



BIG DATA INTERPRETATION AND CHALLENGES IN MOBILE NETWORK TESTING

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TESTING CHALLENGES

MOBILE TELEPHONY NETWORK



- **Network elements**
 - Separate software instances
- **Network**
 - Connection of network elements
 - Communication according to standards

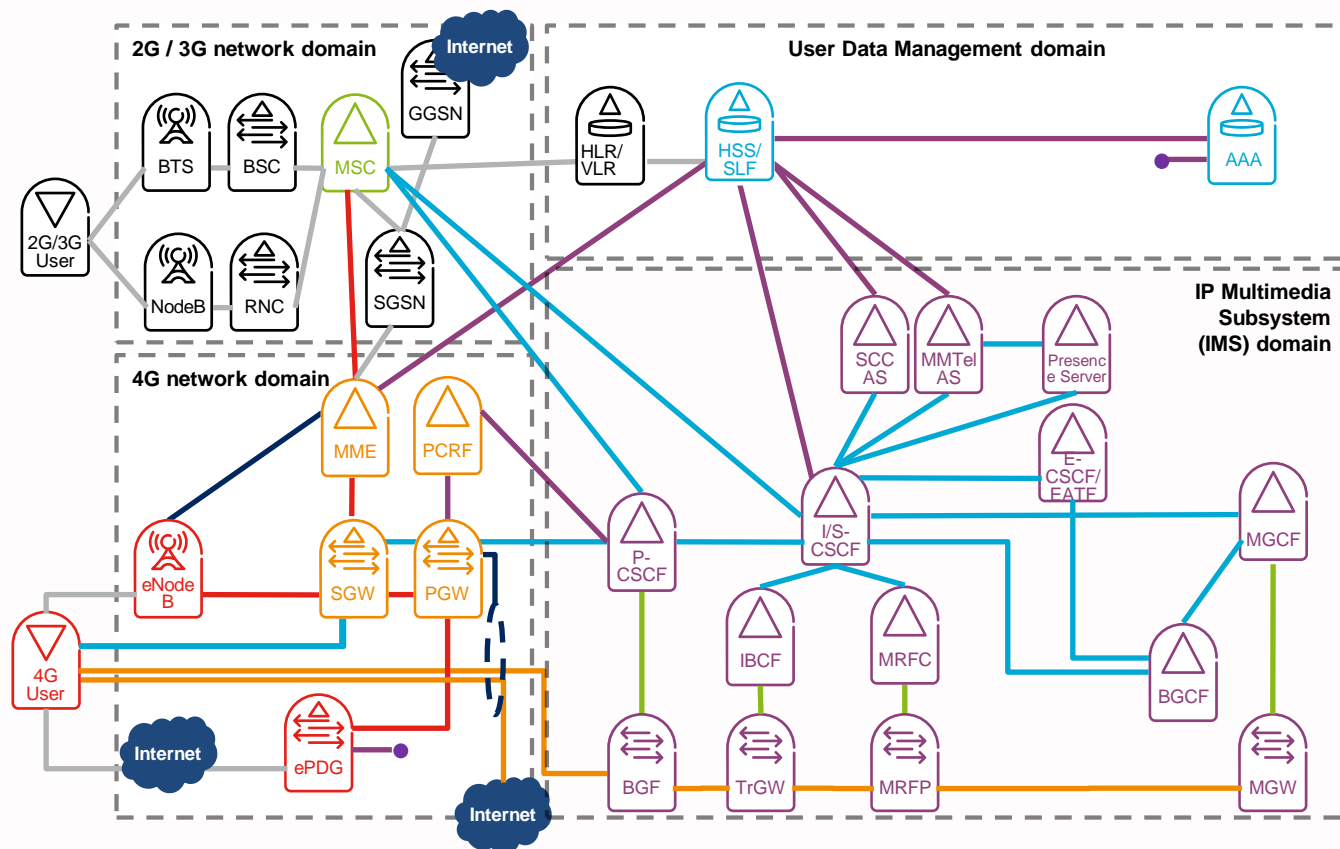


TESTING CHALLENGES

COMPLEXITY GROWTH

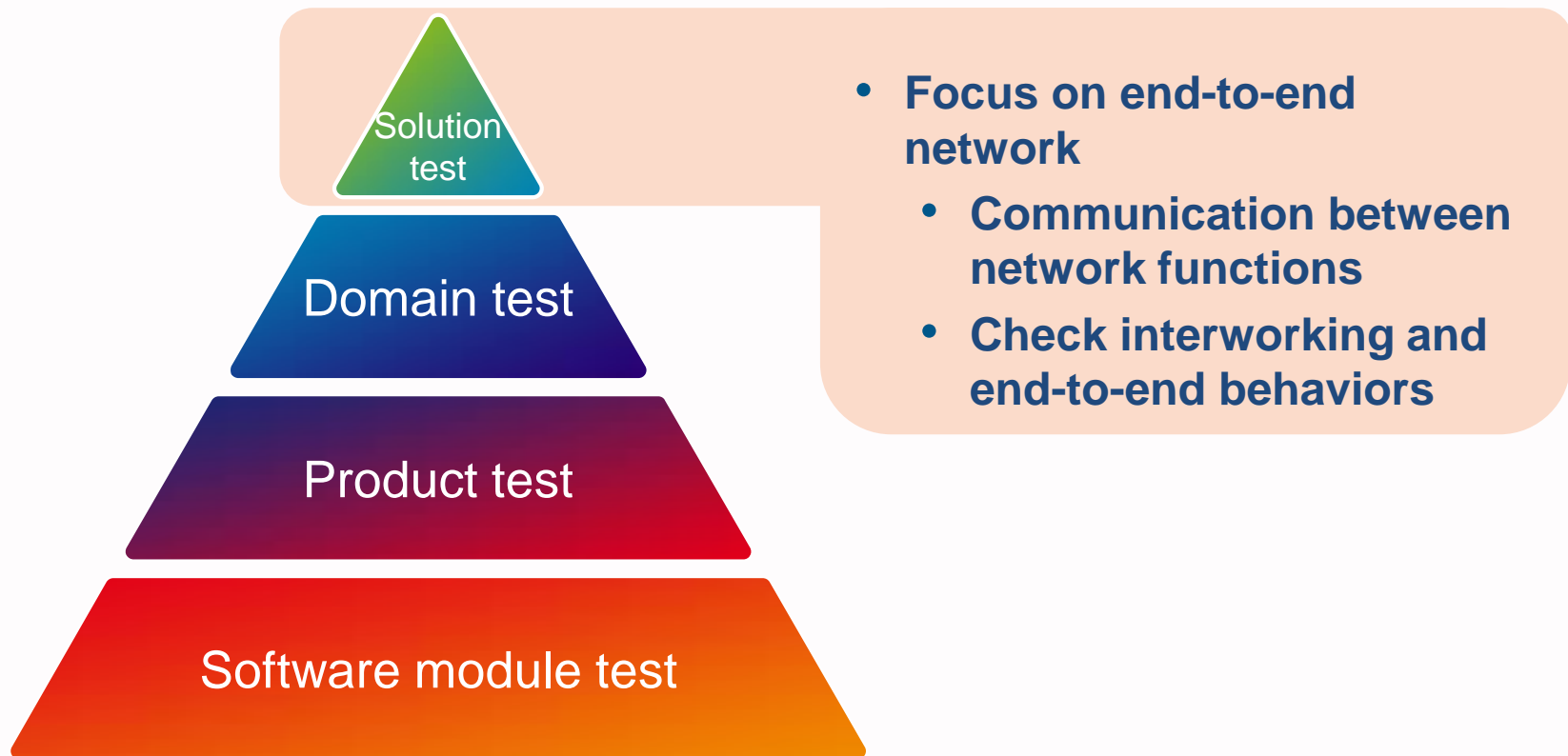
2G
3G
4G (LTE)
Voice over 4G (VoLTE)
Voice over WiFi

