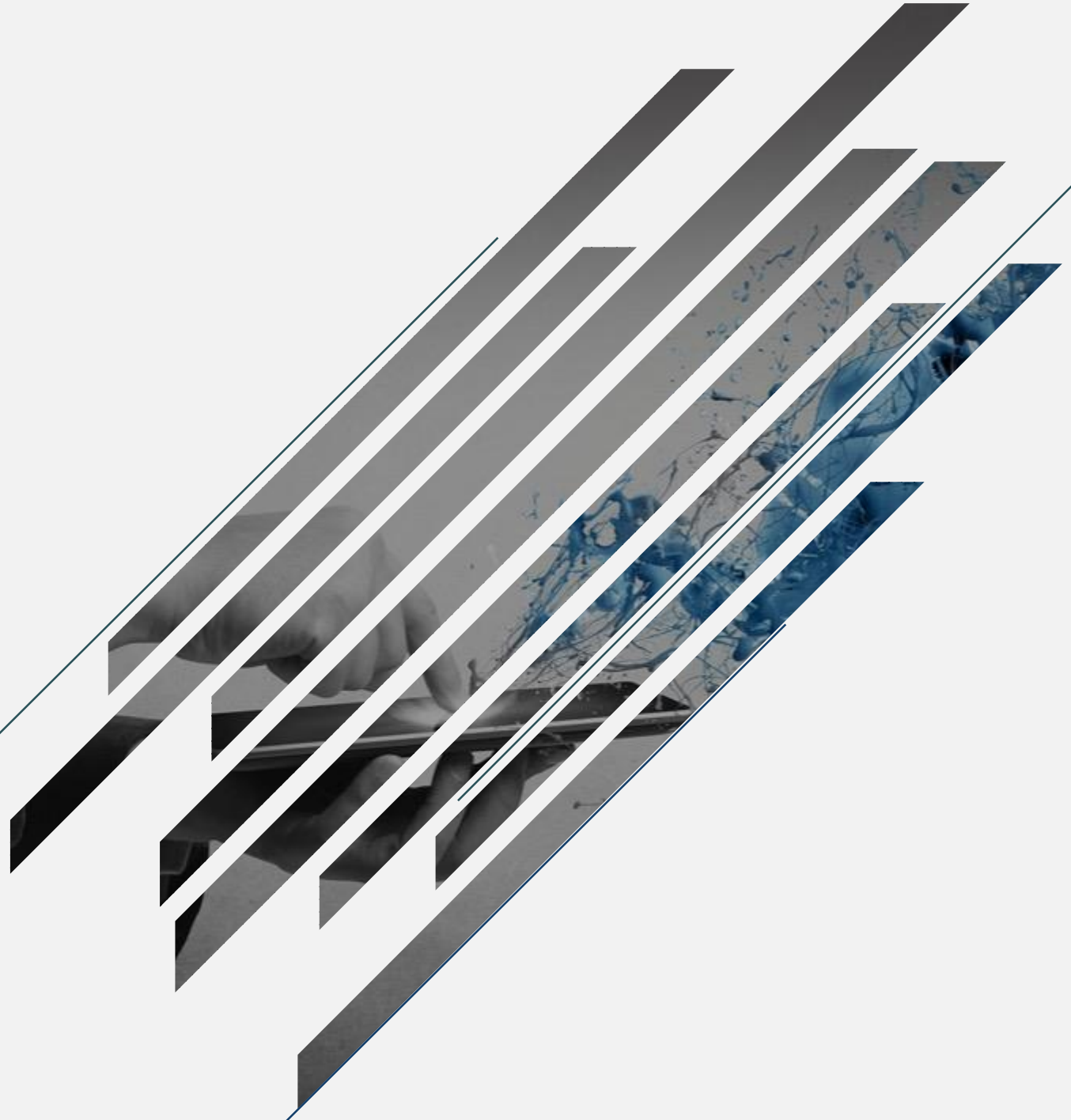
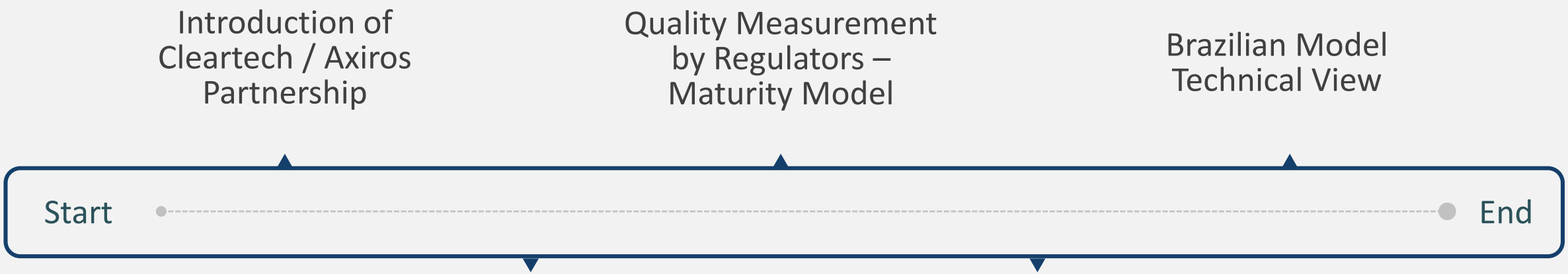


