

TEMS™ Investigation

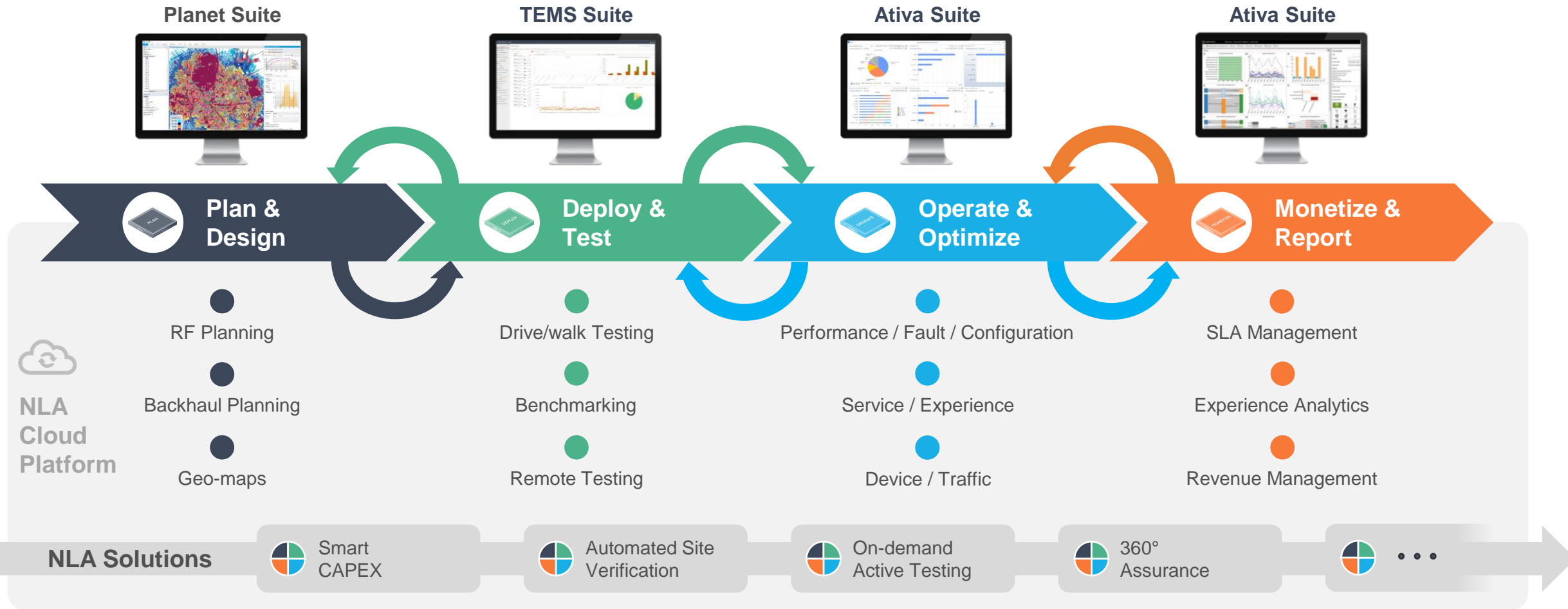
Mobile Network Testing – Drive Testing

infovista



Market-leading products & solutions across the network lifecycle

Brought together by our NLA Cloud Platform



TEMS™ Suite

For over 25 years, TEMS™ has been recognized as the leading network testing solution by mobile network operators and vendors worldwide

Orchestration and Analytics



**TEMS™
Cloud**

Cloud solution providing orchestration and analytics



**TEMS™
Director**

Remote management and analytics for TEMS solutions



**TEMS™
Discovery**

Network analytics and optimization platform

Network Testing



**TEMS™
Investigation**

Network testing and troubleshooting solution

Drive testing



**TEMS™
Pocket**

Portable testing and troubleshooting solution

Walk testing



**TEMS™
Paragon**

Mobile network benchmarking solution

Benchmarking



**TEMS™
Sense**

Automated remote network monitoring solution

Remote testing



**TEMS™
SSV**

Automated 5G site verification solution

Site verification

TEMS™ Investigation



TEMS™ Investigation

Market-leading drive testing solution for verifying, optimizing and troubleshooting your network

Network validation

Perform initial tuning and site acceptance. Validate new hardware, software and features

