



# Connectivity Experience Monitoring for Service Providers

---

**NetForecast**<sup>®</sup>

September 2019  
1818 Library Street, Reston VA 20190

[Rajan.Dass@netforecast.com](mailto:Rajan.Dass@netforecast.com)

# Independent Broadband Performance and Internet Usage Accuracy Solutions

---

NetForecast®

- 20+ years providing accuracy, measurement, analytics and consulting
- Most major terrestrial ISPs use NetForecast
- Technology-agnostic independent quality and accuracy measurements
- NetForecast accuracy methodology audited by leading independent statistical analytics firm



**We currently analyze operators  
representing over 100,000,000  
broadband subscribers**

## CHALLENGES

Rising demand for quality high-speed broadband connectivity

### Poor Customer Experience

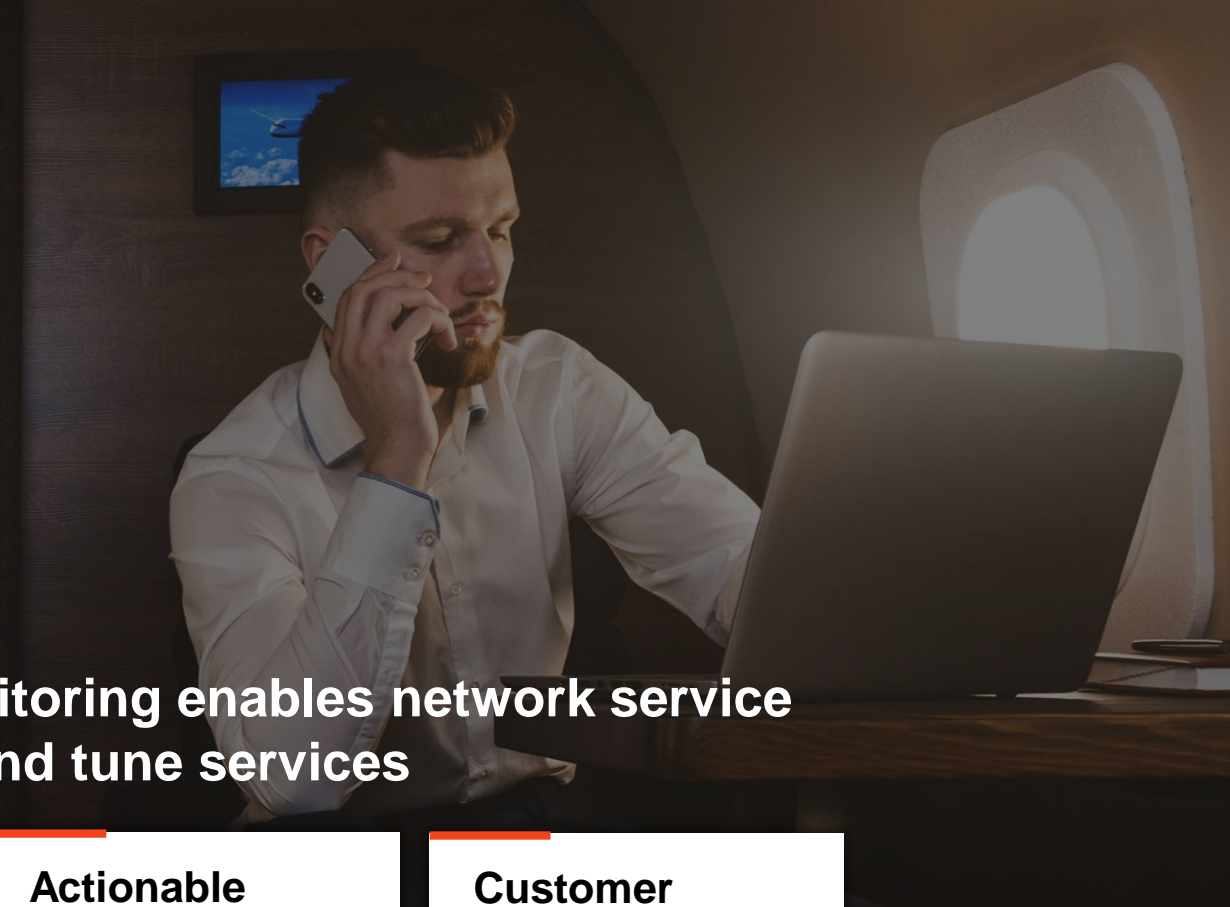
Quality of internet access drives customer satisfaction

