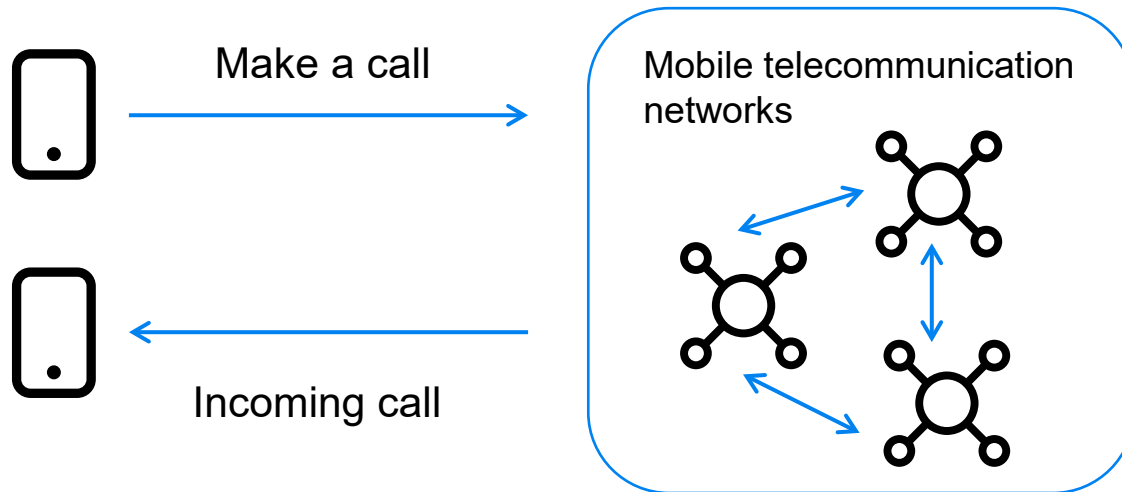
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Test levels & E2E tests



Complexity of telecom networks



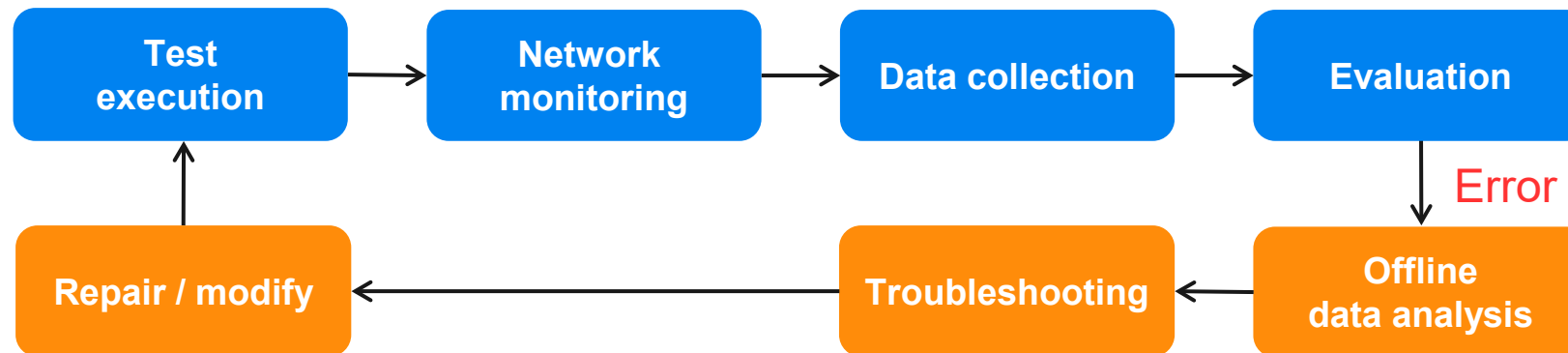
- Complex network architecture
 - 2G/3G, 4G, 5G
- Multiple network elements and systems
 - Interworking