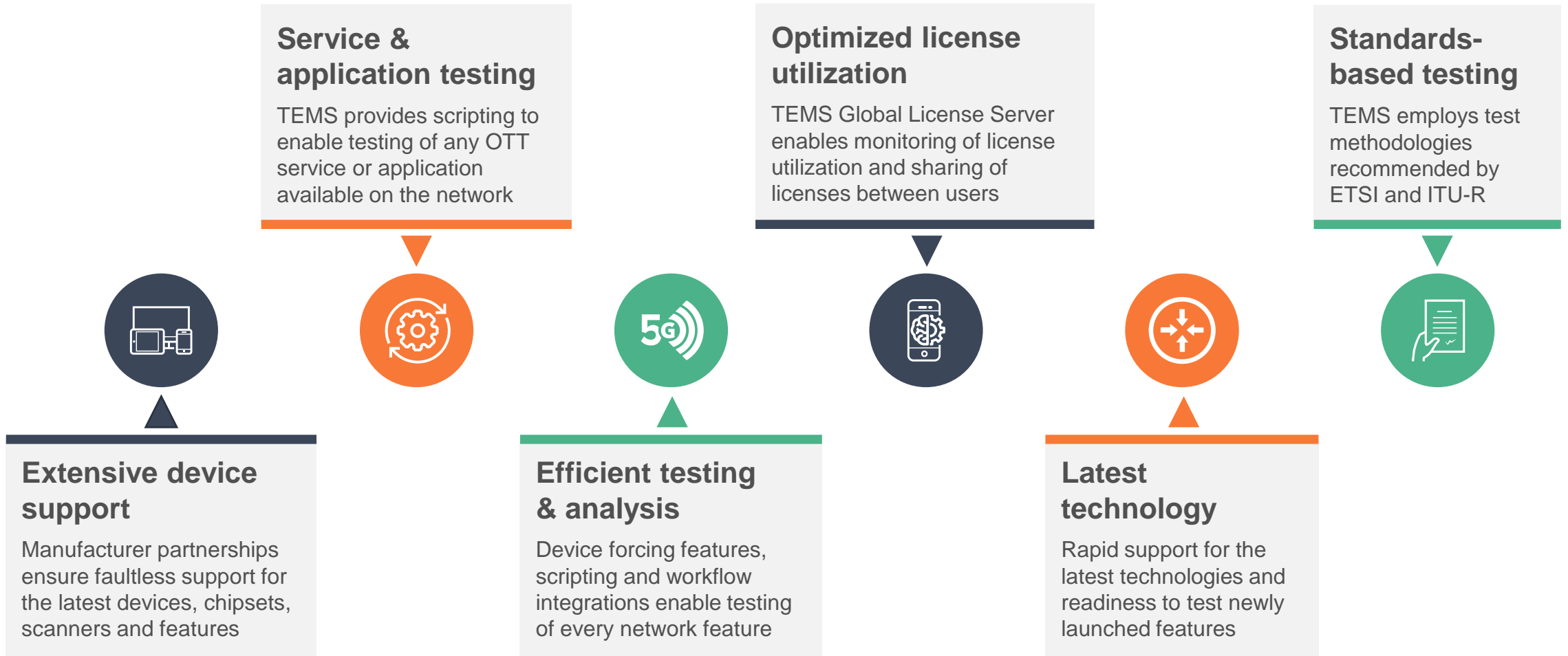
Customer experience

Test and troubleshoot the network and services from a subscriber perspective

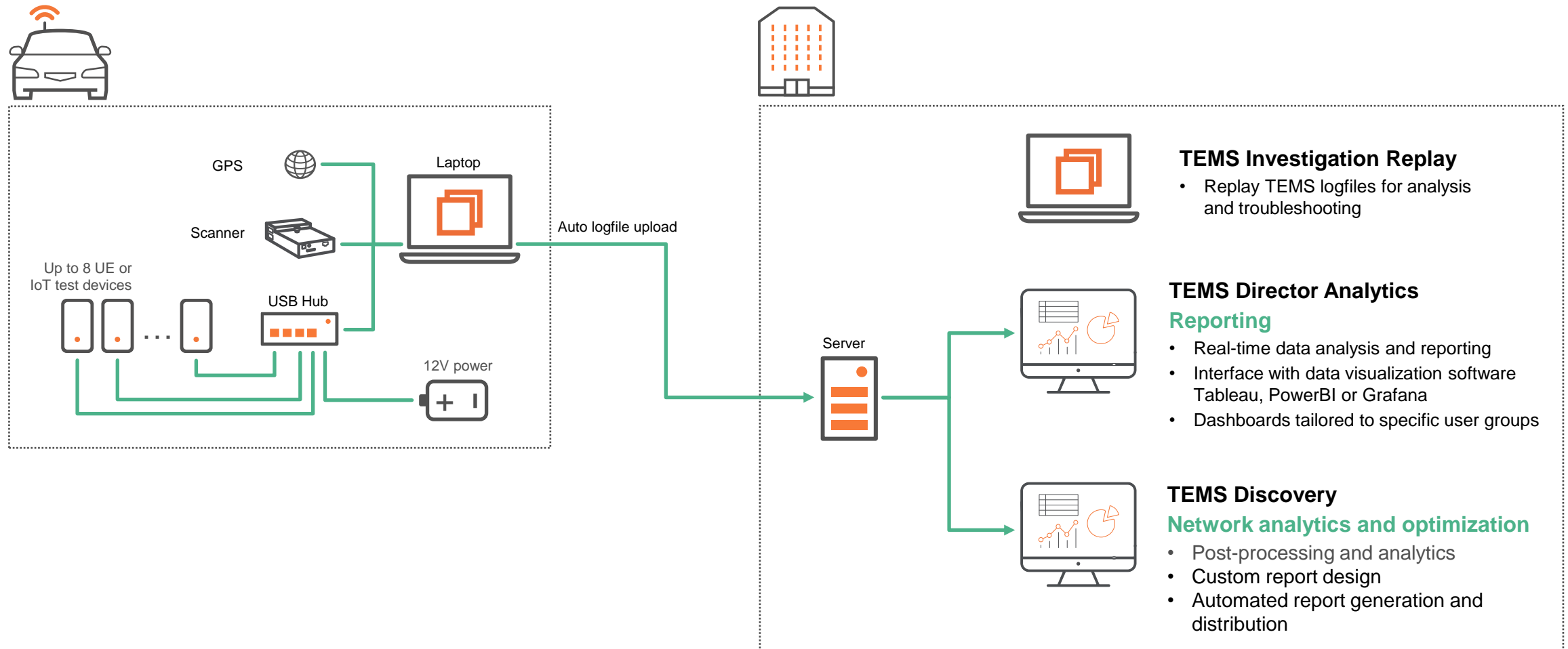
Technology support

Chipset and device partnerships ensure support for the latest technologies, devices and features

TEMS™ Investigation benefits



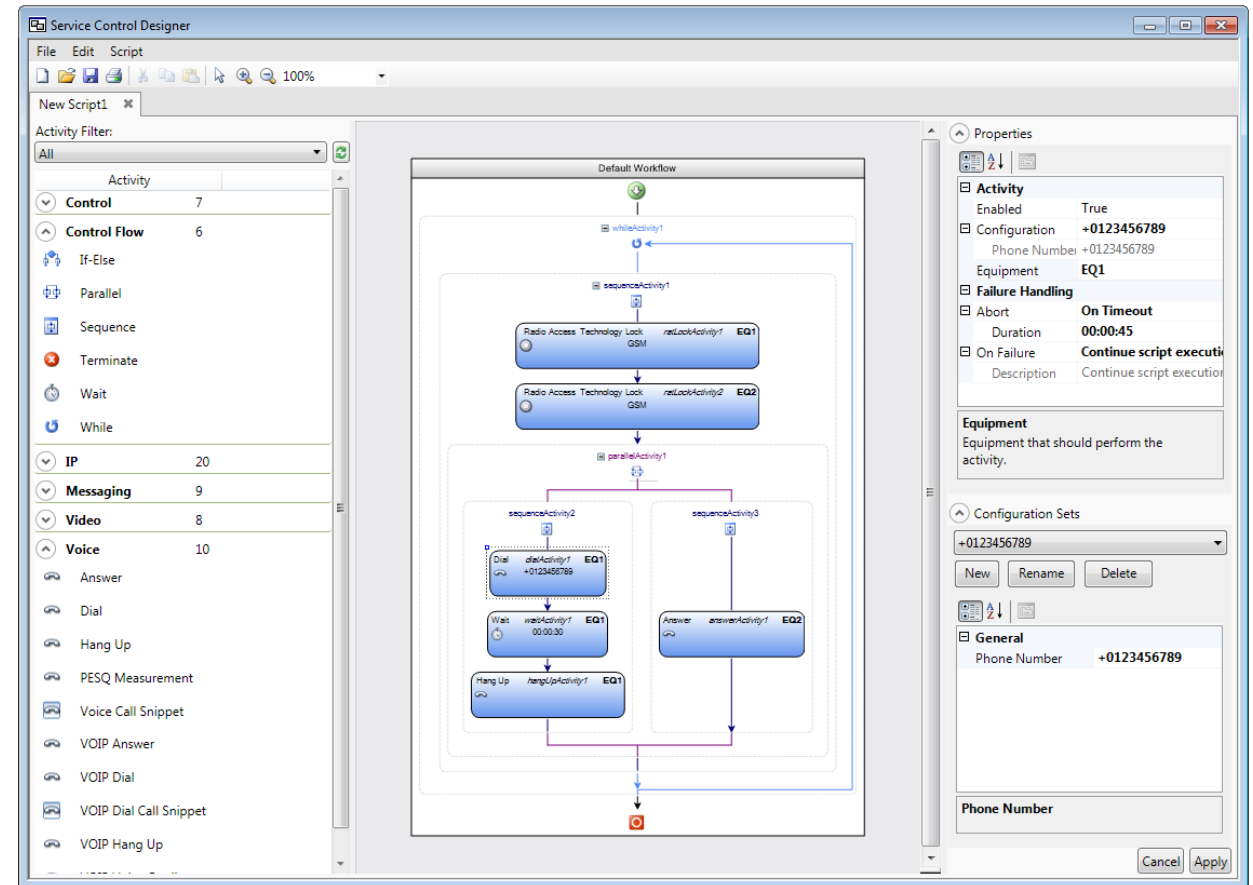
TEMS™ Investigation solution architecture



Service control (script) designer

Flexible and efficient creation of test scripts for simplified data collection and service testing

- Intuitive flow chart concept
 - Drag-and-drop activities into the workflow pane
 - Toolbox of control logic functions
 - Application of control functions to devices
 - Library of predefined test case packages
 - Configuration details (FTP server IP, login credentials, etc.) in separate configuration sets
- Easy to create, adapt, and reuse scripts
- Save scripts locally or for distribution



Audio quality measurement (AQM)

