

SYSTEMICS Group

ITU Workshop on Performance,

QoS and QoE

Dakar, Senegal, 19-March 2018

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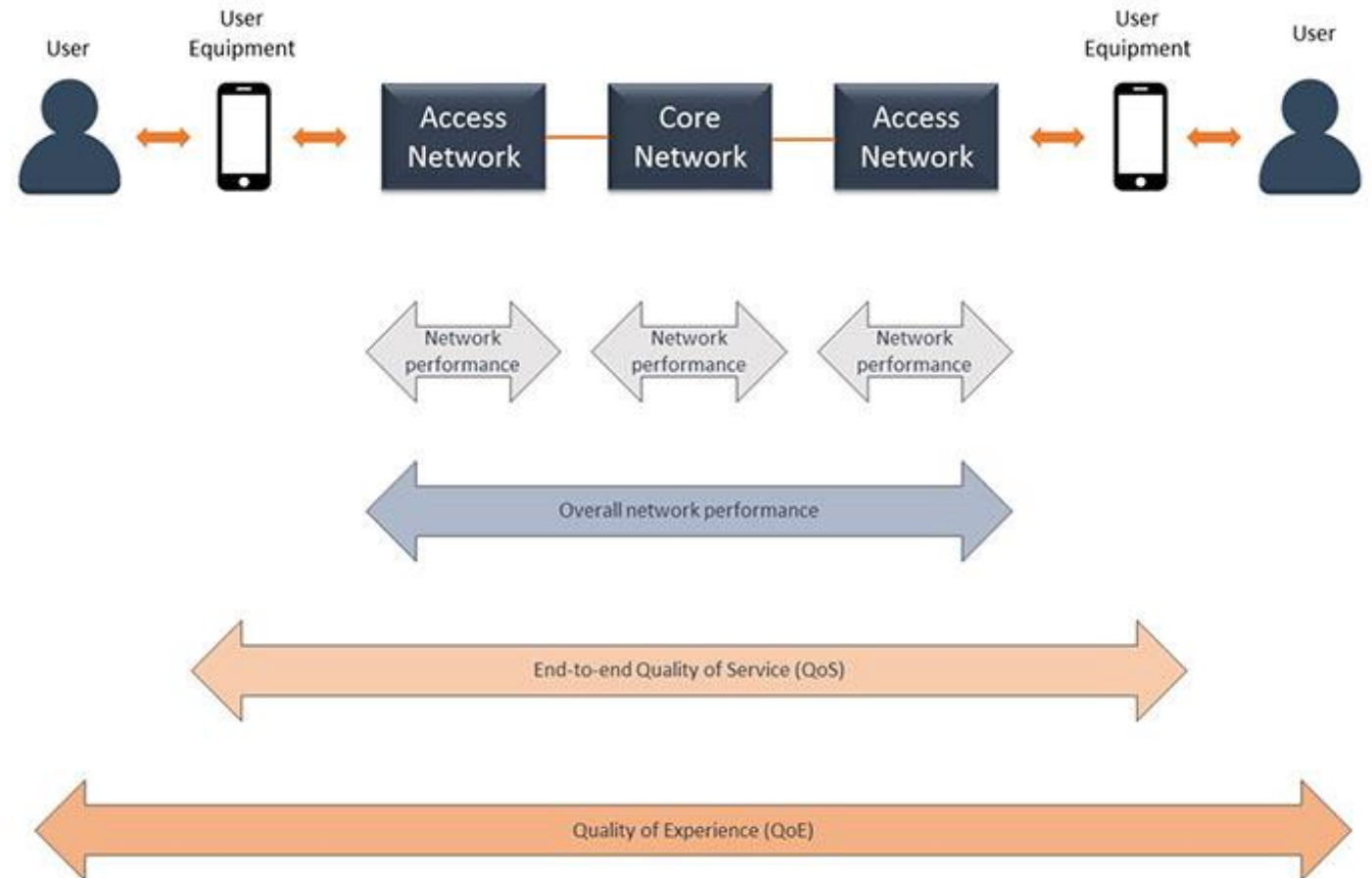
GLOBAL PROVIDER OF NETWORK QUALITY SOLUTIONS

- 12 | ▶ Locations worldwide
- 30 | ▶ Years of experience
- 200 | ▶ Professional experts
- 20 % | ▶ Year-on-Year Growth
- 80 | ▶ Customers in over 40 countries
- 4 | ▶ R&D centres in Poland, Greece, Germany and Switzerland



Overview of Performance, QoS and QoE solutions

- » Network performance = Access Network + Core Network
- » QoS = Network performance + User Equipment
- » QoE = QoS + User
- » So
 - NP parameters determine the QoS
 - QoS parameters determine the QoE
 - NP parameters ultimately determine the QoS/QoE
 - Careful with use of QoE KPI to conclude on NP or QoS



Overview of Performance, QoS and QoE solutions

» KPIs

→ Selected indicators that give a quantification of performance for different services

» QoS

→ Totality of characteristics of a telecommunications service that bear on its ability to satisfy stated and implied needs of the user of the service (ETSI TS 102 250-1)

» QoE

→ Overall acceptability of an application or service, as perceived subjectively by the end-user (ETSI TR 102 643)