axiros Lasting Advantage | CLEARTECH Trust at the heart of Communications

EVALUATING QUALITY USER EXPERIENCE IN TELECOM

From incentives to implementation - The Brazilian Model.

Agenda


Introduction of Cleartech / Axiros Partnership
Quality Measurement by Regulators – Maturity Model
Brazilian Model Technical View
Start
End
Measure Quality in the IP World
Model Implementation Brazilian Experience
• Using an entity
• Technical models

About Cleartech

Our History

Cleartech was established in 1999 with its main goal being to offer the Brazilian market the best option to hire solutions and software specialized in Clearing House with quality, expertise and – above all – **without any bias or conflict of interest.**

More than 17 years

Always at the innovation and technology first wave, with essential services and solutions for the continuity of our customers' business.

Critical Mission Projects

Development, operation and support of large projects with national coverage.

Projects Milestone

2003 - Cobilling

Following ANATEL's regulatory frameworks, Cleartech started to provide Cobilling's Management Service, integrated with the main Telecom operators' in Brazil.

2013 - PGMC

In 2013, Cleartech was chosen to provide the technical platform for negotiating wholesale products between groups with and without Significant Market Power (SMP) – through which small companies can acquire supplies for the set price established by the General Plan for Competition Goals (Plano Geral de Metas de Competição – PGMC).

2017 - EAQ

Cleartech was chosen to develop the Management System for Quality Auditing Entity, as part of the process of measuring the quality indicators of telecommunications networks / internet broadband.

2007 – Portability

In 2007, Cleartech was chosen by ABR Telecom to operate the Brazilian Number Portability Database, which allows for any user of a landline or mobile phone to keep their number when changing service provider.

2017 – Mobile Connect

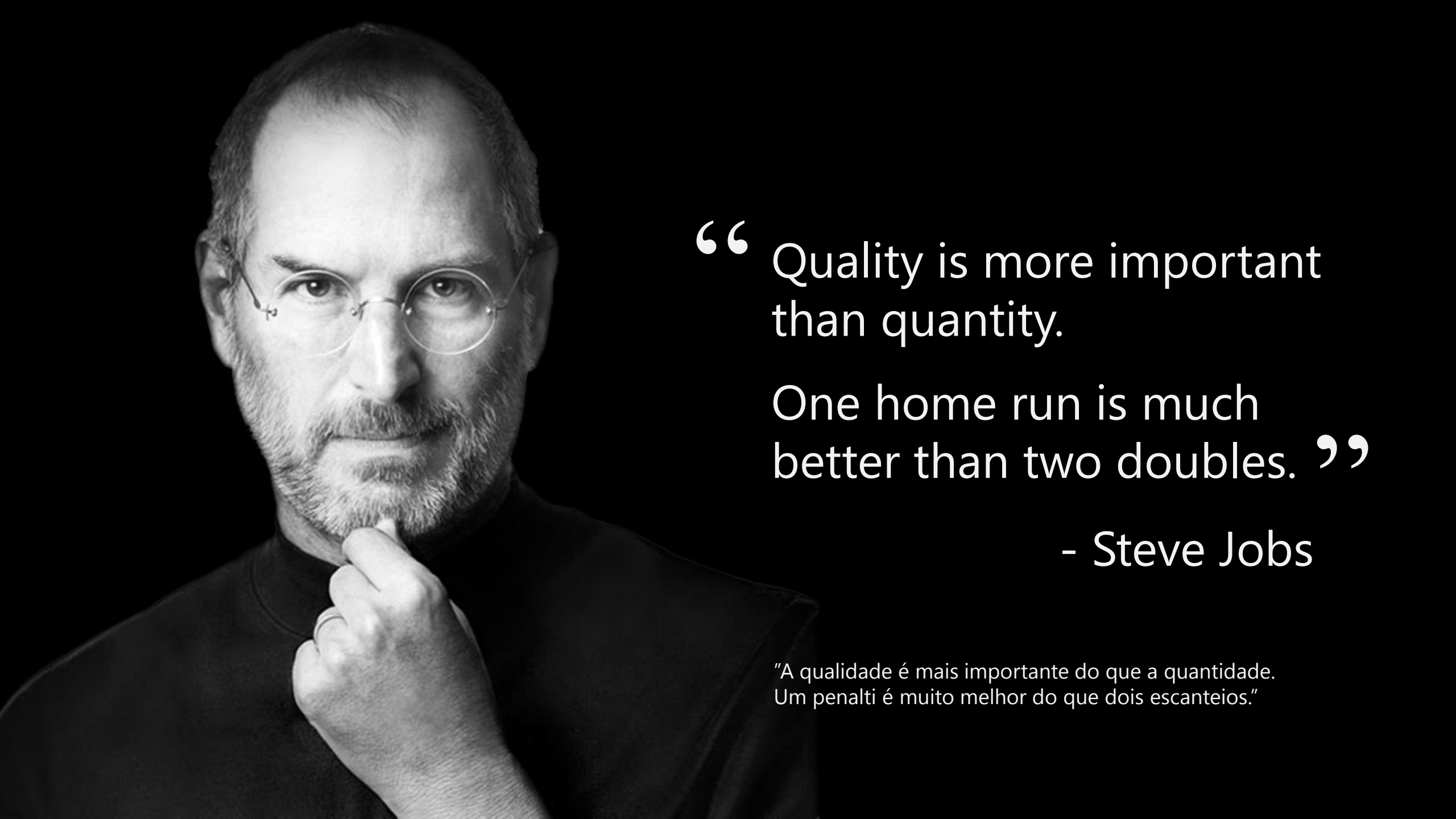
In 2017, Cleartech was chosen by ABR Telecom to manage Mobile Connect services in Brazil. It is a new service by GSMA that allows access to applications on any device based on the cellphone number.