**More complex
network
architecture
=
MORE TESTING**



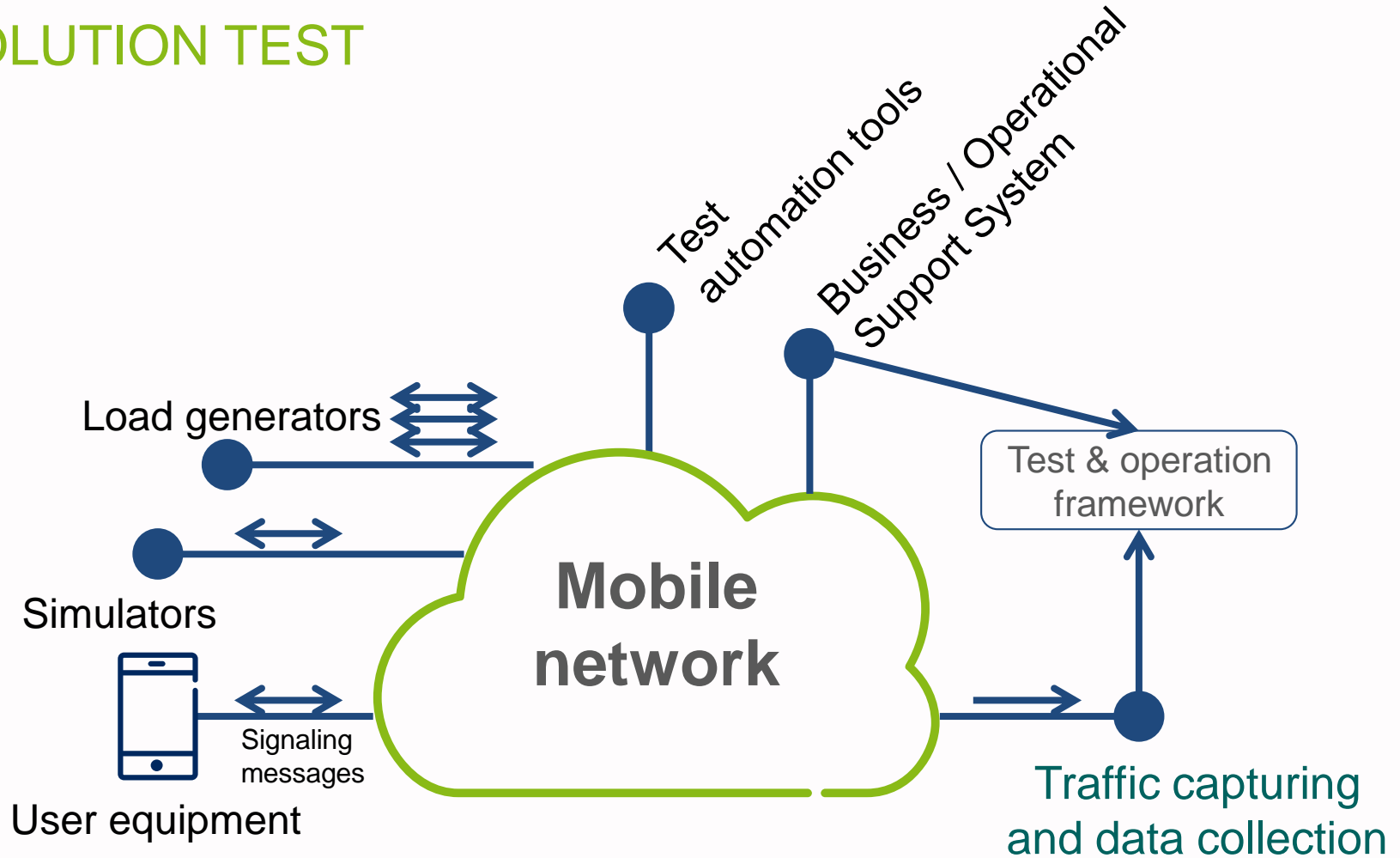
TESTING CHALLENGES

TEST LEVELS IN MOBILE NETWORK DEVELOPMENT



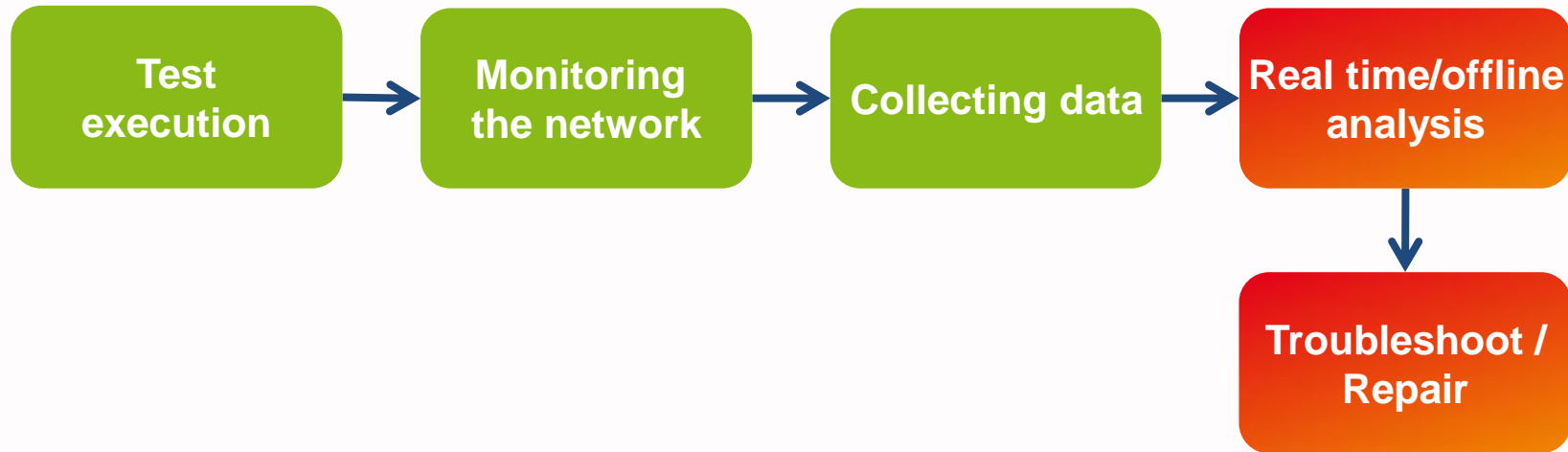
TESTING CHALLENGES

SOLUTION TEST



BEYOND TESTING AFTER TEST EXECUTION

- Automation of steps is required!