Predict MOS (mean opinion score) values to estimate voice quality of service

TEMS Investigation supports **sQLEAR** and **PoLQA v3** to measure the audio quality of modern voice codecs (EVS, OPUS, and AAC) used for VoNR, VoLTE

Note: POLQA v2.4 is not suited for VoLTE, VoNR and OTT voice applications as it is sensitive to distortions above 14KHz, new codecs are minimum 24KHz



sQLEAR
(ITU-T P.565.1)



PoLQA v3
(ITU-T P.863 Edition 3)

On-device measurement (ODM)

Perform measurements on devices for closest alignment to actual end-user experience

- TEMS Investigation controls applications installed on test phones to perform voice and data test cases
- Results reflect true end-user experience more accurately

On-device measurements supported by TEMS



Call control



Media



FTP



TWAMP



HTTP



Ping



iPerf



Video streaming



OTT



IP recording

iPerf3 testing

Measure the maximum throughput of your network

- **Why iPerf3?**

- Well suited to high-bandwidth technologies such as LTE-A and 5G-NR
- Support for UDP testing (User Datagram Protocol testing)

- **Features**

- **TEMS iPerfWatcher service:** Configure a range of ports (pool of ports) to use for iPerf testing
- **Device support:** Commercial (off-the-shelf) and TEMSified devices
- **Server operating system:** Windows or Linux
- **Handset operating system:** Android or iOS

- **Testing Methodology**

- **PC Solution:** Tethered to laptop, run tests on TEMS/commercial devices including routers and modems
- **On-Device Solution:** Run tests on TEMS/commercial devices including routers and modems

Hardware Support



Support for all the major device manufacturers

Agreements with leading handset manufacturers enables Infovista to support full logging capability across a vast array of devices



Apple iPhone 14 Series



Samsung S23 Series



OnePlus 10 Series



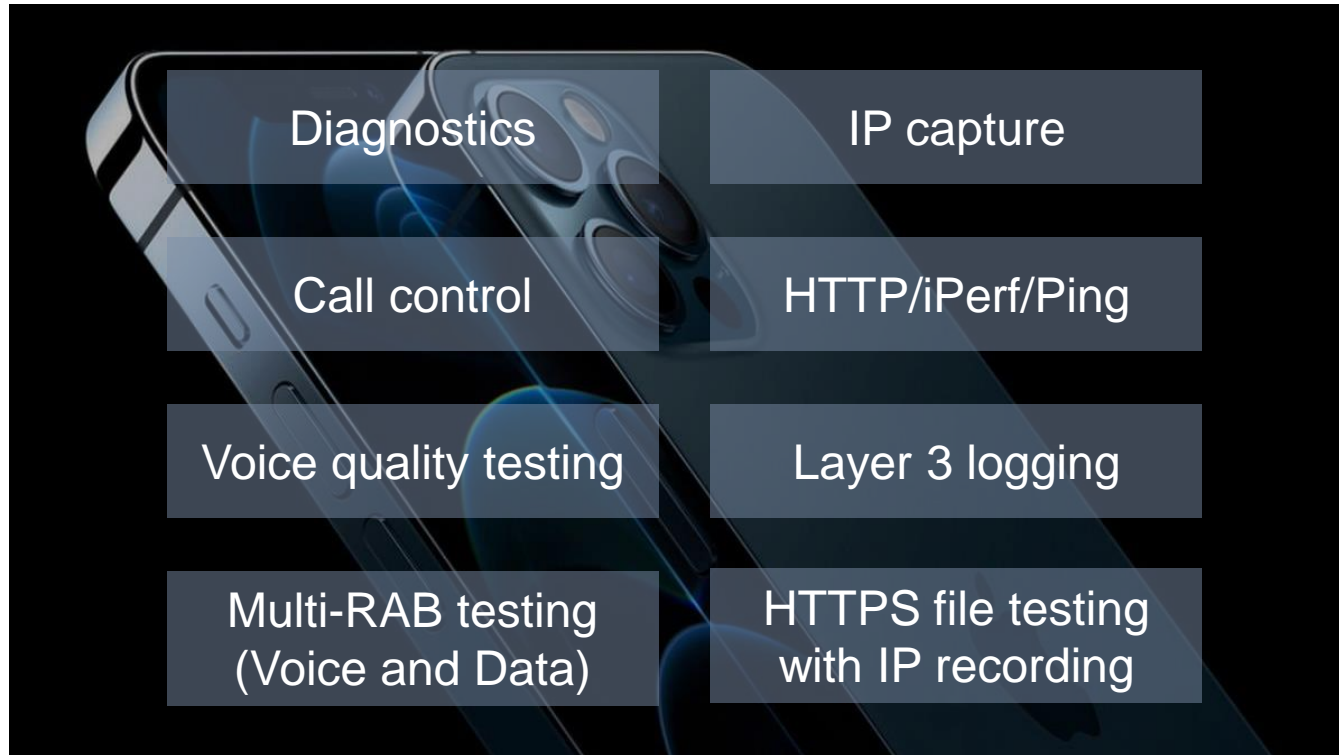
Xiaomi 12 Series



Sony Xperia Mark III Series

Official Apple iPhone support in TEMS

- Infovista has signed an official agreement with Apple to support and supply iPhone devices



iPhone 14 TEMS™ Investigation data screen

The screenshot displays the TEMS Investigation 24.2.1 (Administrator) - [investigation lte nr.tdc *] application window. The interface includes a menu bar (File, View, Logfile, Configuration, Control, Presentation, Worksheet, Window, Help), a toolbar, and several main panels:

- Left Panel:** Shows the selected device as "EQ1 Apple iPhone 14 Pro". Below it are tabs for "Activities" and "Information". Under "Control", there's a tree view for "IP" protocols including FTP Download, FTP Upload, HTTP Get, HTTP Post, Network Bandwidth, Network Connect, Network Disconnect, Ping, PS Attach, PS Detach, and Start IP Sniffing.
- Top Row Panels:**
 - Layer 3 Messages:** A table listing time, ECU, protocol, and name for Layer 3 messages.
 - Mode Reports:** A table listing time, ECU, and name for mode reports.
 - Events:** A table listing time, ECU, event type, and information for system events.
- Bottom Row Panels:**
 - IP Protocol Reports:** A table listing time, ECU, name, protocol, and info for IP-related events.
 - SIP Reports:** A table listing time, ECU, name, protocol, and info for SIP-related events.
 - Data Reports:** A table listing time, ECU, and name for data reports.
- Status Bar:** At the bottom, it shows "Idle 1/1" and a row of tabs: Overview, Signaling, DSS Analysis, Data, Map, Scanner, Ctrl & Config.

Orange arrows point from external labels to specific components: "iPhone 14" points to the device selection area; "IP reports" points to the IP Protocol Reports panel; "Layer 3 messages" points to the Layer 3 Messages panel; "Mode reports" points to the Mode Reports panel; "Events" points to the Events panel; and "SIP reports" points to the SIP Reports panel.

Support for PCTEL and Rohde & Schwarz scanners

Device independent RF measurements across multiple channels/bands/technologies – efficiently identify potential interference sources

- Some of the latest supported features in TEMS Paragon include:
 - **5G mmWave (PCTEL Gflex, PCTEL HBflex and R&S TSME6)**
 - 5G NR, LTE, WCDMA and GSM Mobile Blind Scan
 - Individual MIB/SIB selection Mobile Blind Scan for LTE
 - One-time/continuous - PCI detection Mobile Blind Scan for LTE
 - Multi-unit signal scan with R&S TSME 6 scanner



PCTEL Gflex



PCTEL HBflex



PCTEL iBflex



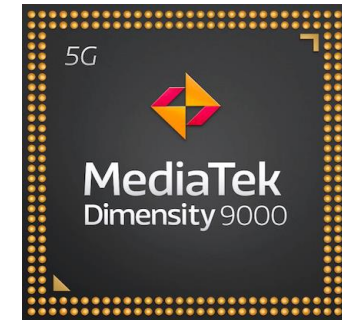
PCTEL MXflex



R&S TSME6

Comprehensive chipset support

- Agreements with major chipset vendors - Qualcomm, Samsung, Huawei, and MediaTek
 - Faster time to market for new devices
 - Access to Layer 3 messages without the need for reverse engineering ensures highly accurate decoding
- Support for devices based on the latest 8th generation chipsets



- Support for IoT devices based on the Qualcomm MDM9206 chipset



TEMS devices vs. off-the-shelf (commercial) devices

TEMS device (*Customized firmware*)

Firmware

Customized TEMS firmware: in-depth testing capabilities

Device control capabilities

Complete control

- Radio access technology
- Band
- PSC/PCI/xARFCN
- EVS codec
- Carrier aggregation

On device measurement

Support for all ODM services: ftp, http, ping, iPerf, call control, streaming

Audio quality testing

PoLQA and sQLEAR

OTT testing

Comprehensive KPI testing: Facebook, Instagram, Twitter, WhatsApp, Skype, Dropbox, Google Drive, Teams and Zoom



Off-the-shelf device (*Commercial firmware*)

Firmware

Standard or country/operator-specific: faster time to test, reduced TCO, customer firmware

Device control capabilities

Basic control

- Radio access technology
- Band
- PSC/PCI/xARFCN

On device measurement

Support for all ODM services: ftp, http, ping, iPerf, call control, streaming

Audio quality testing

sQLEAR only

OTT testing

Limited KPI testing: testing: Facebook, Instagram, Twitter, WhatsApp, Skype, Dropbox, Google Drive, Teams and Zoom