About Axiros

- **100% self-financed, 100% independent. Since 2001.**
- **100% owned by employees**, **profitable** from the beginning.
- **ANY PROTOCOL. ANY DEVICE. ANY SERVICE. AT ANY TIME. Axiros** manages the Internet of Things

- **#1 - Market Leader in Europe in TR-069** - Based on number of provisioned devices, and number of active customers.
- **#1 - Technology Leader Worldwide** - Based on 25+ independent 3rd party benchmarks in the past 5 years, and the amount of supported and integrated devices reported.
- **230+ Operator Customers Worldwide** - From Greenland to Canada to Uruguay, from Iceland to Norway to Russia to Japan.
- **270+ Deployed & Live Axiros Solution Platforms Worldwide** - For Mobile & Fixed Line Broadband, Enterprise, Utilities and CPE Vendors.
- **Global In Scope** - With sales and service offices located in Milan, Lisbon, Aarau, Boston, São Paulo, Singapore and Tokyo and development centers in Germany, Russia and Brazil.

- **16 Years Of Business Experience** - Focused on Open Device & Service Management since 2001.



”A qualidade é mais importante do que a quantidade.
Um penalti é muito melhor do que dois escanteios.”

Measure Quality in the IP World

In an IP World the sum of the components quality does not equal the quality of the sum of components.

$$Qcomp_1 + Qcomp_2 + \ldots Qcomp_n \neq Q\,(comp_1 + comp_2 + \ldots comp_n)$$

There are implications from this, and a question:

HOW TO MEASURE QUALITY IN THE IP WORLD?

Measure Quality in the IP World

The only way to evaluate quality delivered to a user in the IP World is to connect to a service like the user.

Some people argue that it is possible to guarantee quality of a service from a telco or regulators perspective simply by assuring the quality of the network connection…. Not correct.

Measure Quality in the IP World

QoS

The industry evolved around the evolution of QoS concept

QoS (Quality of Service) is the measurement of the overall performance of a service in particular the performance seen by the users of a network. Quantitative aspects of the network are used – upload/download, bit rate, transmission, delay, jitter, latency, etc.

QoS is the ability to provide different priority to different applications or users data flows to guarantee a certain level of performance t**o** a data flow.