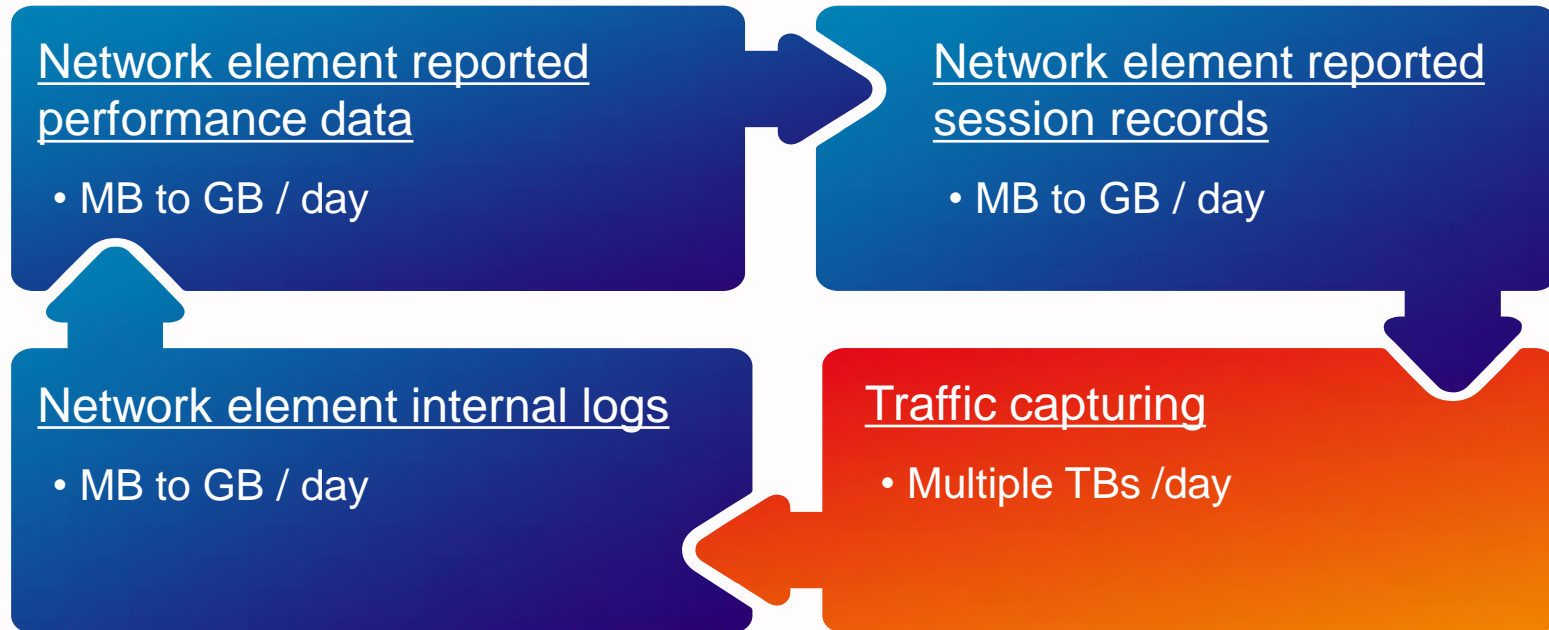


Focus

**Automated analysis, troubleshoot
and repair based on collected data**

BEYOND TESTING

DATA COLLECTION



SUM data size: „Small” VoLTE network = ~1-2 TByte/day

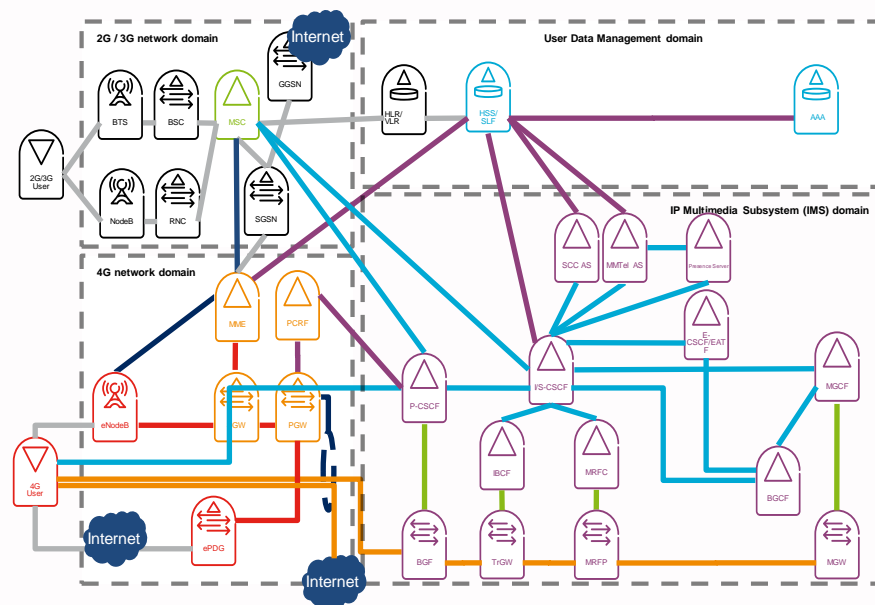
Example: 300+ application level messages per VoLTE call

BEYOND TESTING

DATA COLLECTION – TRAFFIC CAPTURING

„How do we get the data?”