Methodologies/QoS Parameters

» Different and complementary approaches to Mobile QoS

→ Intrusive tests

→ Stationary tests with an installed grid of probes

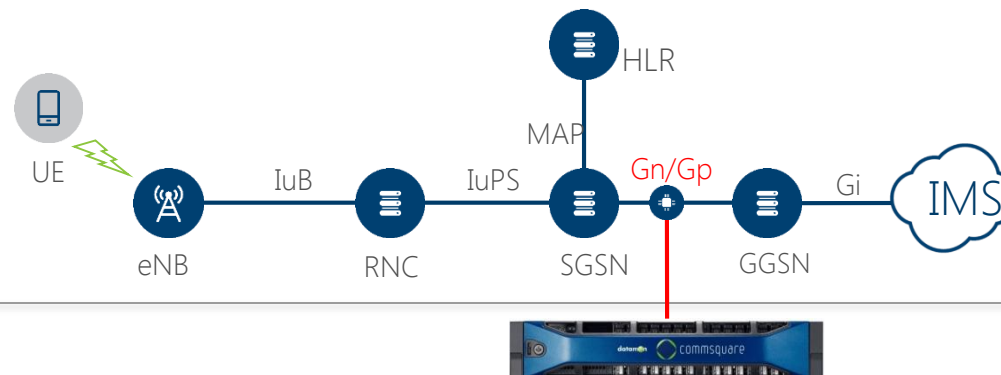
→ Walk/Hot Spot/Railway tests

→ Drive tests with cars

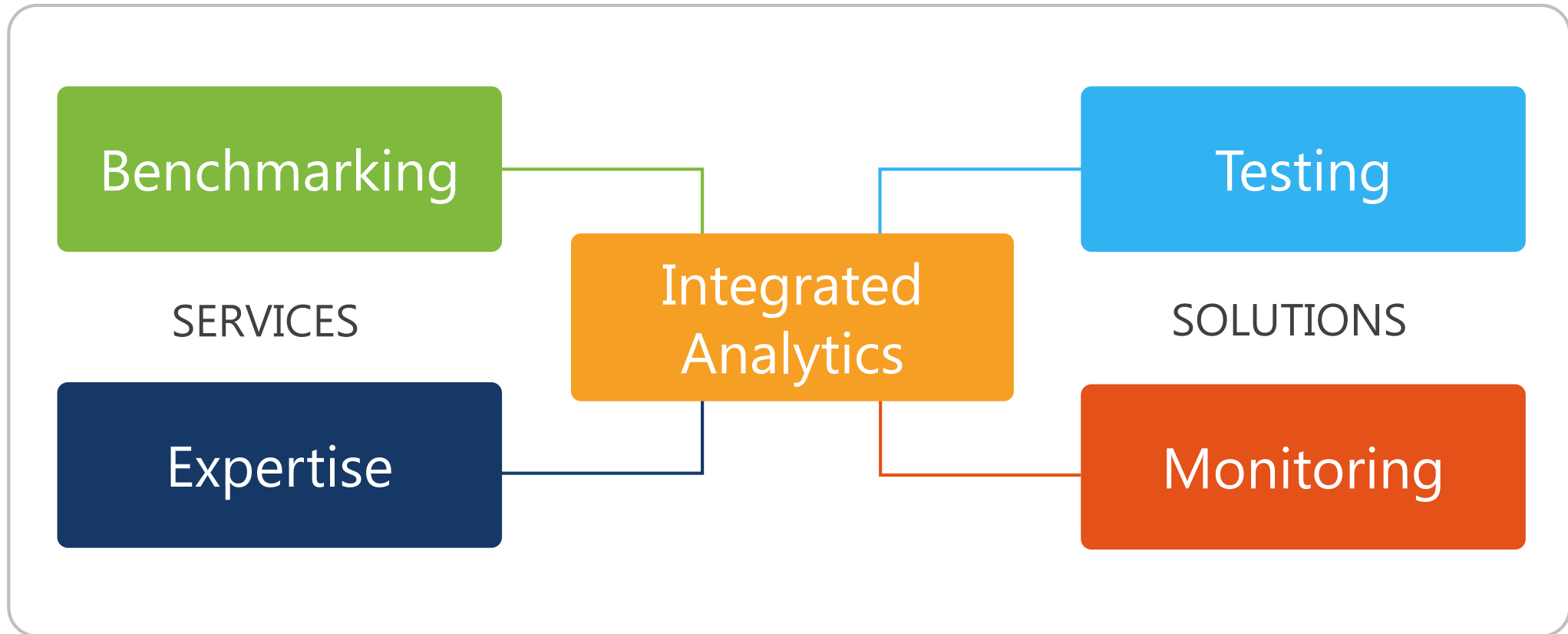
→ Crowdsourcing (take QoE into account)

→ Network counters from NMS

→ Passive probing

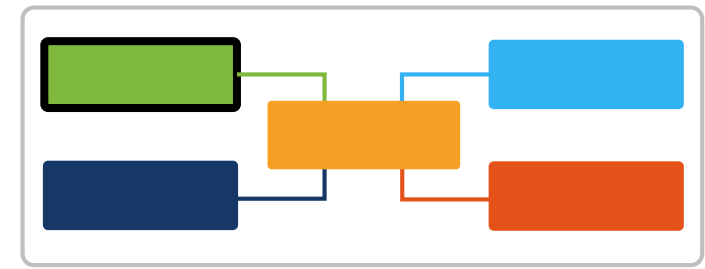


Mapping Performance, QoS and QoE solutions



National benchmarking addressing regulators requirements

- » Use of state-of-the art benchmarking equipment allowing testing of latest technologies and terminals
- » Emphasis on testing KPIs defined in mobile operators licenses
- » Priorities on coverage and Quality of Services
- » Technical analysis of collected data to explain results to operators
- » Validated KPIs that can stand court
- » ISO 9001:2015 certified
 - Measurements in telecommunications networks
- » KPI scoring mechanism according to ETSI standardisation
- » Versatile reporting: BI tools, customized reports, maps, web portal