Measure Quality in the IP World

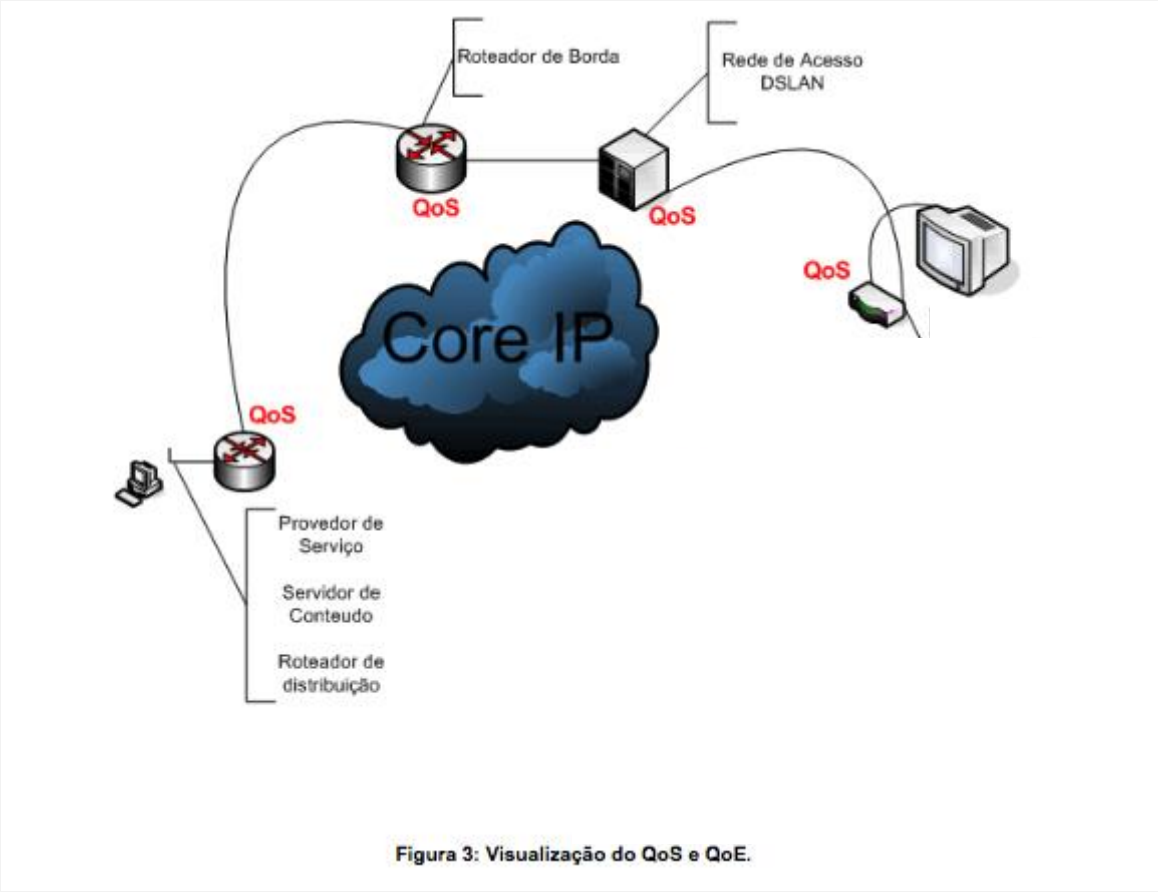
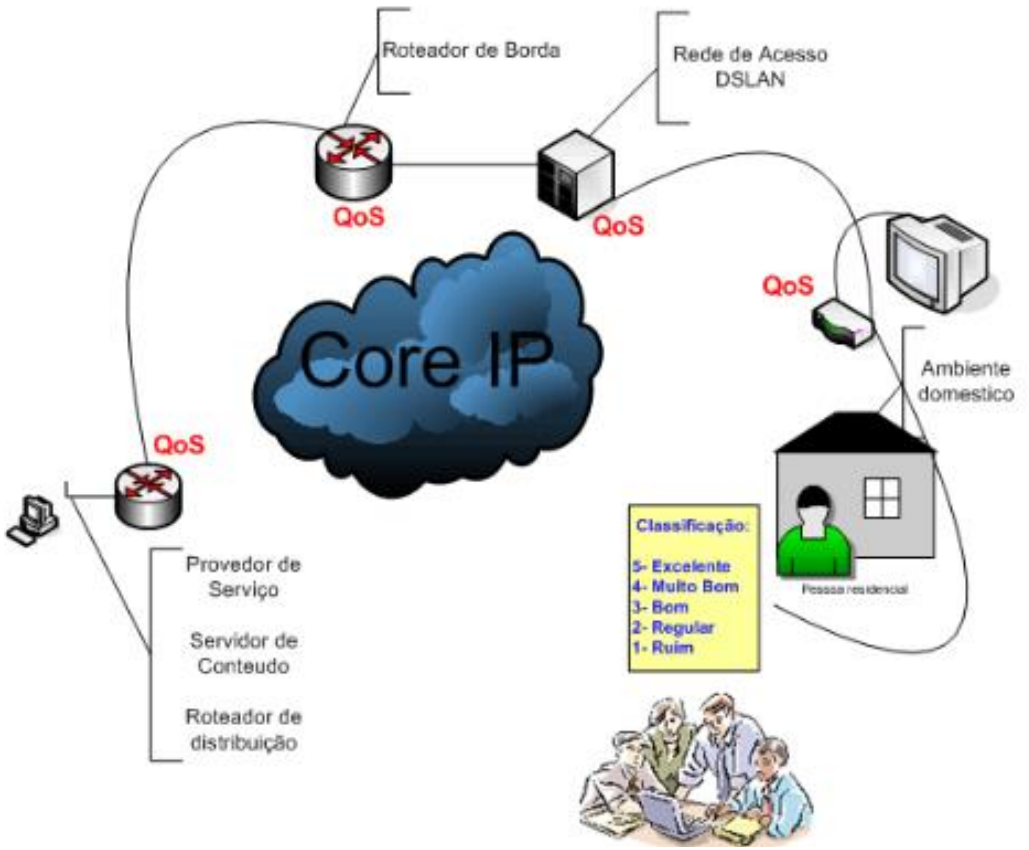