- **Monitoring**
 - Various points of the network
 - Collect signaling messages
- **The gathered data**
 - Linear list of messages
 - Not certainly in the expected order



BEYOND TESTING

CORRELATION – THE TRADITIONAL METHOD

No.	Time	Source	Destination	Protocol	Length	Info
228	4.843066	10.196.84.6	10.196.21.2	SIAP/NAS-E	206	id-initialUEMessage, Attach request, PDN connectivity request
229	4.845876	10.196.14.7	10.196.48.81	GTPV2	328	Create Session Request
230	4.867842	10.196.48.81	10.196.14.7	GTPV2	170	Create Session Response
235	4.904409	10.196.21.2	10.196.84.6	SIAP/NAS-E	306	id-InitialContextSetup, InitialContextSetupRequest
243	4.964386	10.196.84.6	10.196.21.2	SIAP	126	id-UECapabilityInfoIndicationUECapabilityInformation
248	5.004145	10.196.84.6	10.196.21.2	SIAP	106	id-InitialContextSetup, InitialContextSetupResponse
250	5.044712	10.196.84.6	10.196.21.2	SIAP/NAS-E	126	id-uplinkNASTransport
251	5.045572	10.196.14.7	10.196.48.33	GTPV2	81	Modify Bearer Request
252	5.046907	10.196.48.33	10.196.14.7	GTPV2	93	Modify Bearer Response
253	5.063378	10.196.21.2	10.196.84.6	SIAP/NAS-E	134	SACK id-downlinkNASTransport
261	5.173910	10.196.84.6	10.196.21.2	SIAP/NAS-E	162	id-uplinkNASTransport
262	5.175137	10.196.14.7	10.196.48.33	GTPV2	299	Create Session Request
263	5.196283	10.196.60.130	10.196.7.67	DIAMETER	842	cmd=Credit-Control Request(272) flags=RP-- appl=3GPP Gx(16777238)
264	5.212373	10.196.7.67	10.196.60.130	DIAMETER	546	cmd=Credit-Control Answer(272) flags=-P-- appl=3GPP Gx(16777238)
266	5.213256	10.196.48.33	10.196.14.7	GTPV2	226	Create Session Response
268	5.227379	10.196.21.2	10.196.84.6	SIAP/NAS-E	238	id-E-RABSetup, E-RABSetupRequest
274	5.264225	10.196.84.6	10.196.21.2	SIAP	106	id-E-RABSetup, E-RABSetupResponse
275	5.264339	10.196.84.6	10.196.21.2	SIAP/NAS-E	122	id-uplinkNASTransport
277	5.265156	10.196.14.7	10.196.48.33	GTPV2	81	Modify Bearer Request
278	5.266300	10.196.48.33	10.196.14.7	GTPV2	93	Modify Bearer Response
291	5.451528	10.248.0.8	10.196.29.129	SIP	970	Request: REGISTER sip:ims.mnc080.mcc262.3gppnetwork.org (1 bir
292	5.454446	10.196.7.41	icscf001.lmera.eric	SIP	1260	Request: REGISTER sip:ims.mnc080.mcc262.3gppnetwork.org (1 bir
293	5.457131	10.196.7.37	10.196.39.7	DIAMETER	530	cmd=User-Authorization Request(300) flags=RP-- appl=3GPP Cx(167
311	5.625923	10.196.39.7	10.196.7.37	DIAMETER	374	cmd=User-Authorization Answer(300) flags=-P-- appl=3GPP Cx(1677
318	5.629996	icscf001.lmera.eric	scscf002.lmera.eric	SIP	214	Request: REGISTER sip:scscf002.lmera.ericsson.se:5060 (1 bindi
321	5.634563	scscf002.lmera.eric	10.196.7.7	DIAMETER	530	cmd=Multimedia-Auth Request(303) flags=RP-- appl=3GPP Cx(167772
331	5.853035	10.196.7.7	scscf002.lmera.eric	DIAMETER	606	cmd=Multimedia-Auth Answer(303) flags=-P-- appl=3GPP Cx(1677723
332	5.854603	scscf002.lmera.eric	icscf001.lmera.eric	SIP	916	Status: 401 Unauthorized
333	5.855656	icscf001.lmera.eric	10.196.7.41	SIP	769	Status: 401 Unauthorized
334	5.858160	10.196.29.129	10.248.0.8	SIP	729	Status: 401 Unauthorized
358	6.122634	10.248.0.8	10.196.29.129	STP	1334	Request: REGISTER sip:ims.mnc080.mcc262.3gppnetwork.org (1 bir

Frame 228: 206 bytes on wire (1648 bits), 206 bytes captured (1648 bits)

Ethernet II, Src: MS-NLB-PhysServer-02_07:17:e8 (02:02:00:07:17:e8), Dst: Ericsson_e4:a4:2b (3c:19:7d:e4:a4:2b)

Internet Protocol Version 4, Src: 10.196.84.6 (10.196.84.6), Dst: 10.196.21.2 (10.196.21.2)