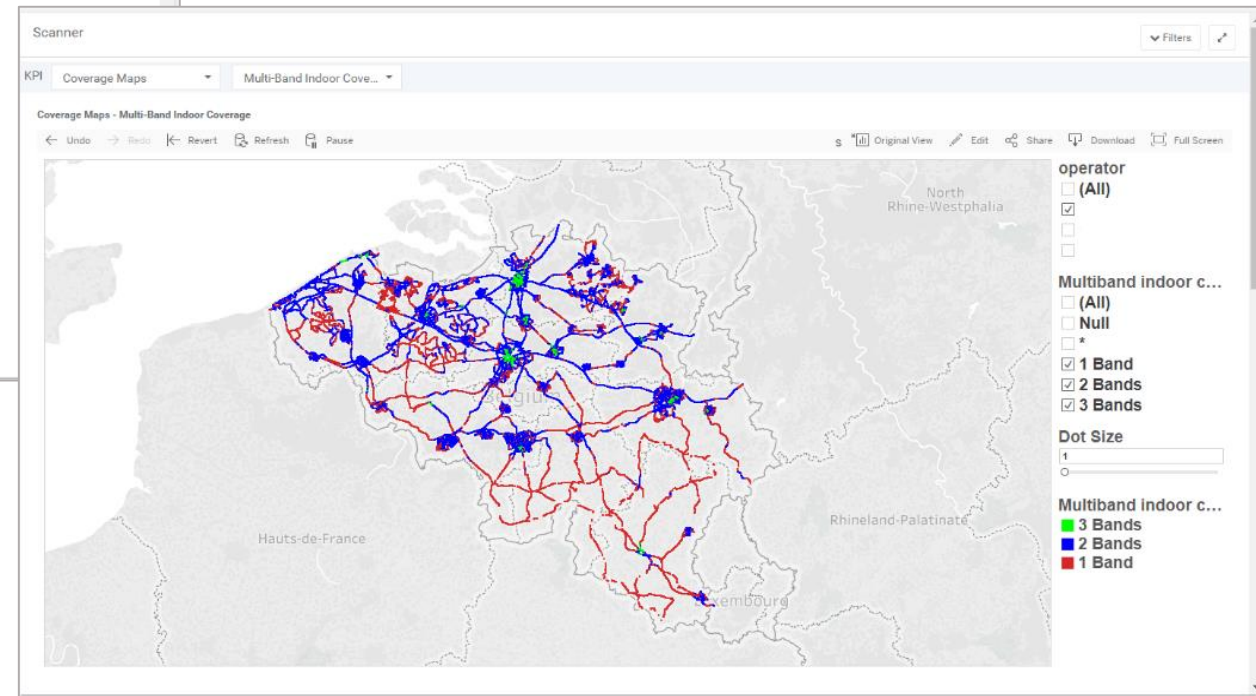
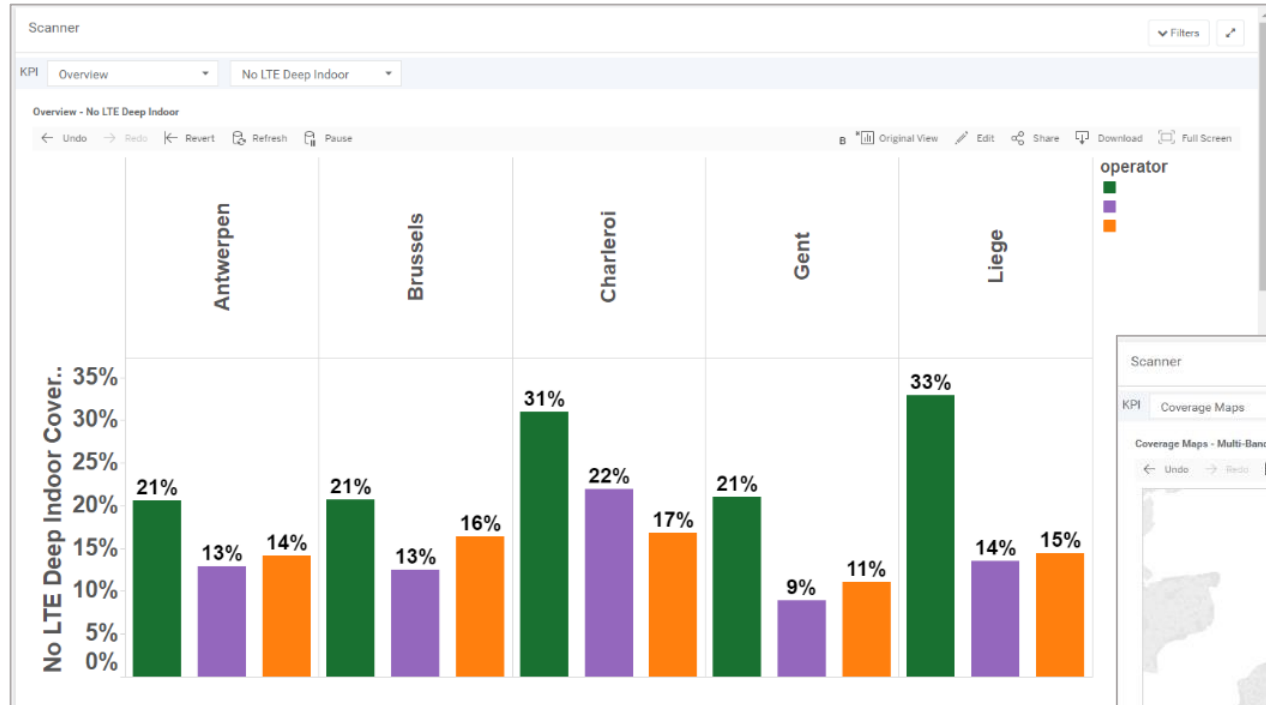