TEMS™ Investigation license packages

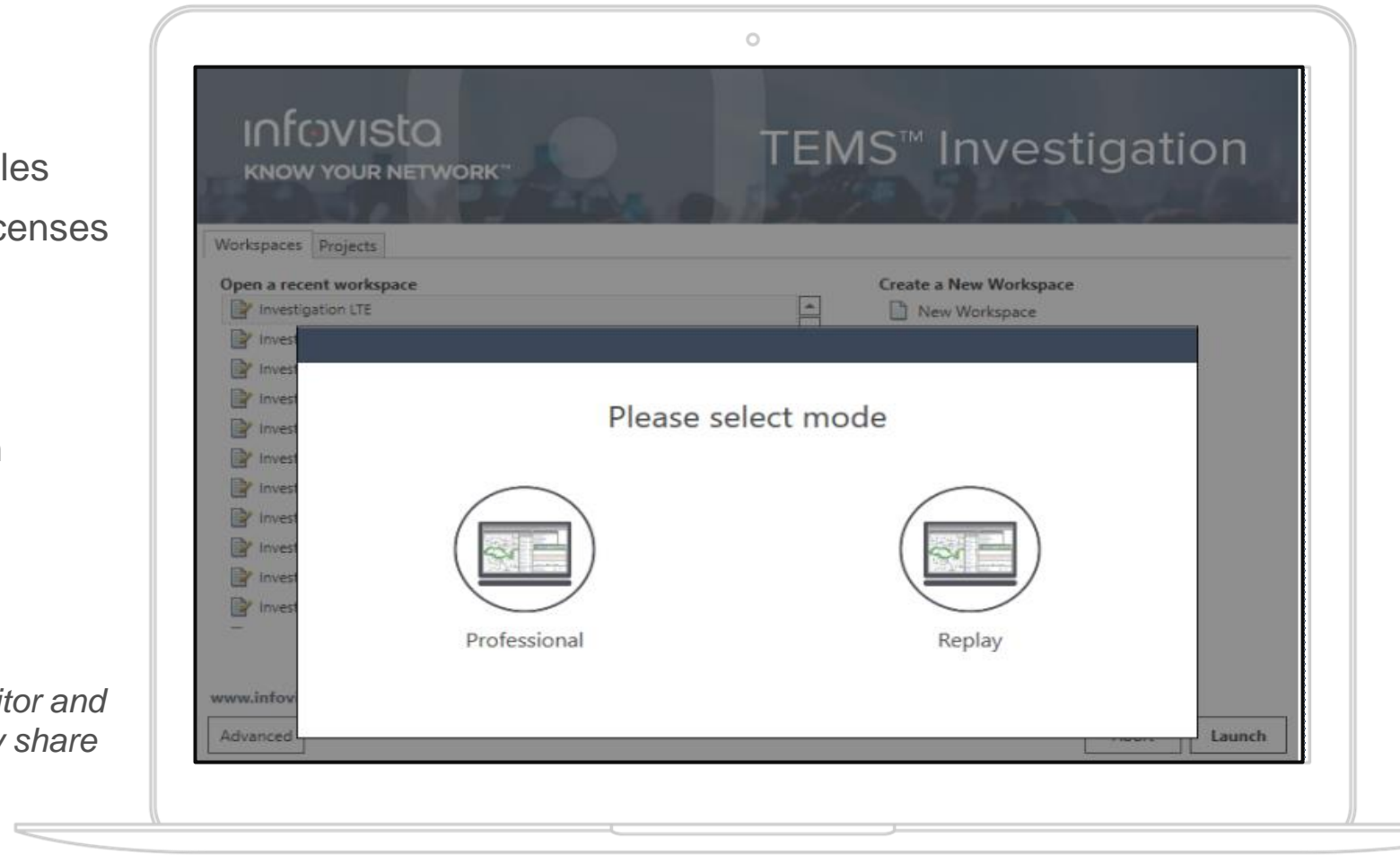
TEMS Investigation Professional

- Full set of product features
- Collect measurement data as TEMS logfiles
- Available as term-based and perpetual licenses
- For drive testing

TEMS Investigation Replay

- Replay TEMS logfiles - no data collection capabilities
- For office-based network analysis and troubleshooting

Via our GLS (Global License Server) you can monitor and optimize equipment utilization and users can easily share licenses to reduce costs



User Experience Testing

Generic testing approach for OTT voice,
video and interactive 5G apps and services