Figura 3: Visualização do QoS e QoE.

Several circuits with the same QoS can deliver different user perception of service.

From QoS to QoE



Quality of User Experience
(QoE)

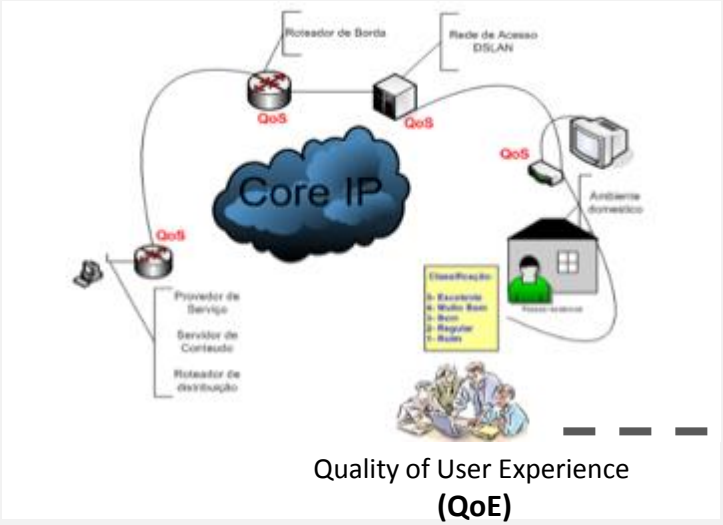
QoE (Quality of Experience) is a measure of delight or annoyance of a customer experience with a service (e.g browsing, call, etc.) it focus in the entire experience, it is a holistic concept in telecommunication.

ITU (International Telecommunication Union)

Recomendation ITU-T P.10

The degree of delight or annoyance of the user of an application or service (eg. browsing, call, etc.). It results from the fulfillment of his or her expectations with respect to the utility and/or enjoyment of the application or service in the light of the users personality and current state.

From QoE to Full Experience



Quality of User Experience
(QoE)

Relevance

Services

Products

Full Experience represents the user perception about a particular Service Provider:

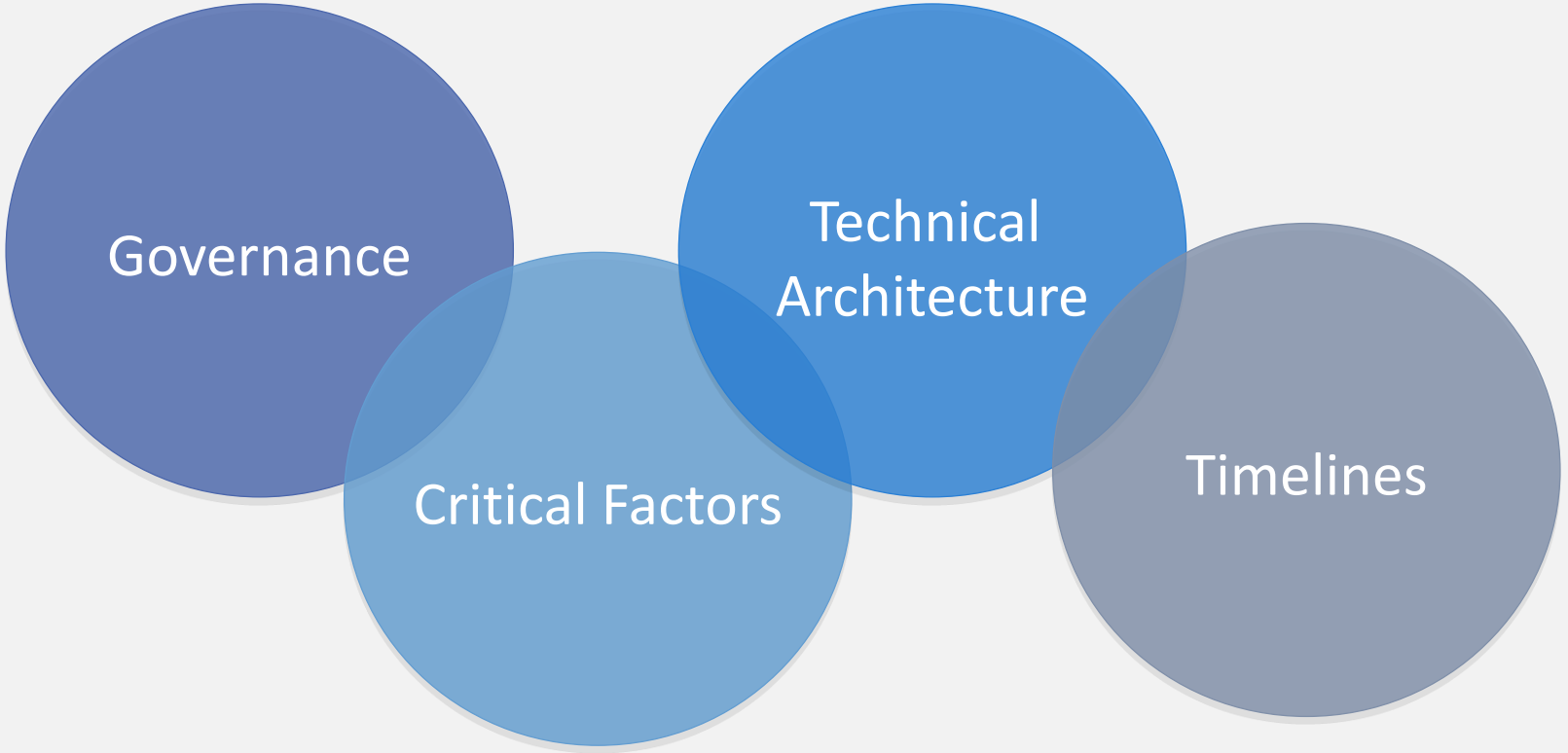
Products	Services	Relevance
• Web access • Video streaming • VOIP • Video on Demand • TTs • Other...	• Call center • Billing / Collections • Provisioning • Other	• Price • Perceived Pricing • Fidelization • Other