### QoS vs QoE

QoS and SLAs only monitor pieces of the overall infrastructure

### Inadequate Data

Information is disjointed, with no hard data reflecting the customer's actual ongoing in-home experience



## SOLUTION

QMap connectivity experience monitoring enables network service providers to understand, manage and tune services

### Experience Visibility

Know what your users are experiencing

### Comprehensive Insights

Gain insights into all network segments through which data traffic passes

### Actionable Analysis

Understand application sensitivities to network performance

### Customer Satisfaction

Provide users the highest quality connectivity possible

# Customer Experience Visibility

**NetForecast**<sup>®</sup>

**QMap emulates what users are doing on their devices to how network performance affects those activities**

---

- Continuously measures users connectivity experience
- Captures all aspects of connectivity
- Independently evaluated

# NetForecast QoE Measurement

NetForecast®

- Measures only from subscriber end-point locations (behind the modem)
- Uses varying locations and service types
- Collects from:
  - Independent volunteer probes
  - NetForecast devices
  - NetForecast apps
- Varies the profiles based on different factors
  - 'Popular' service locations
  - User inputs
  - Specific communications as requested by the NSP



# Why QoE Measurement Is Needed

NetForecast®

## Independent view of subscriber experience

- On user devices (app)
- Inside the subscriber location (probe)

## Different from Network Management and OSS

- Path segments work well but QoE can still suffer
- Service providers need to detect and track QoE degradation events based on hard data