Huge amount of communication

- Single 5G call setup may require more than ~400(!) signaling messages, between ~15 Network Functions

Automated testing and challenges

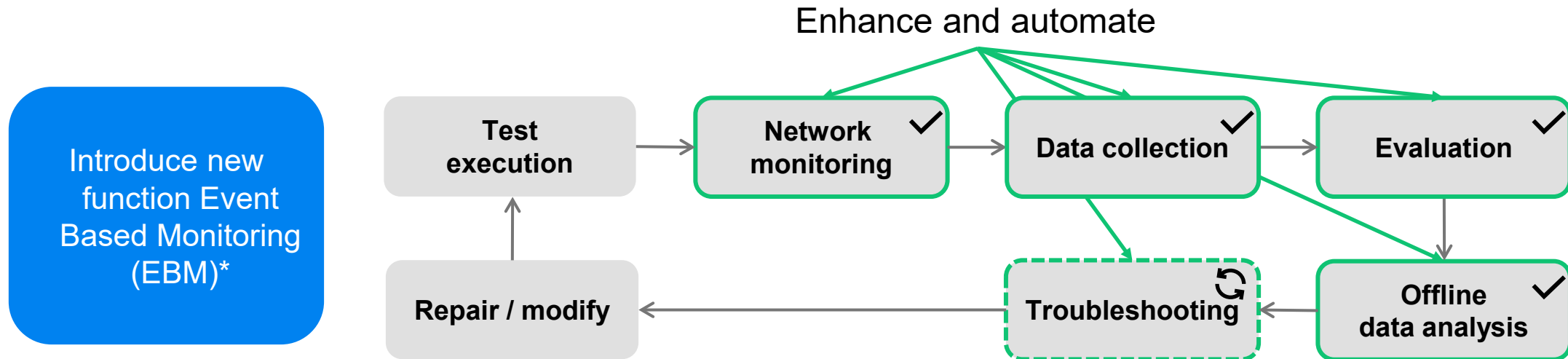
Traditional way telecommunication system testing



End-to-end testing and then troubleshooting is very complex

- Networks are black box from User Equipment
- Network monitoring and insight should be solved
- Manual troubleshooting of errors
- Analyzing data of network probes, counters, alarms manually
- New challenges like encrypted communication

Enhancements with Event Based Monitoring



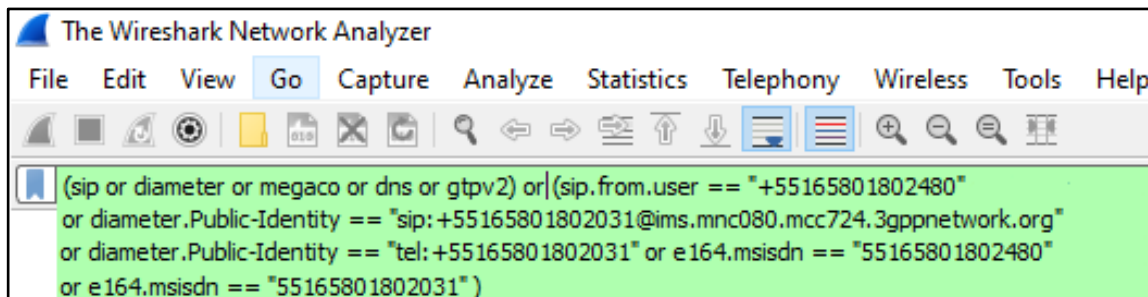
- Generate detailed insight reports from Network Functions for given events
- Answer to a distributed system tracing challenge
- The solution for IMS, Voice Over LTE and Voice Over NR networks enables:
 - High level **observability** of network provides insight
 - Helps in **evaluation** and **analysis**
 - Enhances **troubleshooting** and **data correlation**
 - Provides proposal for **possible problems** and corrections

