



ISP-I™ VQ Voice Testing from Epitiro

End to End Call Quality Analysis Solution

The industry-leading solution for measuring voice quality across all networks

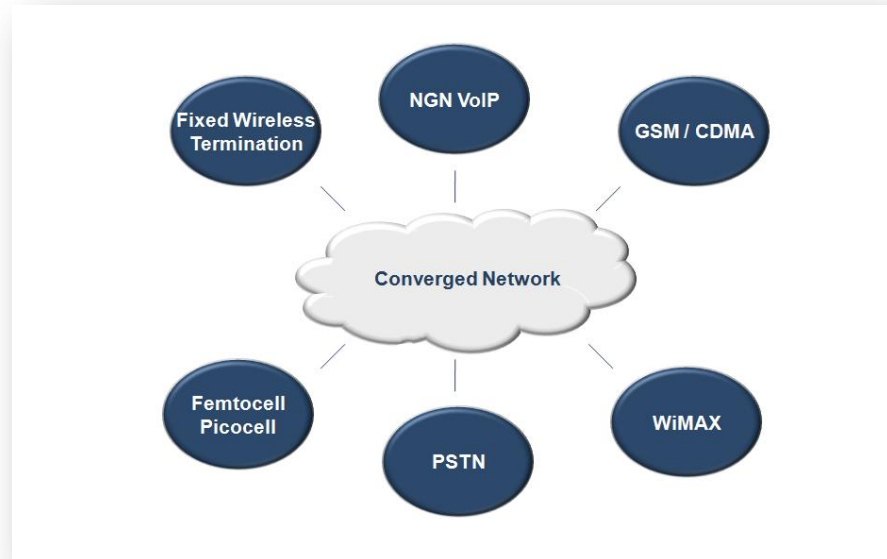
ISP-I™ Voice Testing enables Operators, Government Regulators and Equipment Vendors to quickly and efficiently test voice networks.

ISP-I™ is a scalable and flexible platform to benchmark network performance, manage network quality and understand end-to-end customer experience across any voice service.

Overview

ISP-I's VQ capability empowers regulators, operators and service providers with a flexible, scalable test and reporting solution for understanding true voice performance.

Virtually any of the industry's voice access technologies – mobile, PSTN and VoIP - can be tested from ISP-I to assist with network management, conduct competitive benchmarking or analyze telecom devices.



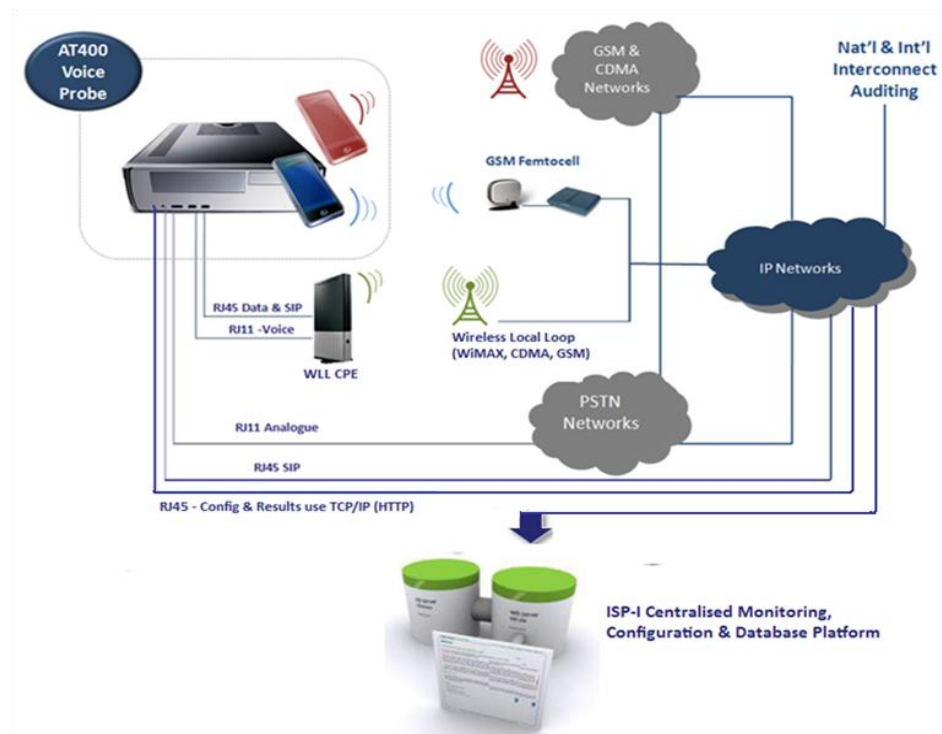
With a host of Key Performance Indicators, on-line views of metrics and the ability to automatically generate fault alerts and reports, ISP-I VQ is the complete voice analysis solution