	QoS	QoE		Full Experience
Telco focus	Regulatory	Internal Quality Assessment		Competitive tool
Telco Stakeholders	Regulatory	Regulatory and Network Engineering		Regulatory Network Engineering Marketing / Commercial
Telco Attitude	Reactive	Proactive	Proactive Analytical	Strategic
Geographical Coverage	Smaller per UF	Municipality	Community	All
Scope measurement	Broadband parameters	Service parameters	User Qualification	User total experience plus OTTs
Volumes of measurements	Small number of dedicated probes	Thousands of Probes	Millions of Embarqued Probes	All user CPES can be used to measure
Type of measure solution	Proprietary probes	Mono Collector Standard Based Probes (TR143)	Multi-Colector Embarqued Software (Standards based)	+OTT Embarqued Probes Bots
Paremeters	Upload + download + jitter + latency + packet loss		Great, Excellent, Good… Parameters that supports products differentiation.	
Measurement object	Access Internet	Access services	App e P2P	Clusters of services
Telco products	Broadband (BB)	BB, Streaming	BB, ST, OTTs, VOD, P2P	BB, ST, OTTs, VOD, P2P, Financial Transactions
	EAQ 1.0	EAQ 2.0	EAQ 3.0	EAQ 4.0

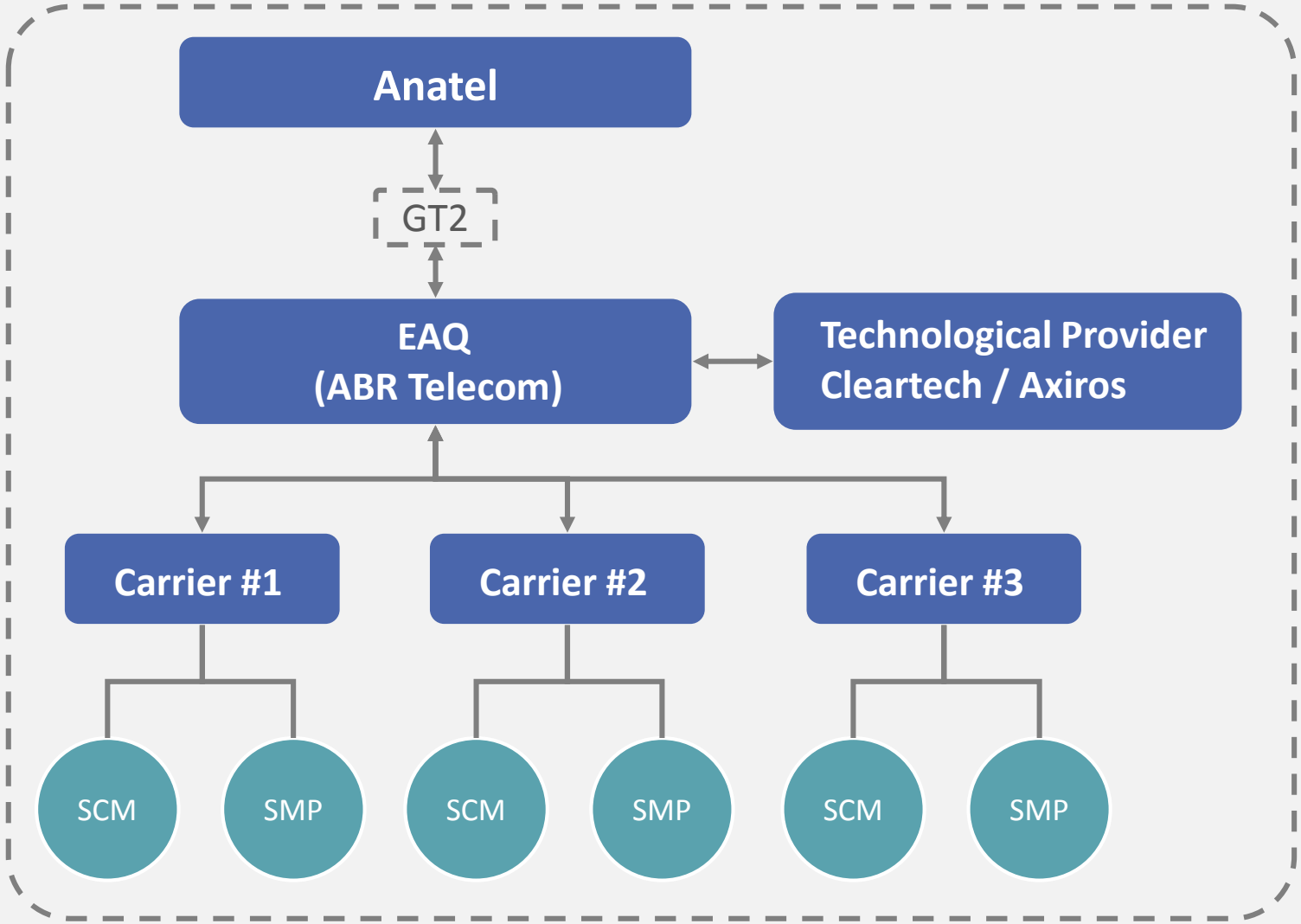
EAQ Model Implementation (The Brazilian Model)

How to implement the vision of the maturity model just introduced ?

- The Steps
- The Technologies



EAQ Model Implementation (The Brazilian Model)



SCM – Fixed Access *SCM – Wireless Access*

Governance

Role of the EAQ (Quality Admin. Entity)

- Provide technical guidance
- Industry leadership and coordination
- Transparency and neutrality of the quality measurement process
- Isonomy among all carriers and measurement technologies
- Negotiation of timetables that suit all carriers
- Transform regulator (Anatel) directives into industry programs with achievable milestones
- Homologation of the different measurement technologies
- Guarantee the production of Anatel Indexes in a timely way

EAQ Model Implementation (The Brazilian Model)

EAQ - Critical Success Factors