## Better than user surveys

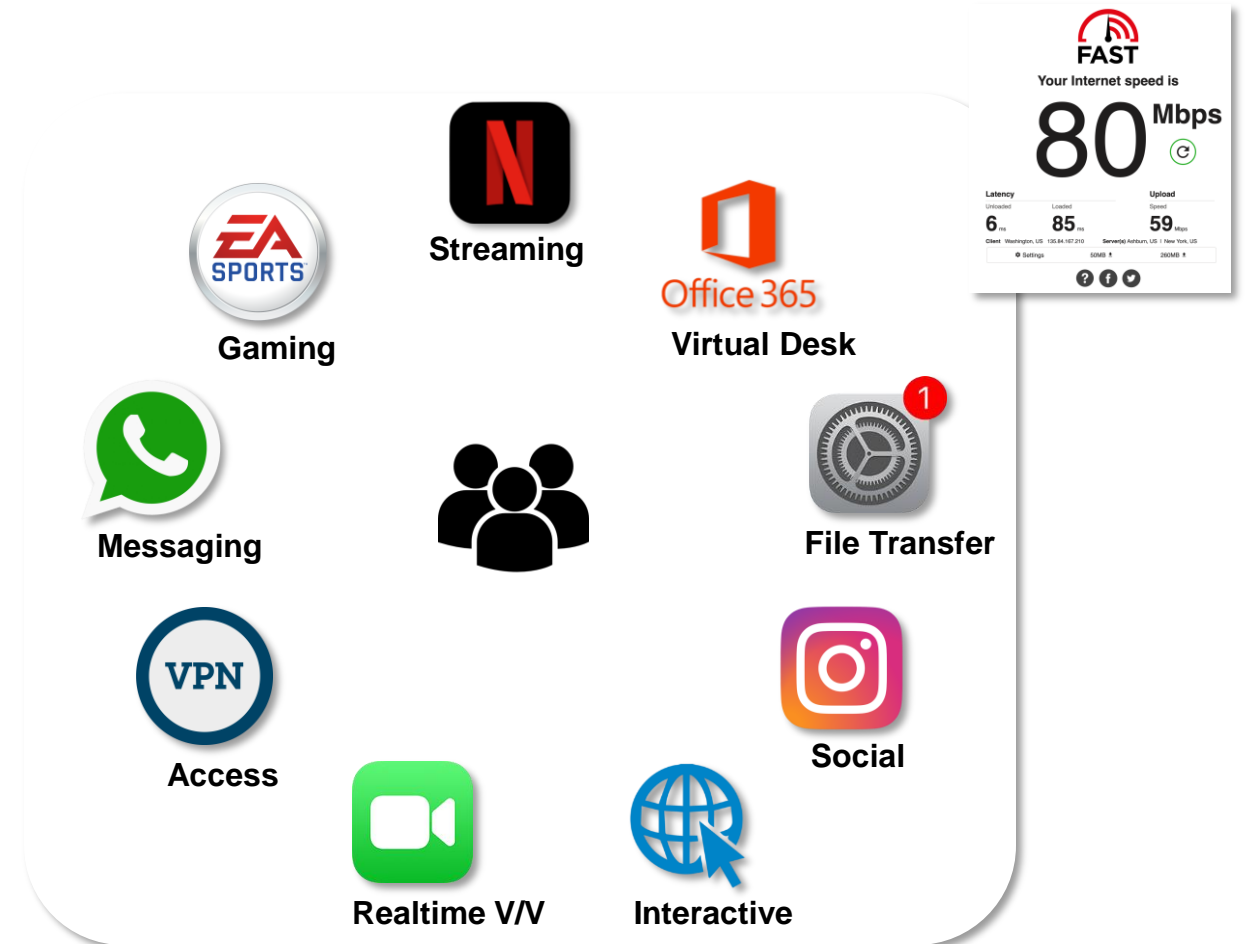
- User surveys are very unreliable
- Instrumenting all the applications in the world is impossible and breaks privacy rules



# What is QoE?

## Quality of Experience (QoE):

*A measure of how well users experience various internet use cases and application categories.*





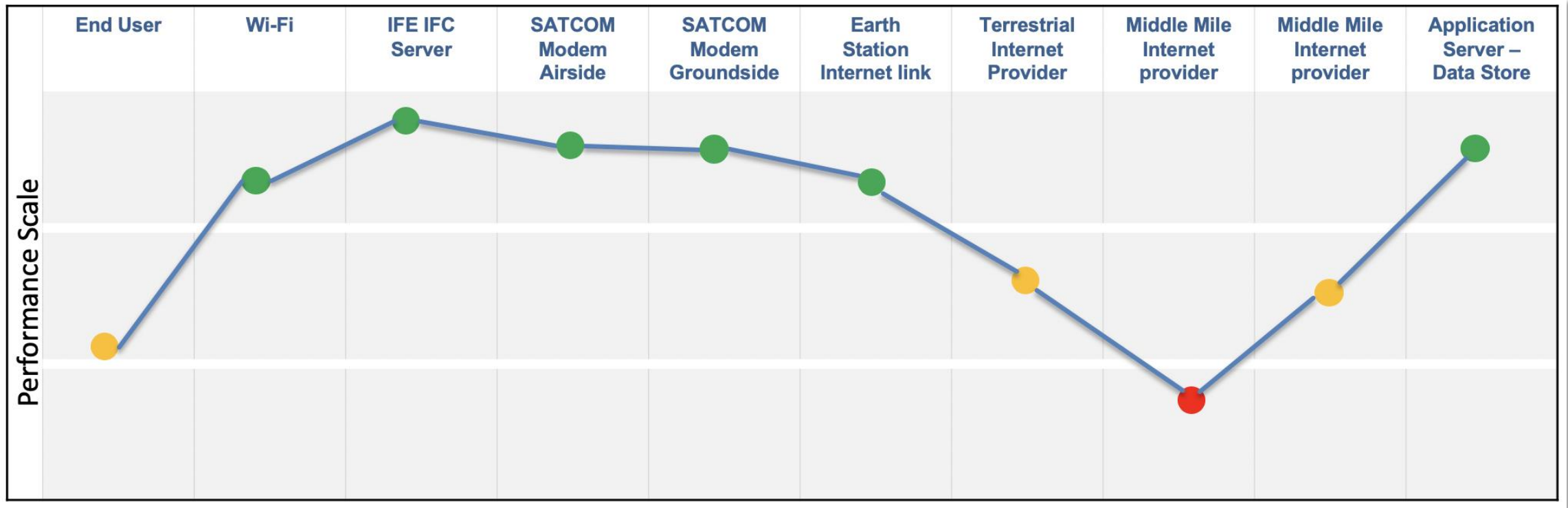
## QMap captures metrics across all network segments through which data traffic passes to predict quality of experience