Measurement Accuracy

- » ETSI standards used TS 102 250 , TR 102 678
- » ITU-T standards used P.800, P.863
- » Statistical theory applied
 - Number of test calls representative for
 - ⊕ Population density
 - ⊕ Measurement routes
 - ⊕ Measurement hours
 - Number of measurement calls depends on the reliability of the results
 - ⊕ Required confidence level
 - ⊕ Fault margin of the used equipment
- » Standard assumptions
 - Measurement error < 3%
 - Confidence level > 95%
 - The span of the confidence interval is 1.28%
 - This results in 1,080 calls per technology
 - ⊕ Source: ETSI TS 102 250-6 V1.2.1 (2004-10), Pearson-Clopper formula

Interactive Reporting with a BART tool

BART = Benchmarking Analysis & Reporting Tool Web GUI



- » Graphs, tables and maps
- » Scoring results
- » Engineering analysis
- » Smart filtering and export capabilities

Analytics - Interactive Portal - Serbia



CHOOSE TEST

Voice Service ▾

AGGREGATION

All ▾

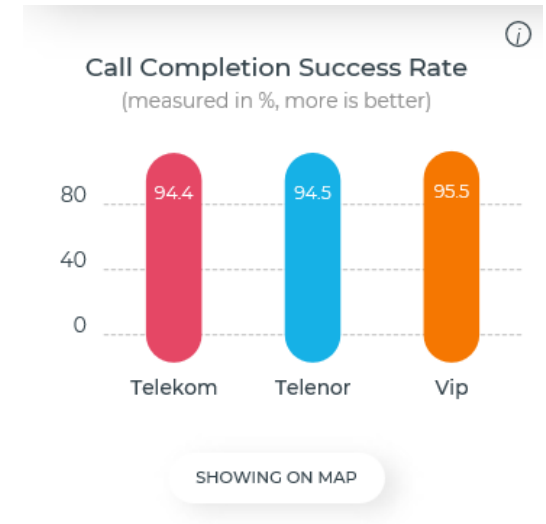
SINGLE LOCATION

All ▾

TECHNOLOGY

All Mixed 2G 3G

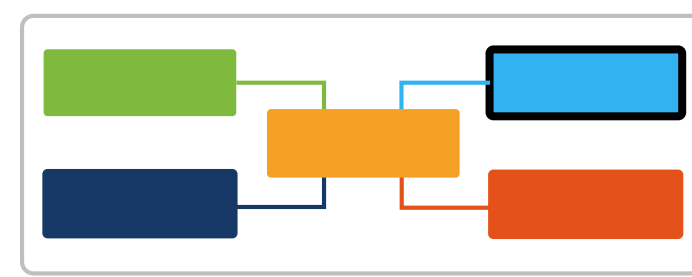
- » RATEL Serbia
- » Publically available website
- » Results presented on the map
- » Freely selectable filter criteria
- » Intuitive user friendly GUI
- » Zooming down to the street level
- » Comparative operators results
- » <http://benchmark.ratel.rs/en/portal>