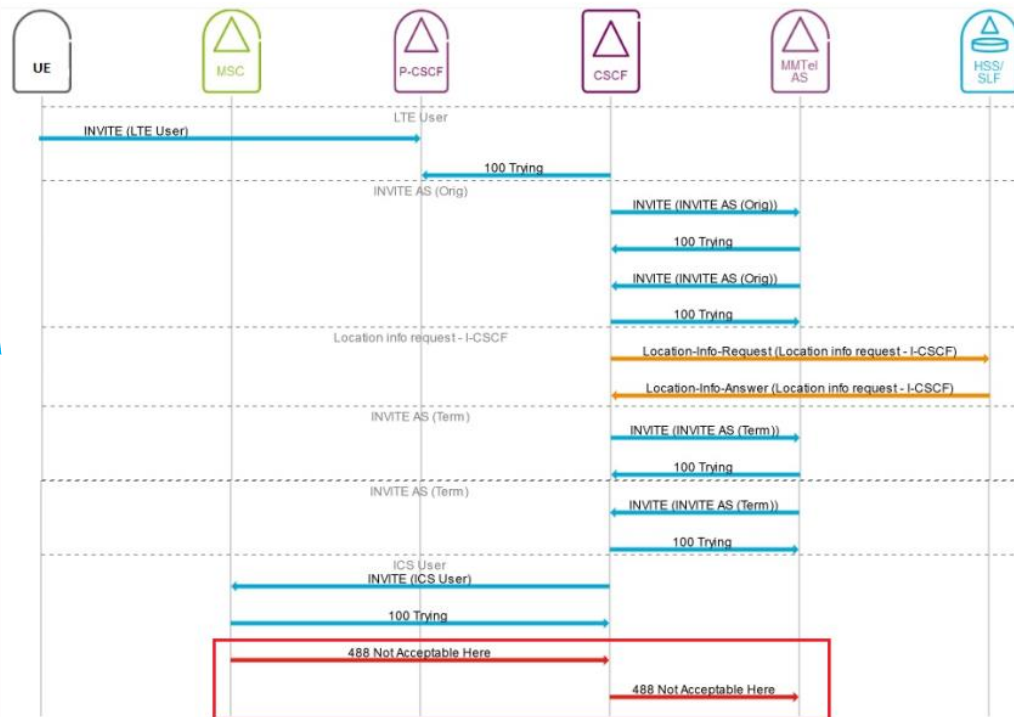
Stream Control Transmission Protocol, Src Port: x2-control (36422), Dst Port: s1-control (36412)

S1 Application Protocol

- **FIND is the keyword**
- **Incoming data**
 - No structure
 - Flows can overlap
- **Troubleshooting**
 - Time consuming
 - Prone to errors

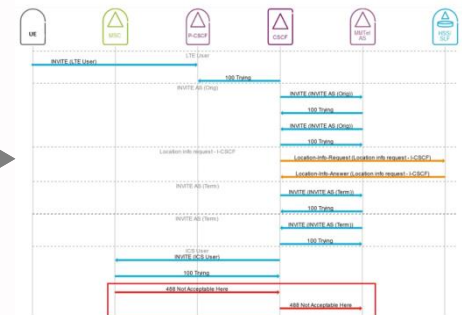
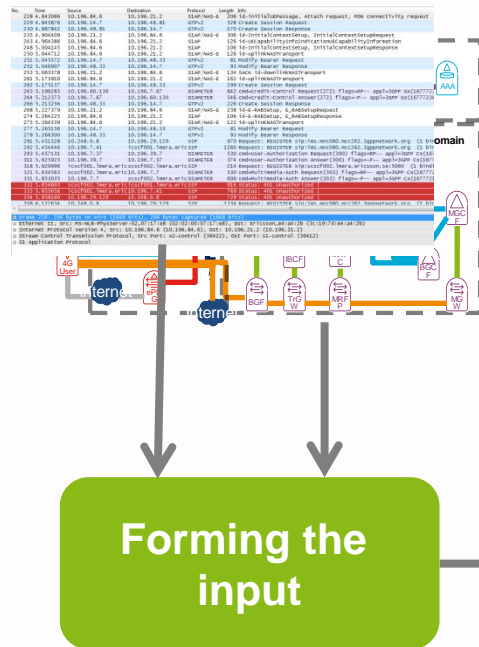
BEYOND TESTING CORRELATION – STRUCTURING THE DATA