- Five key network performance metrics evaluated
- Sensitivity reported by application type
- Metric baselines - true most of the time or application category would not be popular
- Tracking QoE degradation
  - When network metrics degrade, the application category degrades, then...
  - Consumers notice and complain

		Application Sensitivity to Internet Performance Metrics					
		Packet Latency	Packet Loss	Packet Jitter	DNS Response	Effective Bandwidth	
Application Categories	Request-Reply	<b>Messaging</b> <small>(txt msg, WhatsApp, SnapChat)</small>	Neutral	Neutral	Neutral	Low	Low
		<b>Interactive</b> <small>(Single player games, shopping, email)</small>	High	High	Neutral	High	Low
		<b>Virtual Desk</b> <small>(Office360, Google Docs, VPN)</small>	High	High	Neutral	Neutral	Low
		<b>Multi-Player Gaming</b> <small>(Fortnite, etc.)</small>	High	High	Neutral	Neutral	High
	Continuous	<b>File Transfer</b> <small>(s/w updates, backups, photo uploads)</small>	Low	Low	Neutral	Neutral	High
		<b>Streaming</b> <small>(Netflix, Hulu, YouTube, Prime, Spotify)</small>	Neutral	High	Neutral	Neutral	Low
		<b>Social Media</b> <small>(Facebook, Instagram, Twitter, Reddit)</small>	Low	Low	Neutral	Low	Low
		<b>Real Time</b> <small>(Video conferencing, Facetime)</small>	Low	High	High	Neutral	Low

Legend:   Neutral - no or negligible QoE impact   Low - moderate QoE impact   High - noticeable QoE impact

# Example Analysis



# How QoE is Measured

NetForecast®

## Simple probes

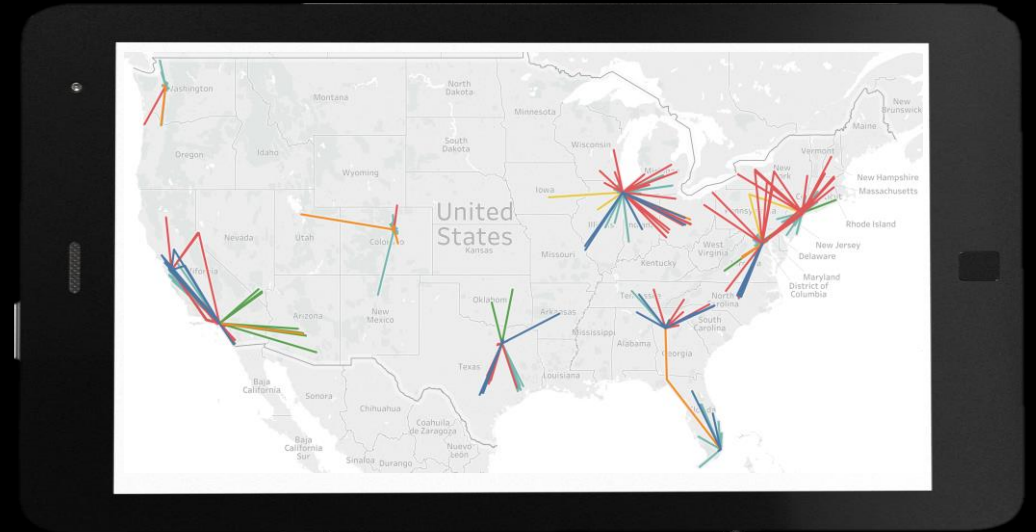
- Volunteers plug a simple probe into their gateway
- Any gateway or router, even those supplied by the ISP