Test Architecture

The ISP-I platform consists of a deployment of customer experience 'probes' that act as typical subscribers by connecting to the voice network and completing telephone calls.

Key Performance Indicator (KPI) metrics are recorded throughout the test calls and forwarded to a central database where you can visually see customer quality statistics via the On-line Dashboard in a variety of graphs, tables and charts.





Probes can be located across a country or region of interest to test not just your network but the networks of competitors also.

MOS: The Heart of Voice Quality

No matter what the access technology, customer experience is based on the ability to easily communicate. That's why ISP-I uses two ITU standards – analogue and digital - to measure end to end voice quality (MOS).

The ITU standard P.862 PESQ quality measurement algorithm is used for all network types. PESQ compares an original reference voice sample with the degraded output from the far-end. The overall audio quality is measured as well as other audio characteristics such as background noise, volume differential and one-way audio delay.

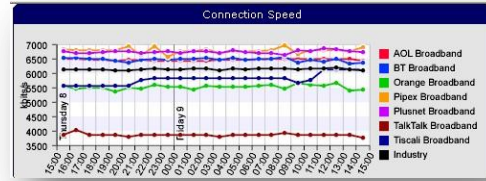
For IP networks, voice quality issues arising from the impact of digital transport issues such as packet loss and jitter can be measured and an ITU E-Model voice quality score determined.

While MOS voice quality scores are certainly an important indicator of customer experience, other metrics are also recorded such as call setup times, dropped calls as well as network information unique to the voice access technologies being used.

| PESQ MOS Voice Quality Scale | |
|------------------------------|-------|
| Subjective Term | Score |
| Excellent | 5 |
| Good | 4 |
| Fair | 3 |
| Poor | 2 |
| Bad | 1 |

3 Key Scenarios

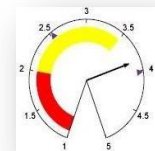
- ✓ **Benchmarking**, comparing your network to others over time, is easily done with ISP-I. Each metric that is measured by ISP-I can be used for comparative benchmarking purposes as well as an overall Ranking.



- ✓ **Network Management and Quality Assurance** initiatives are supported with ISP-I as each metric can have a threshold set which when breached alerts your key staff via an SNMP trap or an automatically generated email.