The pillars of TEMS™ user experience testing



sQLEAR

Voice quality testing for VoNR, VoLTE and OTT voice



Generic OTT voice testing

OTT voice quality testing with a generic client approach



Generic OTT media testing

OTT application testing with a generic framework approach



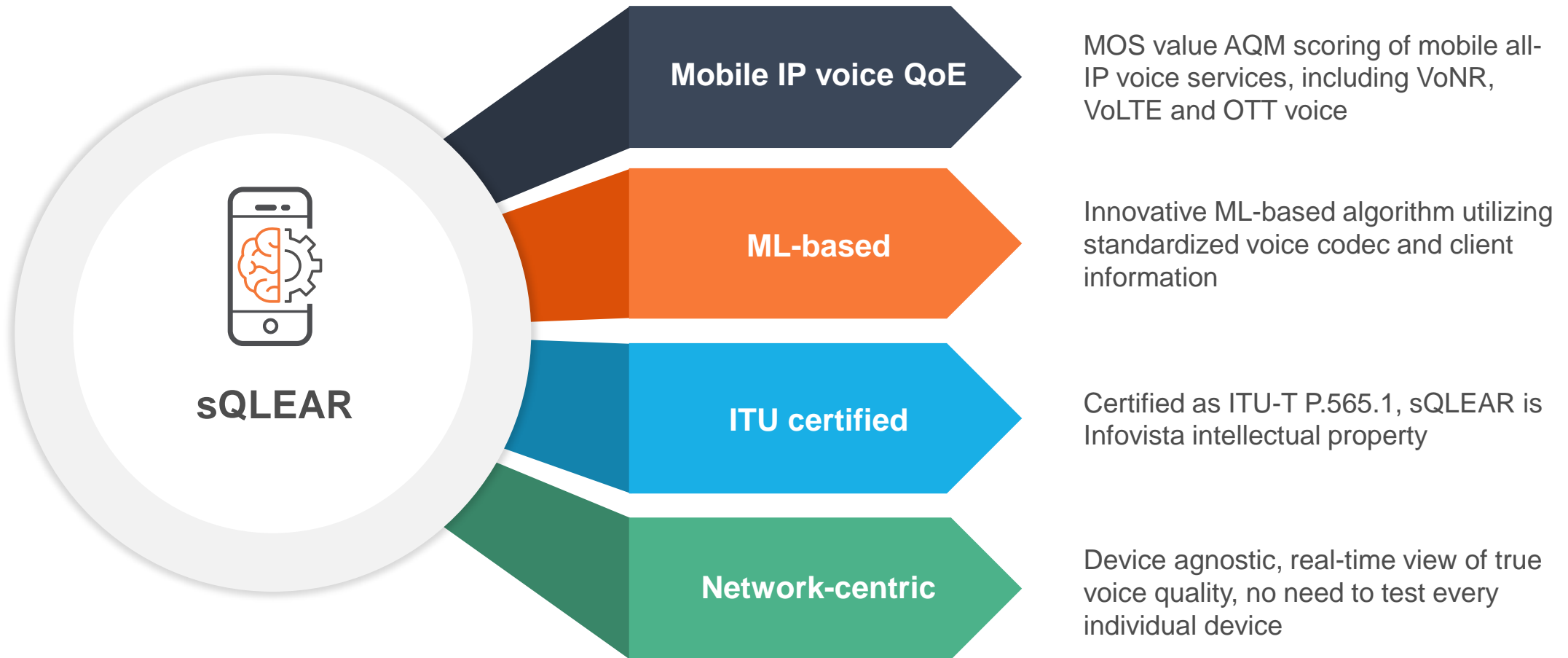
Interactivity Scoring

User interactivity testing with generic OTT service/application traffic patterns



sQLEAR – speech Quality by machine LEARning

VoNR, VoLTE and OTT audio quality testing (MOS scoring)



Generic OTT voice testing

OTT voice quality testing using a generic client approach

Challenge

- Testing mobile OTT voice services/applications is important but practically impossible due to encryption, proprietary codecs, error concealment schemes etc.

Solution

- Infovista's generic OTT voice client accurately mimics the behavior of OTT voice clients (e.g. WhatsApp audio call)

Benefits

- The generic client provides the ability to test only one OTT application, one version and one set of fully accessible KPIs (free of encryption)
- The result is a reference of network performance for OTT voice applications



Generic OTT media testing

OTT media application testing using a generic framework approach

Challenge

- OTT apps are constantly changing and can differ between devices, countries and even networks – not feasible to test them all