## Testing the metrics

- End-to-end active tests of each metric from a “user” device to server
- Apps on phones, tablets, PCs, probes
- Testing to servers on-net, transit nodes, popular services

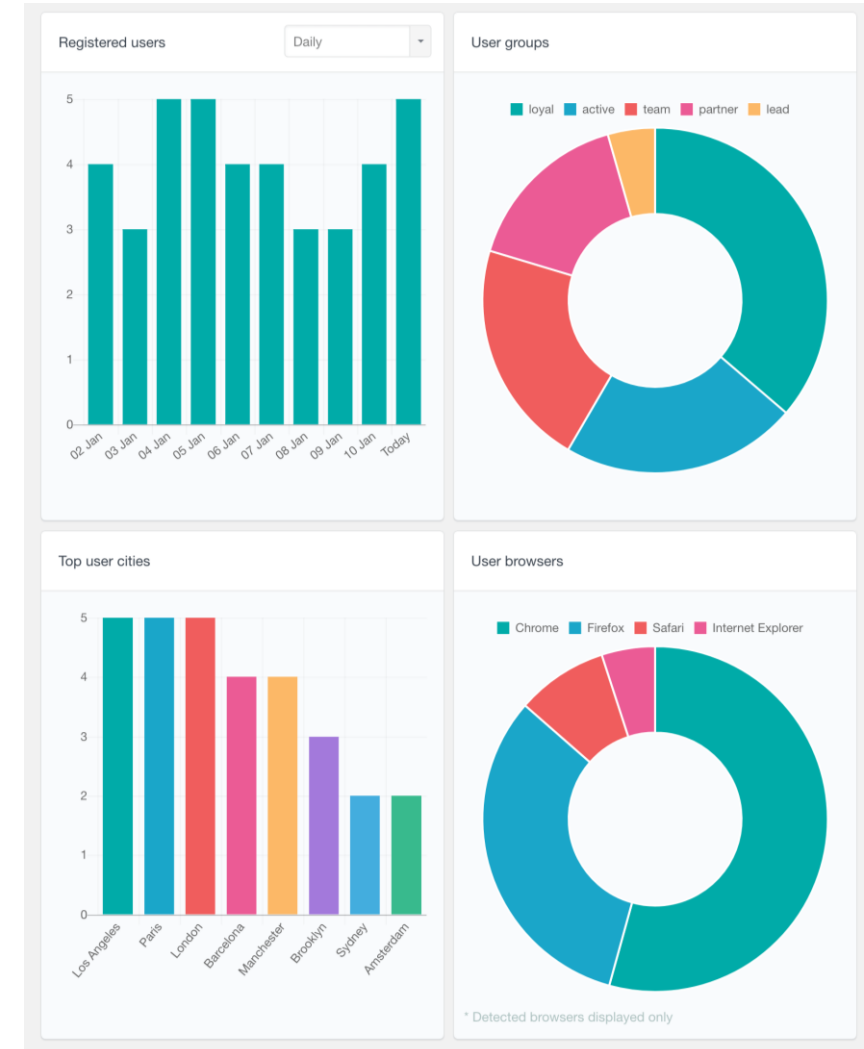
## Tests

- Dynamic assignment of probe-target pairs and test patterns
- Probes run test patterns that reliably measure key metrics driving QoE
- Tests are extremely lightweight
  - Don't interfere with user traffic
  - Don't impact the ISP usage cap if a cap exists