SHOW Failed calls

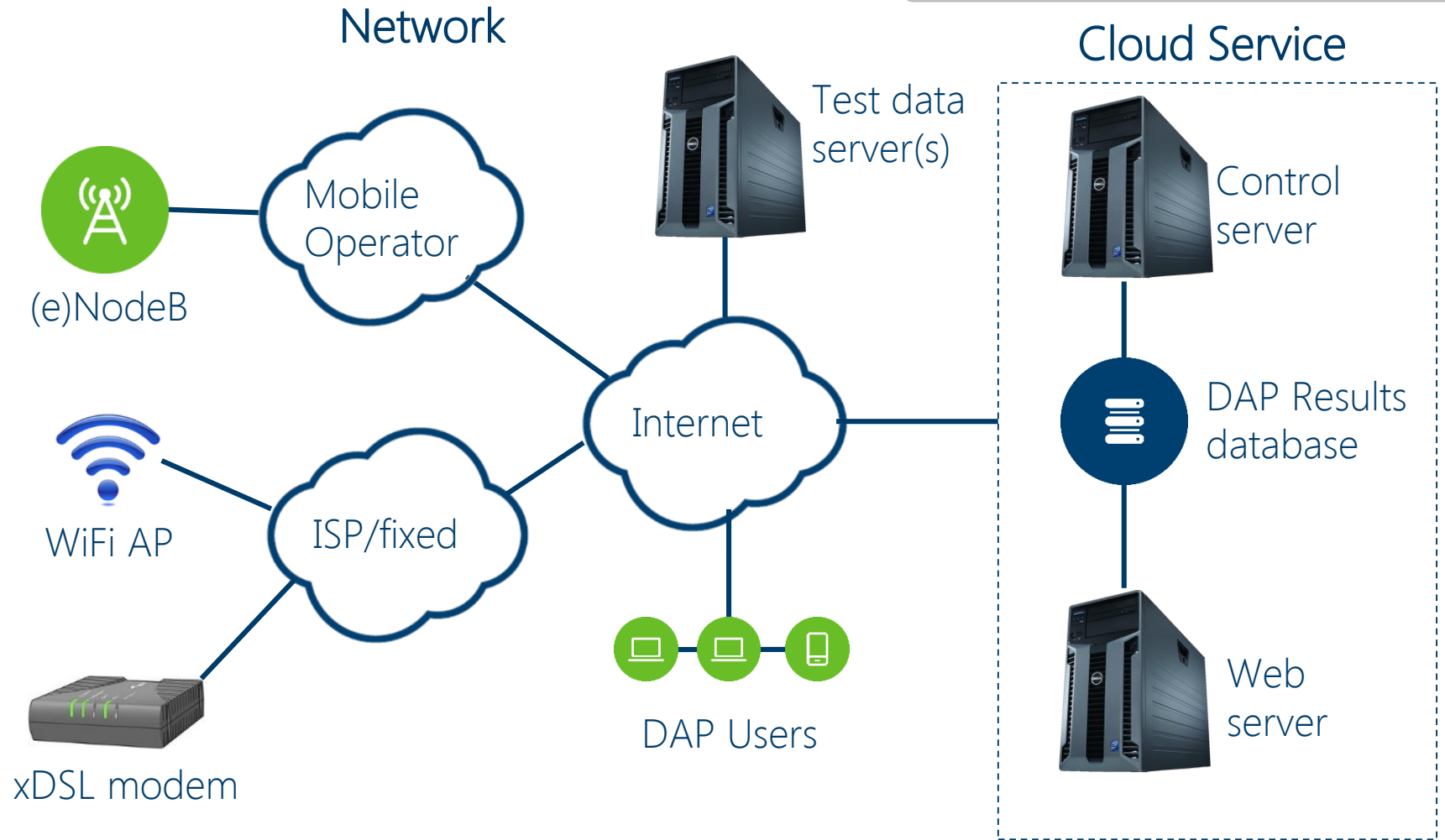
Dropped calls

Active testing – Distributed Active Probes



DAP Active probes

- » Mobile Smartphone DAP App (Android)
- » WiFi
- » Mobile Single-SIM
- » Fixed Line
- » WiFi
- » Mobile Multi-SIM
- » Fixed Line
- » WiFi



Technologies & Services supported

» Technologies

2G/3G/LTE/Freemode

up to 8 SIMs per probe

WiFi 802.11 a/b/g/n/ac

Up to 3 fixed lines (1Gbps) per probe

Support for IPv4 & IPv6

» Data Services:

→ File Transfer:

⌚ HTTP file DL and UL

⌚ FTP DL and UL

→ HTTP web browsing

→ YouTube

→ Facebook

→ Ping latency

→ DNS latency

→ UDP streaming DL and UL (iperf3)

→ Peer-to-Peer

→ SMS

→ Connection setup

» Voice Services:

→ CS

→ VoLTE

→ VoWiFi

→ VoIP



KPIs according to industry standard

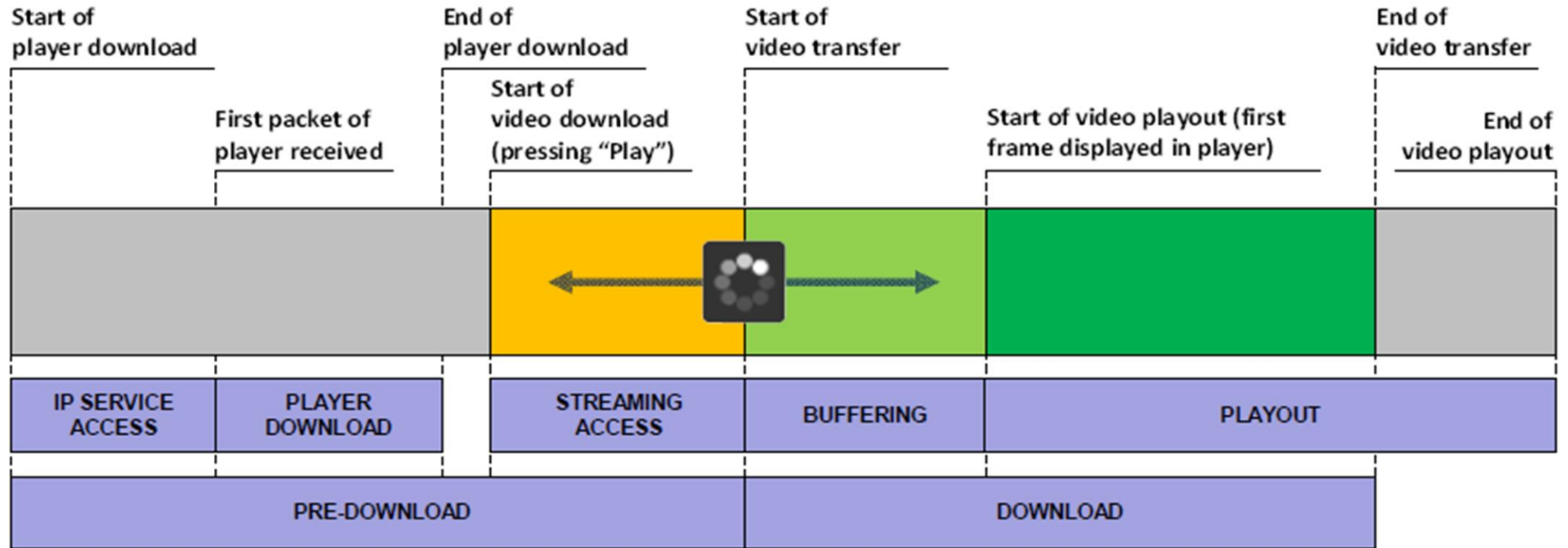
- » ETSI TS 102 250 series
 - Part 2: Definition of Quality of Service parameters and their computation
 - Part 6: Post processing and statistical methods.
- » All Video Streaming KPIs provided by DAP are conform to ETSI TR 101 578 v1.1.1 (Speech and multimedia Transmission Quality (STQ); QoS aspects of TCP-based video services like YouTube™)
- » Operators can use this to report their KPIs to the regulators!