No.	Time	Source	Destination	Protocol	Length	Info
228	4.843066	10.196.84.6	10.196.21.2	SLAP/NAS-E	206	1d-InitialUppmessage, Attach request, PDN connectivity request
229	4.843070	10.196.14.7	10.196.48.81	GTPV2	128	Create Session Request
230	4.867882	10.196.48.81	10.196.14.7	GTPV2	170	Create Session Response
231	4.864409	10.196.21.2	10.196.84.6	SLAP/NAS-E	306	1d-InitialContextSetup, InitialContextSetupRequest
241	4.864886	10.196.84.6	10.196.21.2	SLAP	138	1d-InitialContextSetup, InitialContextSetupResponse
248	5.004145	10.196.84.6	10.196.21.2	SLAP	106	1d-InitialContextSetup, InitialContextSetupResponse
250	5.044712	10.196.84.6	10.196.21.2	SLAP/NAS-E	138	1d-uplinkTransport
251	5.045572	10.196.14.7	10.196.48.33	GTPV2	83	Modify Bearer Request
252	5.045807	10.196.48.33	10.196.14.7	GTPV2	83	Modify Bearer Response
253	5.063378	10.196.21.2	10.196.84.6	SLAP/NAS-E	134	SACK 1d-downlinkTransport
261	5.173810	10.196.84.6	10.196.21.2	SLAP/NAS-E	142	1d-uplinkTransport
262	5.173337	10.196.14.7	10.196.48.33	GTPV2	299	Create Session Request
263	5.180281	10.196.60.130	10.196.7.67	Diameter	842	cmdcref-ctrl Request (272) Flags=... appl=3GPP ox(1677721)
264	5.212373	10.196.7.67	10.196.60.130	Diameter	546	cmdcref-ctrl Answer (272) Flags=... appl=3GPP ox(1677721)
266	5.212376	10.196.48.33	10.196.14.7	GTPV2	228	Create Session Response
268	5.227379	10.196.21.2	10.196.84.6	SLAP/NAS-E	238	1d-e-RABSetup, e-RABSetupRequest
274	5.264225	10.196.84.6	10.196.21.2	SLAP	106	1d-e-RABSetup, e-RABSetupResponse
275	5.264339	10.196.84.6	10.196.21.2	SLAP/NAS-E	122	1d-uplinkTransport
277	5.265356	10.196.14.7	10.196.48.33	GTPV2	83	Modify Bearer Request
278	5.265360	10.196.48.33	10.196.14.7	GTPV2	83	Modify Bearer Response
280	5.451528	10.248.0.8	10.196.29.129	HTTP	1280	Request: REGISTER sip:196.29.129.129,mc262.3gppnetwork.org (1 bit)
282	5.454446	10.196.7.41	10.196.29.7	Diameter	374	cmd-user-authorization Answer (300) Flags=... appl=3GPP ox(487)
293	5.457121	10.196.7.37	10.196.29.7	Diameter	224	Request: REGISTER sip:196.29.7,mc262.3gppnetwork.org (1 bit)
311	5.625921	10.196.39.7	10.196.7.37	Diameter	374	cmd-user-authorization Answer (300) Flags=... appl=3GPP ox(487)
318	5.625996	10.196.39.7	10.196.7.37	Diameter	224	Request: REGISTER sip:196.39.7,mc262.3gppnetwork.org (1 bit)
321	5.634561	10.196.7.7	10.196.7.7	Diameter	530	cmd-multimedia-auth Answer (303) Flags=... appl=3GPP ox(1677721)
323	5.635019	10.196.7.7	10.196.7.7	Diameter	609	cmd-multimedia-auth Answer (303) Flags=... appl=3GPP ox(1677721)
332	5.834093	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
333	5.834101	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
334	5.834109	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
335	5.834117	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
336	5.834125	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
337	5.834133	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
338	5.834141	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
339	5.834149	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
340	5.834157	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
341	5.834165	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
342	5.834173	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
343	5.834181	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
344	5.834189	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
345	5.834197	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
346	5.834205	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
347	5.834213	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
348	5.834221	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
349	5.834229	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
350	5.834237	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
351	5.834245	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
352	5.834253	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
353	5.834261	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
354	5.834269	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
355	5.834277	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
356	5.834285	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
357	5.834293	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
358	5.834301	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
359	5.834309	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
360	5.834317	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
361	5.834325	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
362	5.834333	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
363	5.834341	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
364	5.834349	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
365	5.834357	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
366	5.834365	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
367	5.834373	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
368	5.834381	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
369	5.834389	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
370	5.834397	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
371	5.834405	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
372	5.834413	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
373	5.834421	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
374	5.834429	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
375	5.834437	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
376	5.834445	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
377	5.834453	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
378	5.834461	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
379	5.834469	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
380	5.834477	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
381	5.834485	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
382	5.834493	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
383	5.834501	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
384	5.834509	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
385	5.834517	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
386	5.834525	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
387	5.834533	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
388	5.834541	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
389	5.834549	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
390	5.834557	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
391	5.834565	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
392	5.834573	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
393	5.834581	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
394	5.834589	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
395	5.834597	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
396	5.834605	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
397	5.834613	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
398	5.834621	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
399	5.834629	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable
400	5.834637	10.196.7.7	10.196.7.7	Diameter	456	Status: 400 Unavailable



- Correlated data
- Assembled flows
- With grouping and filtering options
- Placed in the network

BEYOND TESTING CORRELATION – SIMPLIFIED WORKFLOW



BEYOND TESTING

CORRELATION – BIG DATA PROCESSING

Forming the
input

- The tasks can be a separate services
 - Services can run parallel or pipelined parallel
 - Multiple instances can be started