# How QoE is Reported

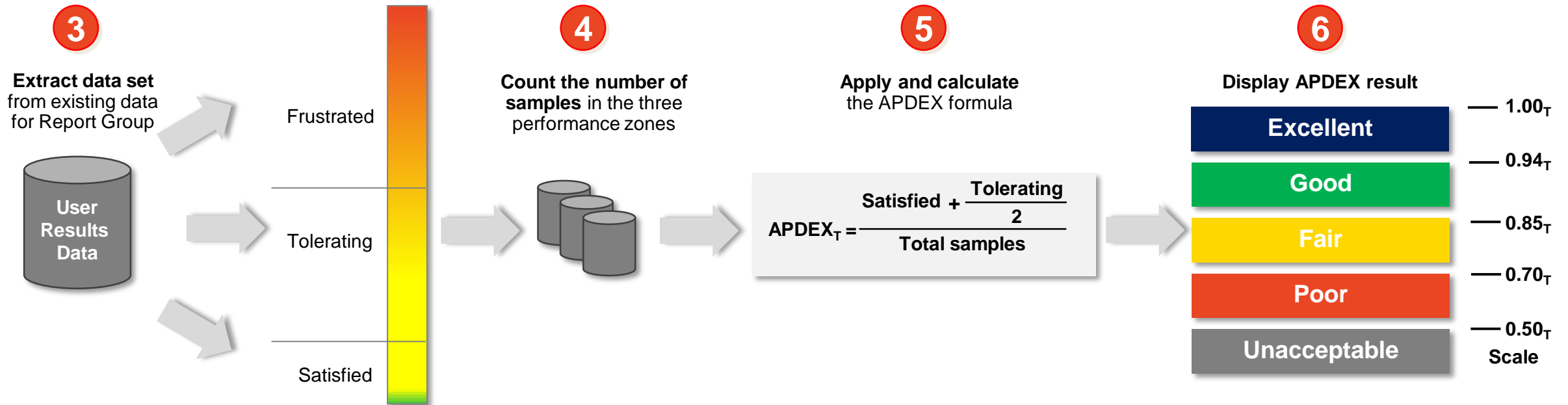
Analysis	<ul style="list-style-type: none"><li>• Test results are analyzed by NetForecast cloud service</li><li>• Separate QoE algorithms for each application category</li></ul>
Satisfactory QoE	<ul style="list-style-type: none"><li>• Defined separately for each application category</li><li>• QoE results are normalized to a single simple Apdex 0-1 scale</li></ul>
Multiple Reporting Modes	<ul style="list-style-type: none"><li>• Absolute: Dynamically assigned parameters based on application category</li><li>• Relative: Dynamically assigned parameters based on ISP's track record</li><li>• Fixed: Specific parameters based on application category and use case</li></ul>
Isolating Problems via Differential Metric Analysis	<ul style="list-style-type: none"><li>• Local mile (within ISP)</li><li>• Middle mile (transit networks)</li><li>• Distant mile (service data center)</li></ul>
Views for ISP Client and Other ISPs as an Option	