*Ericsson terminology

Event Based monitoring benefits

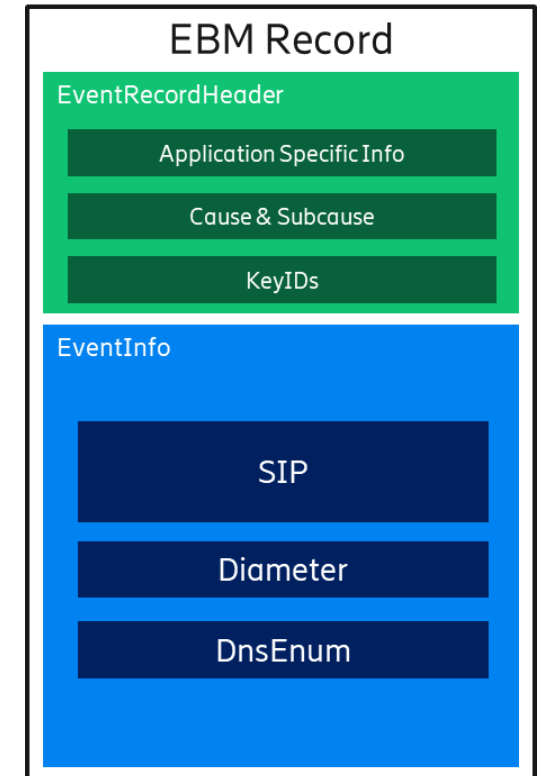
Conventional Methods

- Capture data from all network interfaces separately
- **Huge amount of data** to capture, store and analyse
- **Decryption** of communication difficult or not possible
- Timestamp **inaccuracy** of captures
- **Cumbersome correlation** of multi protocol signaling through network analyzers