- New Financial model allows for the deployment of millions of probes by the Carriers in an Economic way.
- No need for Volunteers and expensive Logistical Deployment Processes and it's maintenance
- Centralized Purchasing for all Carriers provides Gains of Scale.
- Multi Collector Model – carrier can enroll to the EAQ-SW Probe or use its own Probe (providing a raw data subject to centralized processing)
- Extensive collection of CPE data allow data segmentation by the Carrier and Regulator (e.g. iPhone, Android, model, etc.)
- Probes can be monitored and managed by EAQ - ABR Telecom centralized system meaning that support levels will remain intact.
- Millions of measurements per day allow statistical relevance and granularity

EAQ Model Implementation (The Brazilian Model)

Technical Architecture

The only way to evaluate quality delivered to a user in the IP World is to connect to a service like the user

- Cleartech / Axiros technologies transform the CPES (modems, setup boxes, smartphones, etc.) in measuring devices:
- Different models can be implemented (for fixed (SCM) or mobile (SMP)):
  - Standards Based (BBF standard TR-143)
  - Proprietary Probes
  - Transformation of legacy CPEs into standard TR-143 (openWRT)
- Probes to be deployed in the plants in large numbers (millions of probes):
- Legacy Plants can be converted:

EAQ Model Implementation (The Brazilian Model)

Technical Architecture

- Probes in the plants (SCM or SMP) possible alternatives
  - SCM – as new firmware's or compatible openWRT compliant devices
  - SMP – as a dedicates LIB that becomes part of carrier own APPs
- The probes are "dormant" in the devices, until EAQ centralized platform starts "campaigns" to execute the defined "measurement strategies"
- The measurement is executed between the users CPE and a distributed network of servers located at pre-determined internet traffic exchanges (PTTs) at the carriers networks (on-net or off-net)
- The results are submitted to a centralized platform that stores the raw data and produces the indices according to the MOP (Manual Of Operations).