# How APDEX Works

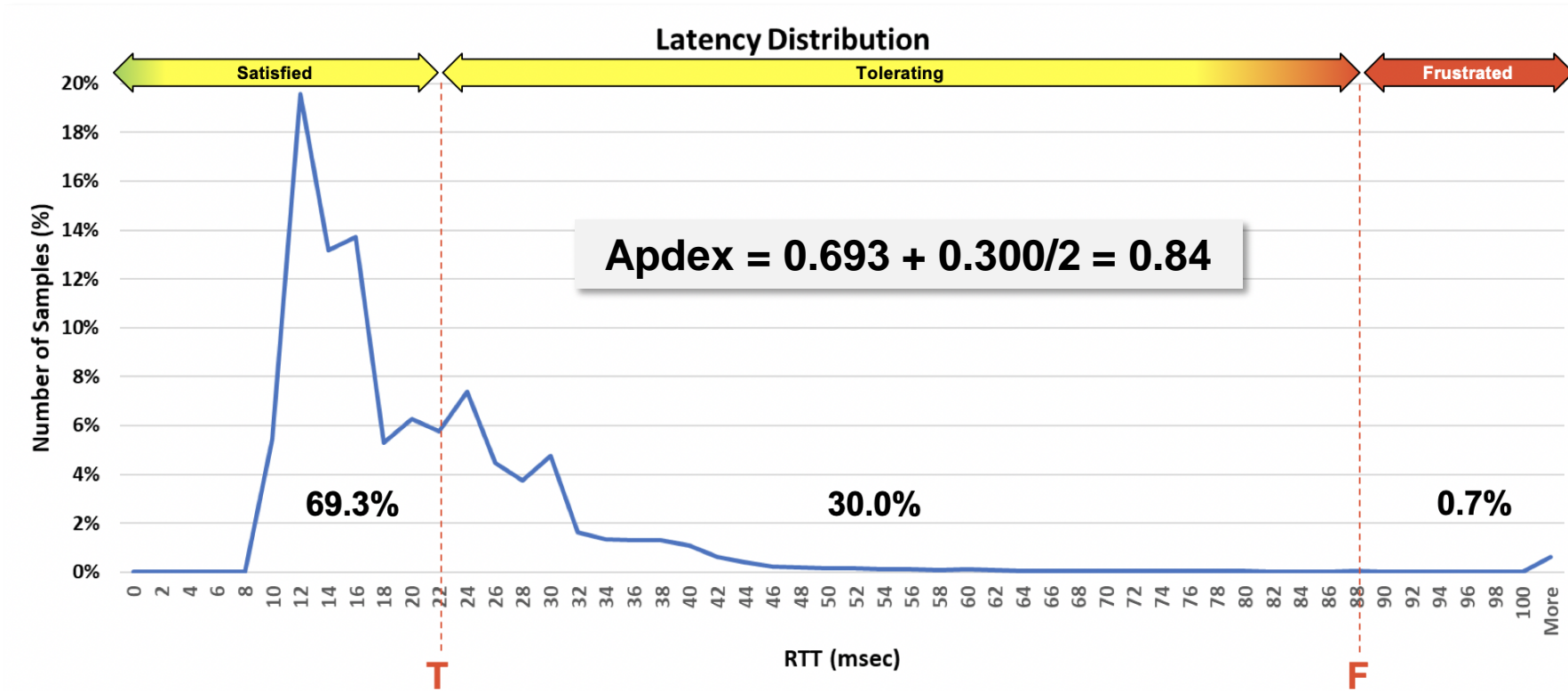
## Pre Processing

- 1 Define T for each application category**  
T = Target time (threshold between satisfied and tolerating user experience).  
F = Threshold between tolerating and frustrated user experience.
- 2 Define a Report Group**  
Tag by: Application Class, Region, Time Period, Internet Layer