KPIs according to industry standard – e.g. web ETSI TS 102 250

KPI Type	KPI Name
HTTP Web	HTTP Web Download Count
	HTTP Web Download Success Rate
	HTTP Web Download Time
	HTTP Web Throughput
	HTTP Web Syn RTT
	HTTP Web TCP Payload
	Various TCP/IP performance metrics

KPI Type	KPI Name
HTTP File Download / Upload	HTTP File Download Count
	HTTP File Download Success Rate
	HTTP File Download Syn RTT
	HTTP File Download Time
	HTTP File Download Throughput
	Various TCP/IP performance metrics

KPIs according to industry standards – e.g. YouTube ETSI TS 101 578 V1.1.1



KPIs according to industry standard – e.g. YouTube

KPI Type	KPI Name
Video Streaming (YouTube)	Player Session Time (msec)
	Video IP Service Access Time (msec)
	IP Service Access Time (msec)
	Video Reproduction Start Delay (msec)
	Video Play Start Time (msec)
	Video Payout Duration (msec)
	Video Session Time (msec)
	Video Freeze Occurrences
	Video Maximum Freeze Duration (msec)
	Video Freeze Time Proportion (%)

KPI Type	KPI Name
Video Streaming (YouTube)	Total Freeze Duration (msec)
	Quality used
	Player Session Success
	Player Session Success Rate (%)
	Video IP Service Access Success
	Video IP Service Access Success Rate (%)
	Video Reproduction Start Success
	Video Reproduction Start Success Rate (%)
	Video Payout Success
	Video Payout Success Rate (%)
	Video Session Success
	Video Session Success Rate (%)

DAP Benchmarking – As an addition to benchmarking

- » Comparative results for FTP, HTTP, UDP, ping, DNS, VoIP, YouTube, P2P (main KPI)
- » Performance ranking using colour codes (green best, red worst, orange other)
- » Sampling information
- » Selection of: time period, composite sequence & sequences to appear as table columns
- » Just a click on “Command” needed to access respective statistical details

Start Date
12-03-2014

End Date
19-03-2014

Compos. Sequences
Demo_Bench_bDAP

Change

Sequences

Demo_Bench_Operator 1

Demo_Bench_Operator 2

Demo_Bench_Operator 3

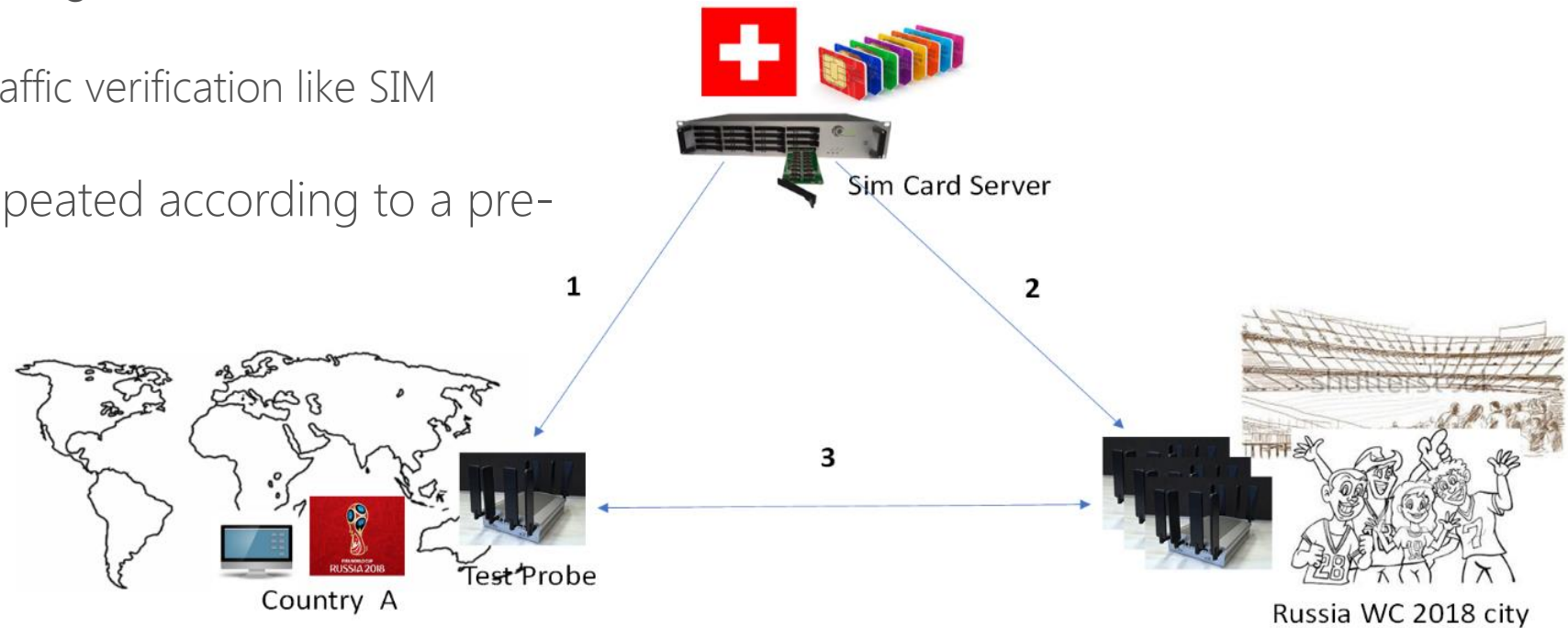
Check all Uncheck all

Command	Unit	Demo_Bench_Operator 1	Demo_Bench_Operator 2	Demo_Bench_Operator 3
FTP_DL_5M	Mbps	● 7.3	● 7.02	● 8.39
FTP_UL_2M	Mbps	● 2.03	● 2.47	● 3.11
Ping_32B	ms	● 52	● 67	● 43
HTTP_Kepler	sec	● 8.69	● 10.3	● 8.27
DNS_Google	ms	● 82	● 42	● 52