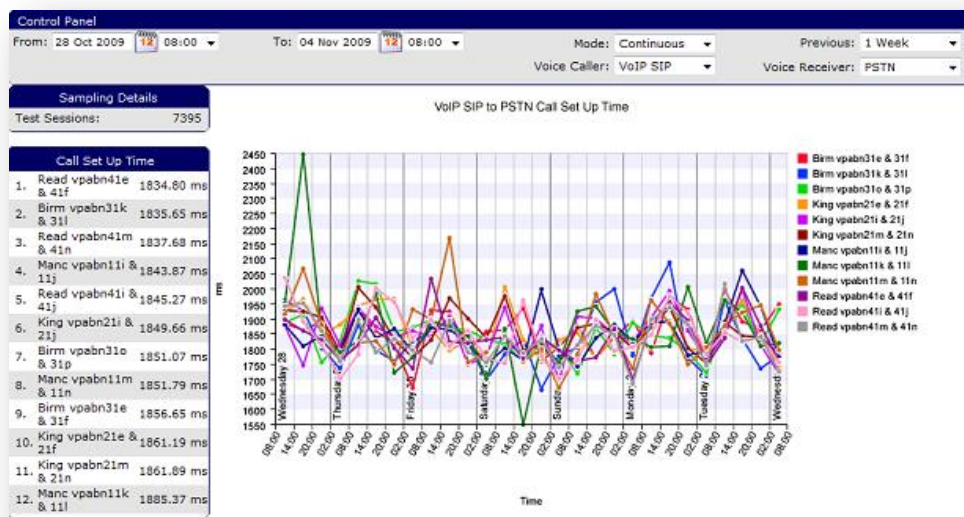
| Name | Description | Rule Group | Warnings | Critical | Out of Order | Active |
|---------------|----------------------------|------------|----------|----------|--------------|--------|
| Connection | Connection Speed Threshold | 1998 Cable | 6 | 999 | NA | ✓ |
| Connection | Connection Failure | 1998 Cable | 6 | 999 | NA | ✓ |
| Loss | Packet Loss Threshold | 1998 Cable | 12 | 999 | NA | ✓ |
| Jitter | QoS Jitter Threshold | 1998 Cable | 12 | 999 | NA | ✓ |
| QoS | QoS Delay | 1998 Cable | 12 | 999 | NA | ✓ |
| EmailDelivery | Email Delivery Time | 1998 Cable | 12 | 999 | NA | ✓ |
| FileDownload | FTP Download Threshold | 1998 Cable | 6 | 999 | NA | ✓ |

- ✓ **Pre testing** new devices and services is easily accomplished with ISP-I to ensure changes to your service offering meet customer expectations.



Web Access to Data

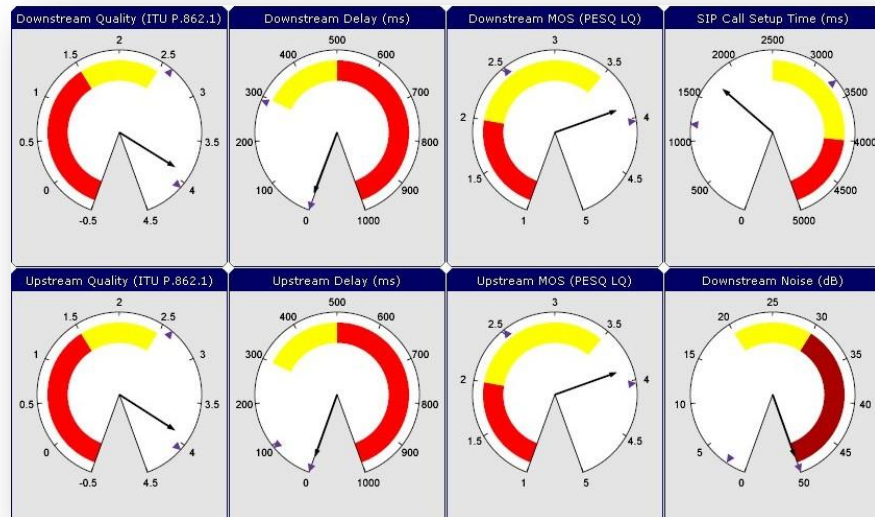
Each metric can be accessed online via the secure ISP-I web browser interface. From there you can view up-to-the-minute data results and understand how your network is performing overall while also seeing the performance of other competing networks.



Root Cause Analysis

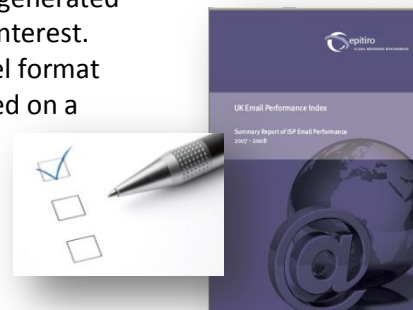
ISP-I goes beyond measurement of overall network health and quality performance and enables you to drill down to the root cause of network issues.

When probes are deployed in the core network, a view of network elements (MSC, DSLAM/MSAN, B-RAS and Packet Gateways) can provide comprehensive network insight for fast and accurate troubleshooting.