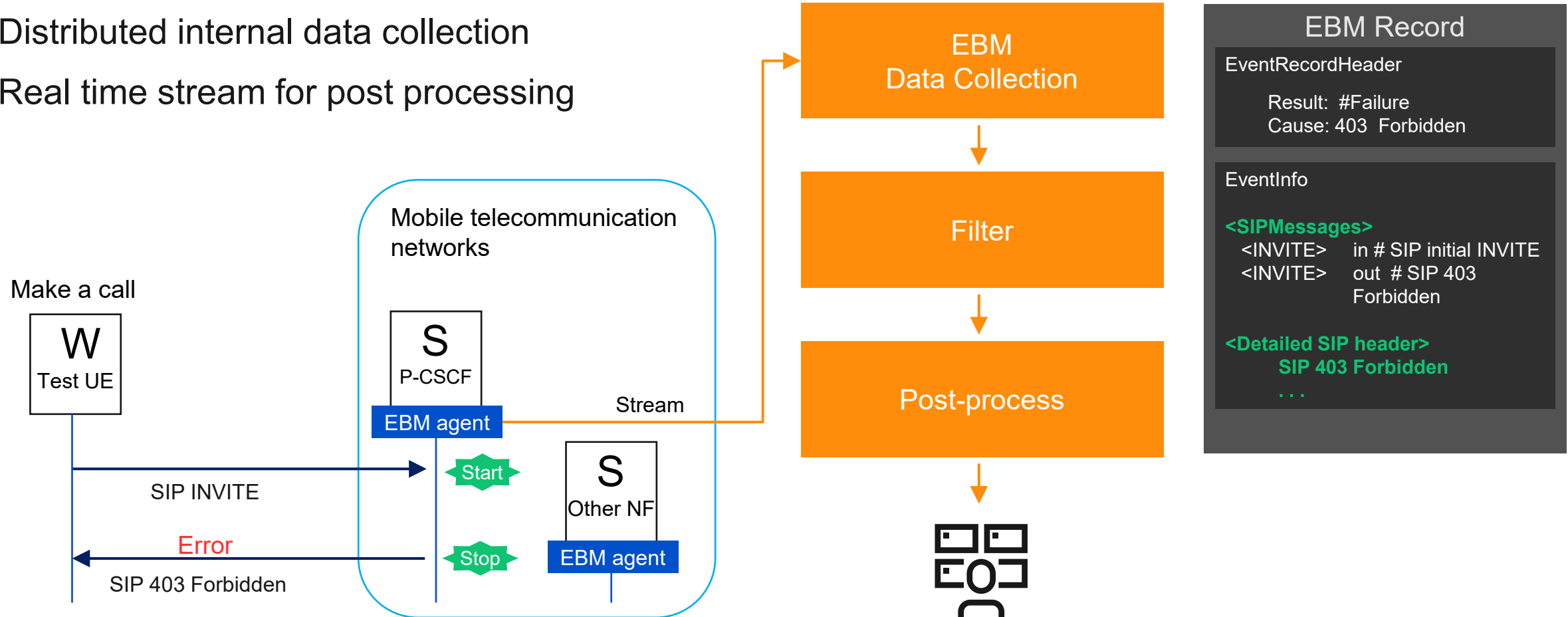
Event Based Monitoring

- **All information within 1 record**
- Only relevant information for troubleshooting and **real-time** assurance
- Insight from network **behind encrypted communication**
- **Machines and humans** easily identify the cause of the problem
- Multiprotocol **correlation** solved



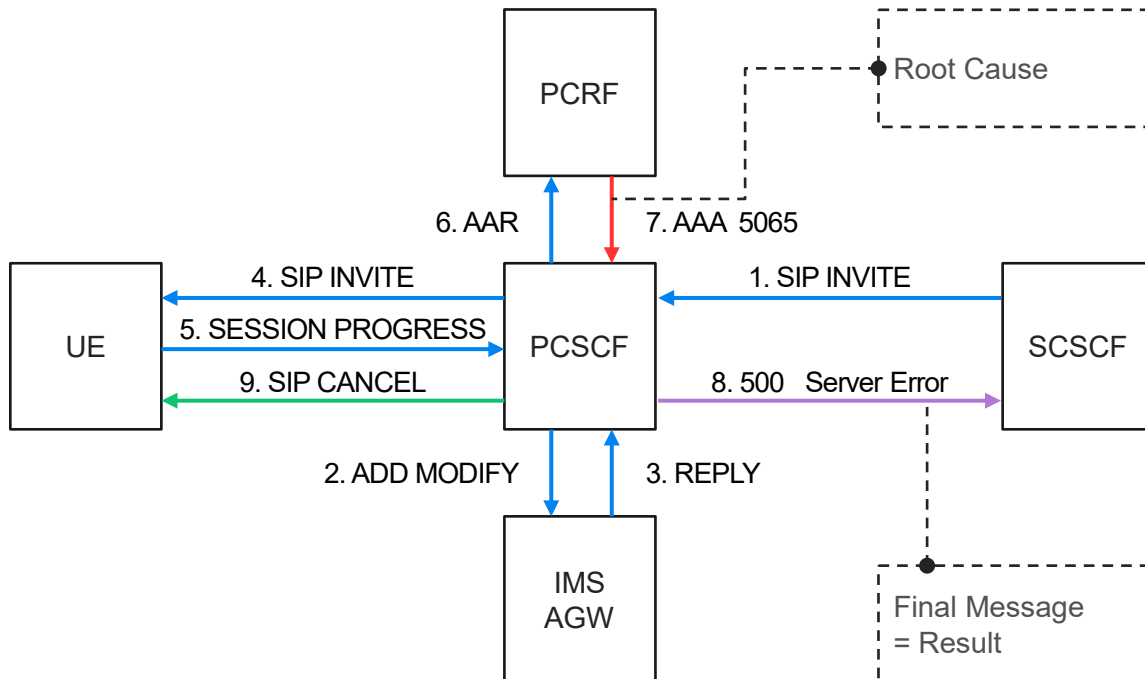
Event Based monitoring

Distributed internal data collection
Real time stream for post processing



Event Based monitoring - example

Using for troubleshooting, scenario: Incoming call - QoS or bearer resources are no longer available: indicated by 5065 in Diameter message