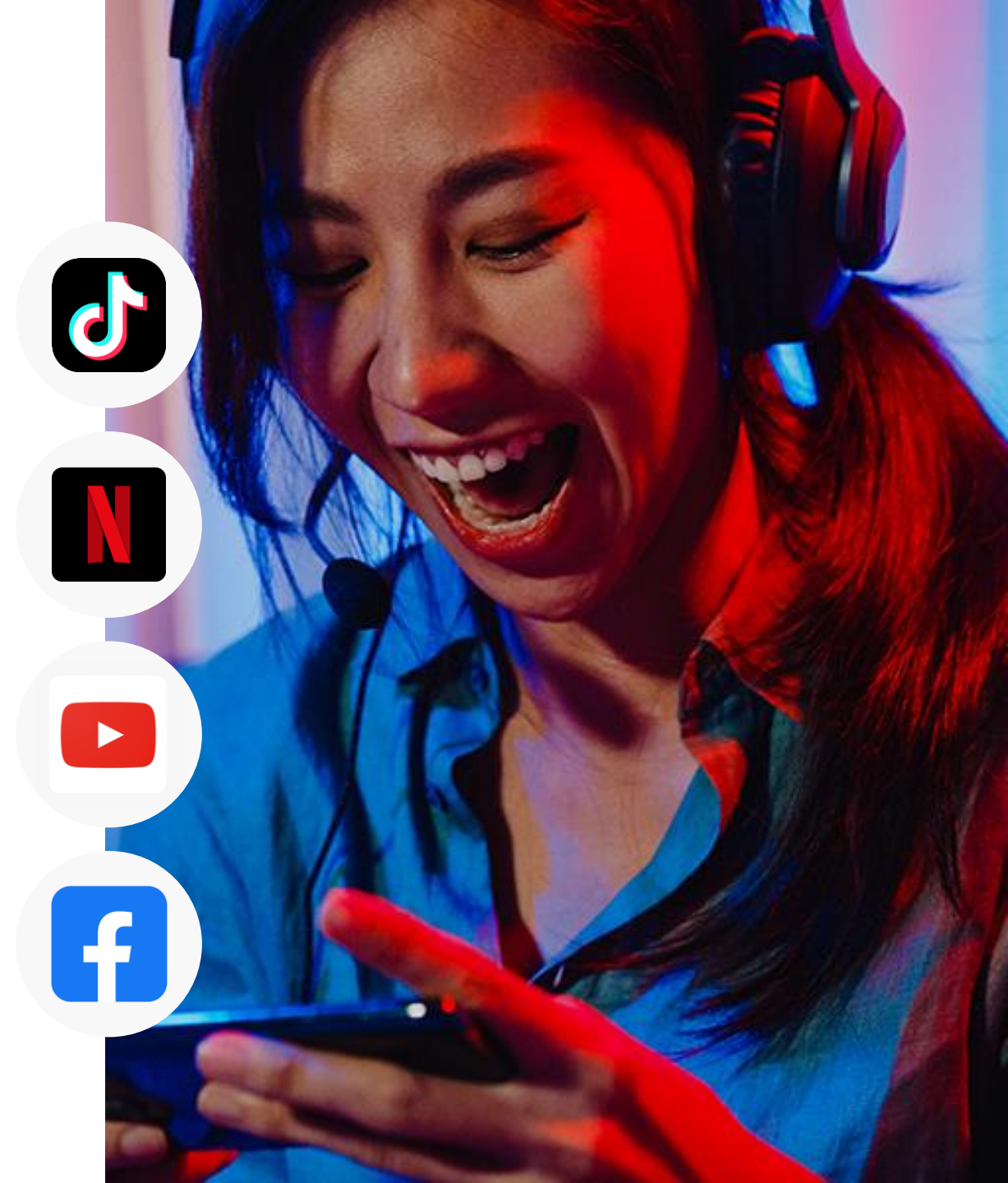
Solution

- Native Python UI automation scripting for setting up the tests solves the changing application challenge
- Generic test methodology and KPIs across all OTT media applications, aligned with ETSI specifications

Benefits

- Generic framework approach allows operators to quickly test any OTT media application with consistency and confidence

infovista



Thank you!

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TEMSified vs. off-the-shelf (commercial) devices

Script Actions	TEMS Device	Commercial (Samsung or Root access)
·FTP upload/download	Y	Y
·HTTP Get/Post	Y	Y
·Streaming (YouTube)	Y, also with MOS (PEVQs)	Y, ETSI KPIs only, without PEVQs
·Email	y- tethered	y- tethered
·SMS (Send and Receive)	y- tethered	y- tethered
·Facebook		
ODM Social Media lic.: Post status	Y	N
ODM Social Media lic.: Post photo	Y	N
ODM Social Media lic.: Load page feeds	Y	N
ODM Social Media lic.: Load feeds	Y	N
ODM Social Media lic.: Comment post	Y	N
ODM Social Media lic.: Like post	Y	N
ODM Social Media lic.: Post video	Y	N
ODM Social Media lic.: Delete post	Y	N
OTT Media Lic: Streaming DL (ESTI KPIs)	Y	Y
OTT Media Lic: Skype: File sharing	Y	Y
·Instagram		
ODM Social Media lic.: Load feeds	Y	N
ODM Social Media lic.: Search by hashtag	Y	N
ODM Social Media lic.: Post photo	Y	N
·Twitter		
ODM Social Media lic.: Twitter Load Home timeline	Y	N
ODM Social Media lic.: User Home timeline	Y	N
ODM Social Media lic.: Post tweet	Y	N
ODM Social Media lic.: Search tweet	Y	N
·WhatsApp		
ODM Social Media lic.: What'App: Messaging	Y	N
ODM Social Media lic.: What'App: Post file	Y	N
ODM Social Media lic.: What'App: Voice Call	Y	N
OTT Media Lic: Messaging	Y	Y
OTT Media Lic: File sharing	Y	Y
gOTT Audio Call (MOS-POLQA+ call control)	Y	N
Microsoft Teams		
gOTT Remote Meeting	Y	Y
Zoom		
gOTT Remote Meeting	Y	Y
·Ping	Y	Y
·Voice MO (CS and VoLTE)	Y- call set-up	Y- call set-up
·Toggle Wi-Fi On/Off	Y	Y
·Voice MT (receiving mobile-terminated calls)	Y- call set-up	Y- call set-up
·AQM (voice with audio quality measurement)	Y with POLQA/ sQlear	Y with sQlear using DCU
·Call sequence (sequence of MT + MO calls)	Y	Y
·Control function (applies one or more control functions)	Y- refer to supported" device list for compliance	Y- refer to supported" device list for compliance
-RAT	Y- refer to supported" device list for compliance	Y- refer to supported" device list for compliance
-Band	Y- refer to supported" device list for compliance	Y- refer to supported" device list for compliance
-Frequency (EARFCN/UARFCN)	Y- refer to supported" device list for compliance	Y- refer to supported" device list for compliance
-Cell lock (PCI)	Y- refer to supported" device list for compliance	Y- refer to supported" device list for compliance
·IP capture	Y	Y
·IPERF	Y	Y
·Mobile network scanning (With external scanner)	Y- PCTel& R&S, connected to PC	Y- PCTel& R&S, connected to PC