Easy Reports

Reports on any or all metrics are easily generated simply by selecting the type of data of interest. Reports can be presented in pdf or excel format and automatically published and emailed on a regular basis.



Flexible Testing

Many aspects of the testing can be customized to meet requirements. The occurrence frequency of the test script is programmable while the destination, routes, duration of the test call, number tests per test call and more can be changed via Epiro's Network Operations Centre.



Test All Voice Access Technologies

ISP-I is able to test to and from virtually any type of voice access technology that is popular around the globe. A full complement of Call Setup and Connectivity metrics is included with ISP-I as are voice quality KPIs which are all given in context of the time and location data recorded with each test. Some features are unique to specific technologies;



PSTN

Full RJ11 connectivity is available for connecting directly to the PSTN (POTS) network. Essential analogue advisory tones (busy, ringing, dialtone, re-order, silence) can be detected.



Mobile

Mobile phone radio signal strength and CellID help you to understand the environmental and location affects of mobile phone services.



WiMAX

Essential transmission characteristics such as signal-to-noise (+interference) ratio (SNR/SINR) and carrier-to-noise (+interference) ratio (CNR, CINR) can be measured for WiMAX installations in addition to voice and broadband performance for a complete WiMAX analysis.



VoIP

ISP-I's UDP testing simulates actual VoIP signals to determine packet loss, jitter and delay based on real VoIP traffic scenarios. IP addressing adds further insight.



Femtocell Picocell

With the ability to generate multiple simultaneous voice and data connections over a single access point (AP) ISP-I can fully load-test femtocell and picocell services to provide a real-life view of customer experience.



Metrics by Voice Access Technology

ISP-I VQ has a suite of key performance indicator metrics for testing all voice access technologies plus technology-specific metrics.



| Metrics | Mobile | PSTN | VoIP | WiMAX | Femtocell | Fixed Wireless |
|------------------------------|--------|------|------|-------|-----------|----------------|
| Set Up Metrics ** | | | | | | |
| Call Setup Time | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Call Completion Rate | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Call Duration Statistics | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Ring Duration Statistics | | | ✓ | | | |
| Call Setup Failures | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Call Drop Rate | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Dial Tone Delay | n/a | ✓ | ✓ | | n/a | ✓ |
| Pre Dialling Delay | n/a | ✓ | ✓ | ✓ | n/a | ✓ |
| Post Dialling Delay | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Answer Signal Delay | n/a | | ✓ | | n/a | |
| Call Release Delay | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Busy Signal Detect | | ✓ | ✓ | ✓ | | ✓ |
| Congestion Signal Detect | | ✓ | ✓ | ✓ | | ✓ |
| Ringing Signal Detect | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Audio Quality Metrics | | | | | | |
| P.862 Voice Quality | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Signal Level (db) | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Transmission Delay | | | ✓ | | | |
| Transmission Loss | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Background Noise | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| IP Metrics | | | | | | |
| TCP/UDP Performance | | | ✓ | ✓ | ✓ | |
| E-Model MOS | | | ✓ | ✓ | ✓ | |
| Packet Loss | | | ✓ | ✓ | ✓ | |
| Jitter | | | ✓ | ✓ | ✓ | |
| Round Trip Delay | | | ✓ | ✓ | ✓ | |
| IP Address | | | ✓ | ✓ | ✓ | |
| IP Network Analysis* | | | ✓ | ✓ | ✓ | |
| Radio Metrics | | | | | | |
| RSSI | ✓ | | | | ✓ | |
| Cell ID | ✓ | | | | ✓ | |
| CINR | | | | ✓ | | |
| SINR | | | | ✓ | | |
| CNR | | | | ✓ | | |
| SNR | | | | ✓ | | |

*ISP-I has an extensive suite of broadband test and measurement capabilities based on RFC 2544

** Requires per-configuration based on International PSTN tone Definition

ISP-I

ISP-I is used by regulators, operators and ISPs for authoritative analysis of voice and broadband networks.

The choice of industry

Whether it's benchmarking the leading voice operators across a country, managing network performance or launching new services ISP-I VQ has the capability to meet your analysis requirements.



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