EBM Record

```

EventRecordHeader
  Result: 1 #Failure
  Cause: 500 Server Internal Error
  Sub-Cause Code: "Internal"
  
```

Detailed Fault Info

```

EventInfo
  <DiameterMessages>
    <AAR> out # Diameter initial Accounting request to PCRF
    <AAA> in # AAA with error 5065
  <H.248Messages>
    <ADD> out # H.248 ADD request
    <REPLY> in # H.248 ADD REPLY answer
    <MODIFY> out # H.248 MODIFY request
    <REPLY> in # H.248 MODIFY REPLY answer
  <SIPMessages>
    <INVITE> in # SIP initial INVITE incoming from S-CSCF
    <INVITE> out # SIP initial INVITE outgoing to UE
    <183> in # 183 Session Progress incoming from UE
    <500> out # 500 Server Internal Error to S-CSCF
  <DnsEnumMessages>
    <Query>
    <Respond>
  
```

Fault Counters

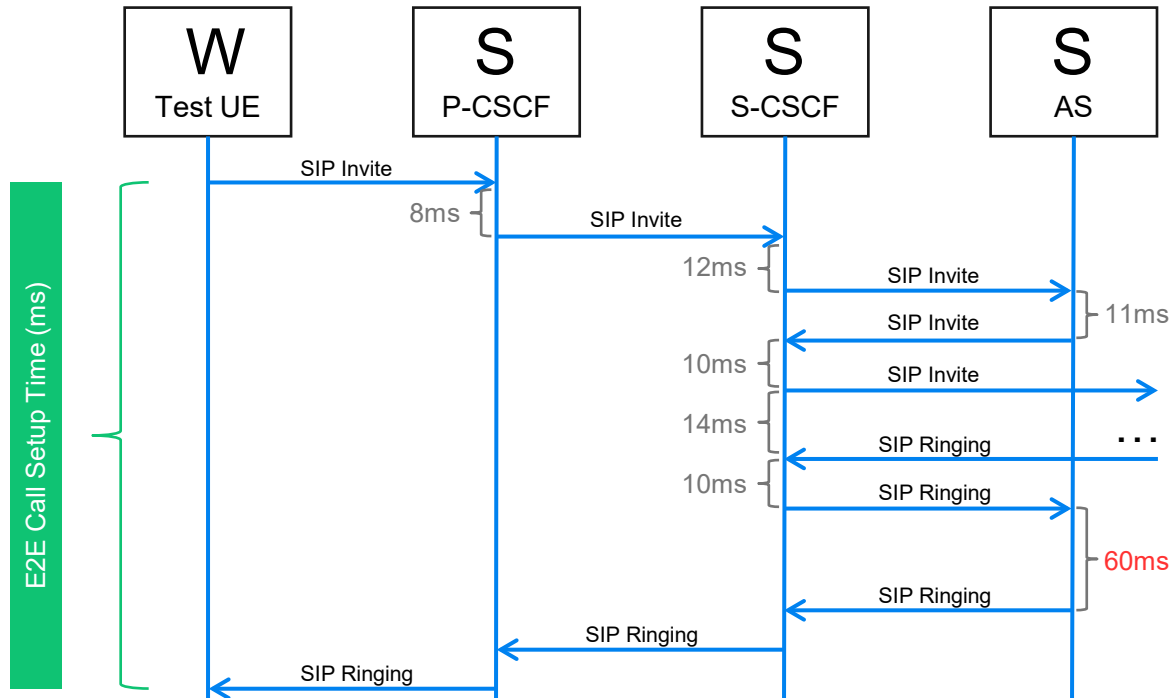
SIP Headers

Root Cause

Final Message = Result

Event Based monitoring - example

KPI calculation breakdown, scenario: E2E Call Setup Time for a 5G call takes too long. Breakdown to node contribution