Command	Demo_Bench_Operator 1	Demo_Bench_Operator 2	Demo_Bench_Operator 3
FTP_DL_5M	67	68	75
FTP_UL_2M	72	81	77
Ping_32B	77	84	81
HTTP_Kepler	77	84	81
DNS_Google	78	83	82

QoS during major events – e.g. FIFA World Cup

- » DAP mimics the behavior of roaming Customer
 - The probe in “Country A” loads a profile of a customer from the SIM card server
 - The probe in the WC 2018 city loads a profile of a roaming customer visiting Russia
 - Calls between probes are generated and the defined KPIs are measured
 - Including fraudulent traffic verification like SIM boxes/call masking
- » Tests are automatically repeated according to a pre-defined call sequence



SIM Box Detection

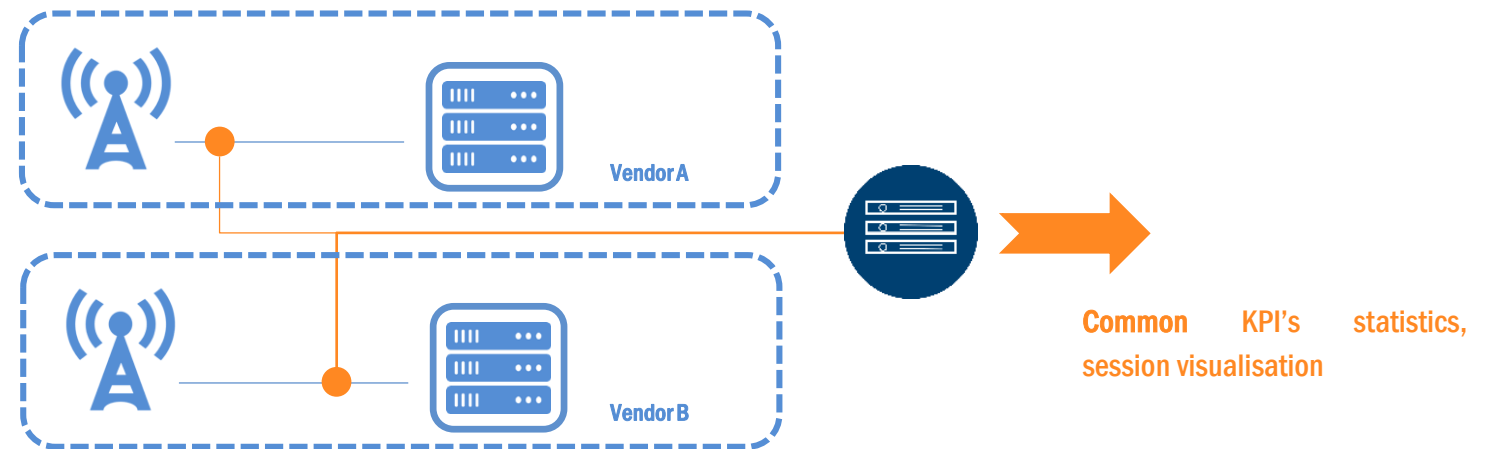
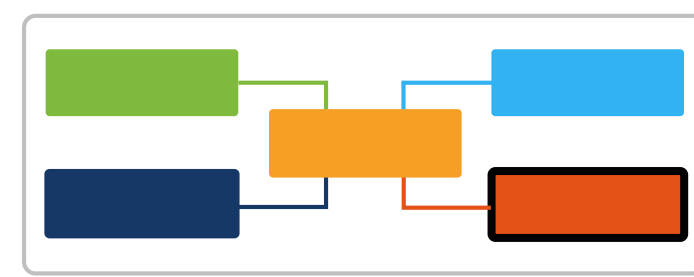
- » A DAP can detect SIM Box by comparing A number with the CLI displayed on the B side
- » Subscriber A number substitution can be correlated with low MOS value
- » User can find the Potential SIM Box number and perform adequate action

Origin Location: Saudi Arabia
Terminating Location: Iran

State	MSISDN/CLIP	Operator	Called Number	Start Time	LUP	CallEsDur	CallRel Dur	MOS A/B	CallDur
Passed	[REDACTED] 4372	Mobily	[REDACTED] 4365	04/09/17 14:48	3.25	12.31	1.02	2.15	54.332
	[REDACTED] 4372							2.24	
Passed	[REDACTED] 4372	Mobily	[REDACTED] 4365	04/09/17 15:03	3.24	13.86	1.32	2.02	54.296
	[REDACTED] 1588							1.91	
Passed	[REDACTED] 4372	Mobily	[REDACTED] 4365	04/09/17 15:23	3.23	11.69	0.93	3.11	54.33
	[REDACTED] 4372							3.14	
Passed	[REDACTED] 4372	Mobily	[REDACTED] 4365	04/09/17 15:38	3.26	14.16	1.41	2.02	54.147
	[REDACTED] 1082							1.92	
Passed	[REDACTED] 4372	Mobily	[REDACTED] 4365	05/09/17 14:48	3.23	13.90	1.08	3.07	54.22
	[REDACTED] 4372							3.12	
Passed	[REDACTED] 4372	Mobily	[REDACTED] 4365	05/09/17 15:03	3.24	22.18	2.23	1.98	54.384
	[REDACTED] 9072							1.96	