# Example Analysis

## Subscribers to Near Servers in Chicago



**Apdex translates to NPS**

# Automated Management Process

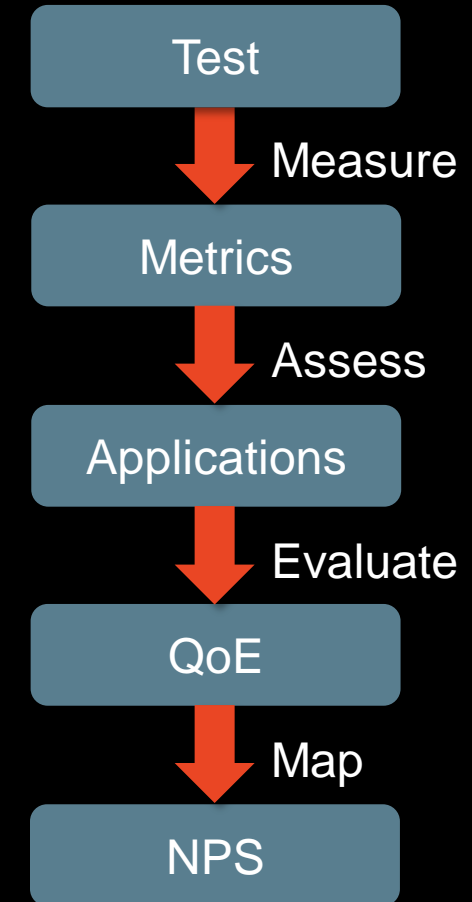
- NetForecast application performance models
- Built over decades of experience
- Logical progression of network metrics to user QoE
- Includes Management views and Diagnostic views for engineers
- Service operates seamlessly in the cloud
- Unique dashboards for various client needs
- QoE mapping to Net Promotor Score (NPS) for executives

## NPS for Internet Service Providers

AOL, AT&T, Verizon, Cablevision,  
Charter Communications, Comcast,  
Time Warner Cable, Cox Communications



# NetForecast®

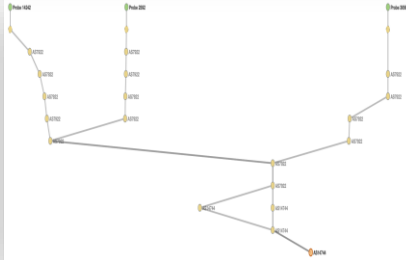


# **QoE Environment & Methodology**

---



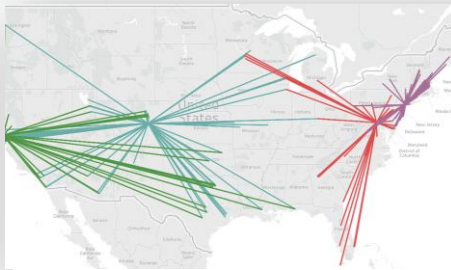
# QoE Process & Processing



2.7 Million+  
traceroute  
measurements/mo.

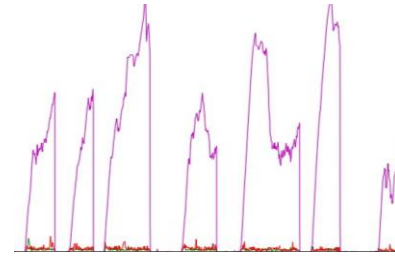


394 unique  
probes\*  
  
\*and growing

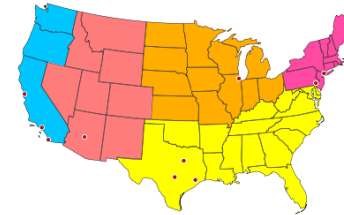


19 Anchor  
Sites

230,000+ ping  
measurements/day



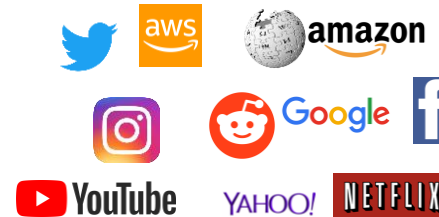
Top 10 major cities in  
continental US



39 MBA Targets



10 Consumer  
Sites



# NetForecast<sup>®</sup>

Millions of  
samples are  
collected 24/7

Tests are run  
from subscriber  
locations to  
multiple sites

# NetForecast<sup>®</sup>

Ready to provide  
world-class  
customer experience?



[www.netforecast.com](http://www.netforecast.com)



+1 540 454 9035



[rajan.dass@netforecast.com](mailto:rajan.dass@netforecast.com)



@net4cast



/NetForecast



#NetForecast