CST KPI limit: 100ms | Measured value: **150ms**

EBM Record

```

EventRecordHeader
  Result: Successful
  Node: P-CSCF
  Event: Session Setup

EventInfo
  <SIPMessages>
    <INVITE> in Time: 2023.09.10 10:30:10.480
    <INVITE> out Time: 2023.09.10 10:30:10.488
    <Ringing> in Time: 2023.09.10 10:30:10.615
    <Ringing> out Time: 2023.09.10 10:30:10.623
  
```

Timestamps

```

EventRecordHeader
  Result: Successful
  Node: Application Server
  Event: Session Setup

EventInfo
  <SIPMessages>
    <INVITE> in Time: 2023.09.10 10:30:10.500
    <INVITE> out Time: 2023.09.10 10:30:10.511
    <Ringing> in Time: 2023.09.10 10:30:10.545
    <Ringing> out Time: 2023.09.10 10:30:10.605
  
```

KPI calculation in post processing tools

Useability



Reporting near real time any end user's relevant activity in form of events.

Can be used for:

- Real time monitoring and insight of the network
- Troubleshooting
- Exposing the end to end activity of a multi-domain network
- End-to-end KPI calculation (call success rate, call setup time, failure rate, etc.)
- SLA enforcement
- Input to network management automation

The screenshot displays the 'Analytics' section of a data collection and analysis tool. It is divided into three main panels: 'All events', 'All failures', and 'Details'.

All events: A table with columns for DC name, Event type, Count, and Percentage. The data is as follows:

DC name	Event type	Count	Percentage
Schedule	IMS_SES_SESSION_SETUP_ORIG	166234	39%
Schedule	IMS_SES_SESSION_SETUP_TERM	42089	10%
Schedule	IMS_SES_SESSION_INIT_ORIG	166023	39%
Schedule	IMS_SES_SESSION_INIT_TERM	41885	10%

Failure distribution: A table with columns for Hexadecimal code, Failures(#), and Percentage. The data is as follows:

Hexadecimal code	Failures(#)	Percentage
040351931	120295	94.59%
N/A	3824	3.01%
030351966	3060	2.41%

All failures: A table with columns for DC name, Event type, and Error code. The data is as follows:

DC name	Event type	Error code
Schedule	IMS_SES_SESSION_SETUP_ORIG	502 (Bad DNS Request)
Schedule	IMS_SES_SESSION_SETUP_ORIG	500 (Server Internal Err)
Schedule	IMS_SES_SESSION_SETUP_ORIG	480 (Called User Not Re)
Schedule	IMS_SES_SESSION_SETUP_TERM	480 (Called User Not Re)
Schedule	IMS_SES_SESSION_SETUP_ORIG	503 (CSCF Server Interr)
Schedule	IMS_SES_SESSION_SETUP_ORIG	500 (CSCF Server Interr)

Details: A table with columns for DC name, Start time, End time, Event type, Error code, and Warning. The data is as follows:

DC name	Start time	End time	Event type	Error code	Warning
Schedule	2023-07-19 17:58:59.944	2023-07-19 17:59:00.070	IMS_SES_SESSION_SETUP_ORIG	502 (Bad DNS Request)	N/A
Schedule	2023-07-19 17:58:59.945	2023-07-19 17:59:00.086	IMS_SES_SESSION_SETUP_ORIG	502 (Bad DNS Request)	N/A
Schedule	2023-07-19 17:59:00.177	2023-07-19 17:59:00.317	IMS_SES_SESSION_SETUP_ORIG	502 (Bad DNS Request)	N/A

Summary and takeaway

Monitoring and troubleshooting for all signaling interfaces in mobile network

One record ✓

Per event, per network element, containing all relevant information

Insight ✓

Real-time monitoring of the network elements and encrypted communication

Error pin-point ✓

Automated support for troubleshooting

Test support ✓

Improve analysis, troubleshooting, evaluation and helps in correction

Future

Automated proposals for error correction

- Utilize AI/ML technics

Prediction and automation of repair

- Close the loop for automation

Any further questions?

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