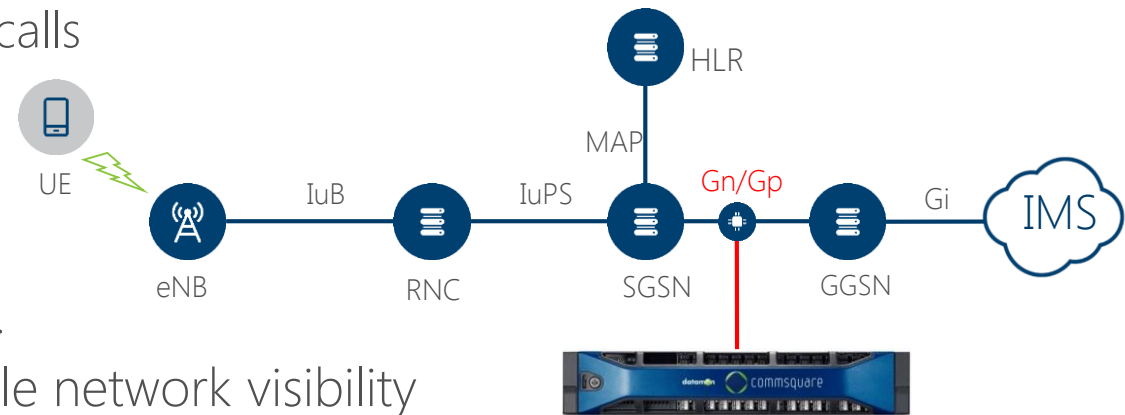
Passive probes

- » Probe monitors data from standard network interfaces instead of processing traces provided by network elements
- » Such approach makes network monitoring independent from particular vendor's constraints and limitations.
- » KPI's, statistics are calculated based on the same known formulas for all vendors. This allows for vendors benchmarking in multi-vendor networks.



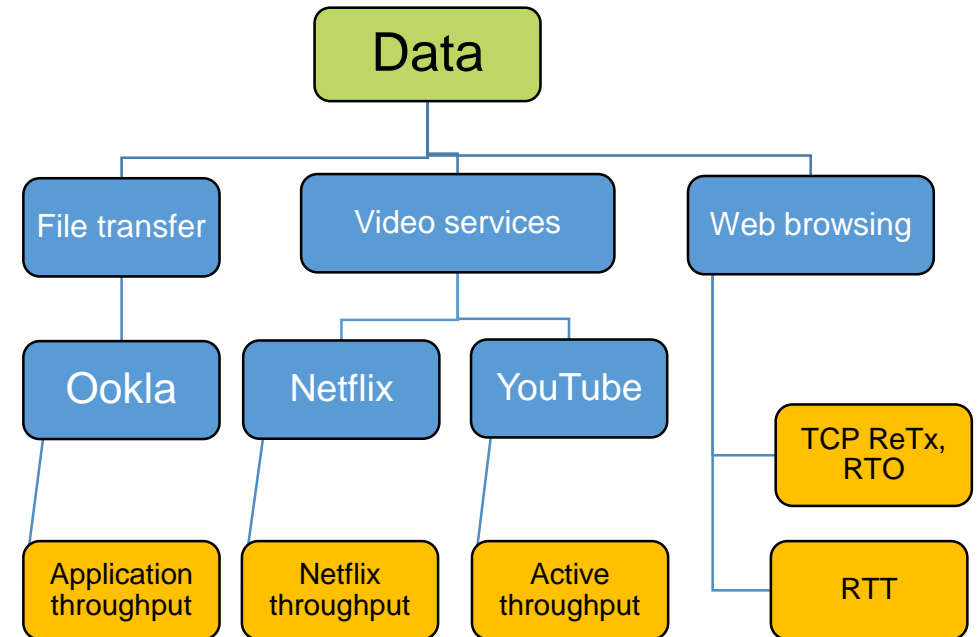
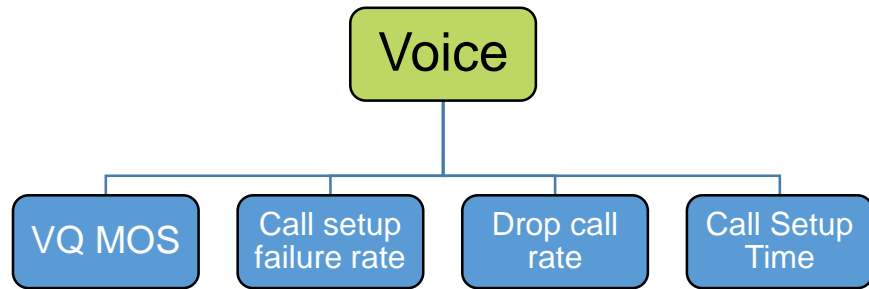
Passive probing possibilities for Regulators

- » Possible options for the Regulatory Body:
 - Monitor only interconnects (connection between mobile operator and external world)
 - ⊕ Relatively low cost
 - ⊕ Limited information narrowed to interconnect calls
 - ⊕ No visibility on internal calls
 - Monitor all interfaces of mobile operator
 - ⊕ Best results but is most expensive
 - ⊕ Several systems monitoring separate networks.
 - Monitor selected interfaces to get most possible network visibility
 - ⊕ A interface for GSM
 - ⊕ IuCS/IuPS or Gn/Gp interface for UMTS network
 - ⊕ S1-MME or S11/S5/S8 for LTE
 - ⊕ Best quality to price ratio
 - ⊕ E.g. Ability to trace fake user equipment with their IMEI number/GSMA TAC list



Passive probing can also measure QoE

- » Creating Voice and Data customer experience metrics by blending and weighting the underlying technical KPIs
- » The analytics platform displays results from PS and CS monitoring tools
- » Evaluate service quality with a point scoring system 0 - 100
 - Quality points measuring customer experience of voice and data services



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