Intra-protocol
correlation

Inter-protocol
correlation

- Real-time processing is achievable
 - Micro-batch processing
 - Same algorithm for offline and online processing

Connect flows
to end-user

"Information must be correlated"

BEYOND TESTING

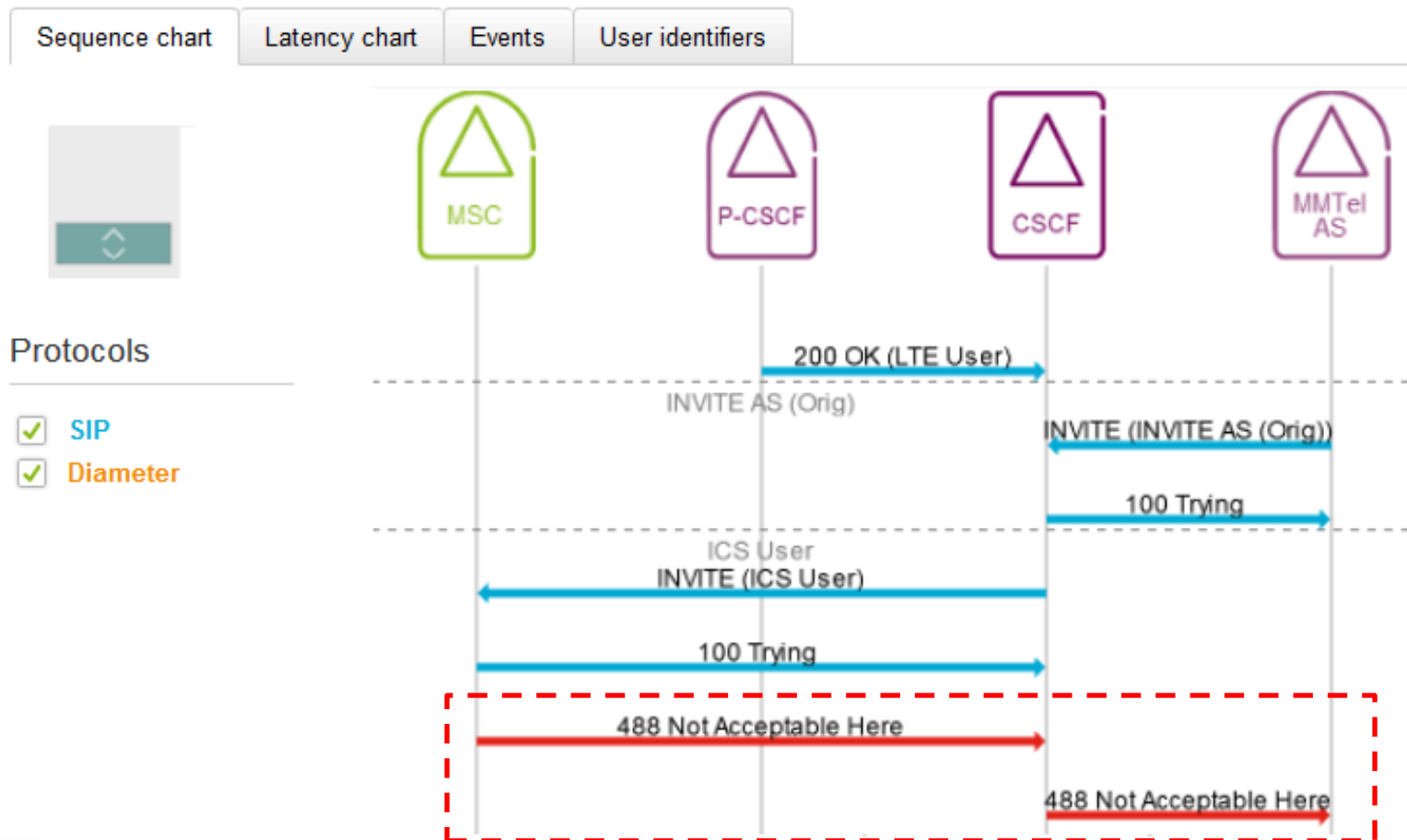
BIG DATA FRAMEWORKS – WHAT DO WE USE?

- **Own platform**
 - Helps to develop, test, maintain applications using Big Data technologies
 - Gathers open source frameworks
- **Used frameworks**
 - Processing: Hadoop MapReduce, Apache Storm, Apache Spark
 - Messaging: ZeroMQ, Apache Kafka
 - Misc.: Hadoop HDFS, Apache HBase, Apache Phoenix



EXAMPLE

VoLTE Call reference call-flow type **Error**



TAKEAWAY

**Focus on end-to-end
system behavior and drill
down to the details**

**Automation of data
collection, analysis and
troubleshooting**

**Multi-stage correlation to
parallelly process diverse
data**

**Common solution for
offline and online analysis**



QUESTIONS & ANSWER

Thank you for your attention.

COME AND SEE OUR DEMO