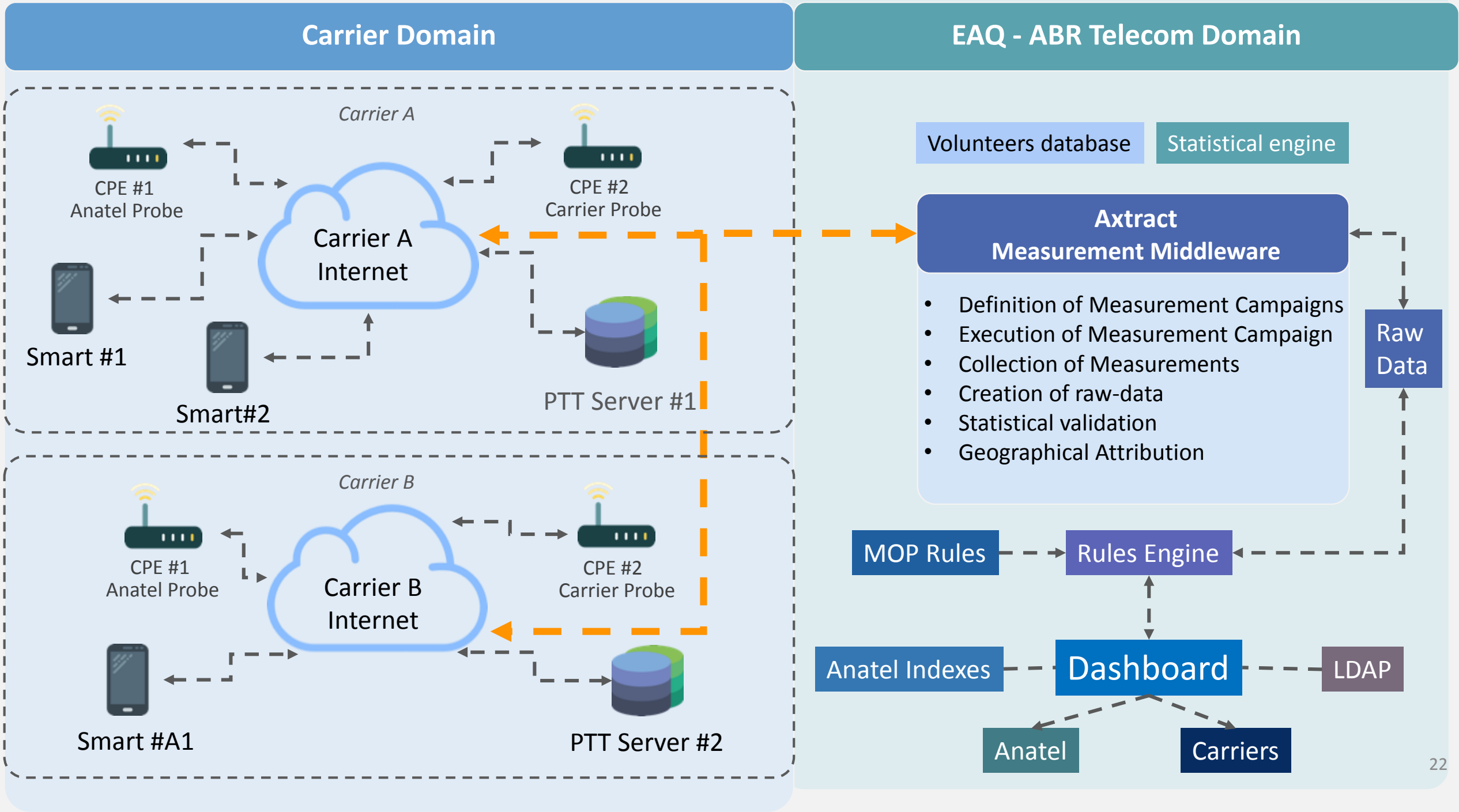
EAQ Model Implementation (The Brazilian Model)

Technical Architecture

- The MOP defines the ”rules and exceptions, timetables” in the calculation of the ANATEL indexes
- A dashboard, for the regulator, provides access to processed data and raw data originated in the measurement process
- The measurement campaigns are delivered from statistical rules that define the sampling rates and geographical coverage (granularity) rules to produce statistical valid campaigns
- Users are selected from a volunteer database or as per carrier definition / random selection
- Probes are available in large numbers (millions) providing statistical relevance and device independency.

Parameters Under Management Brazilian model

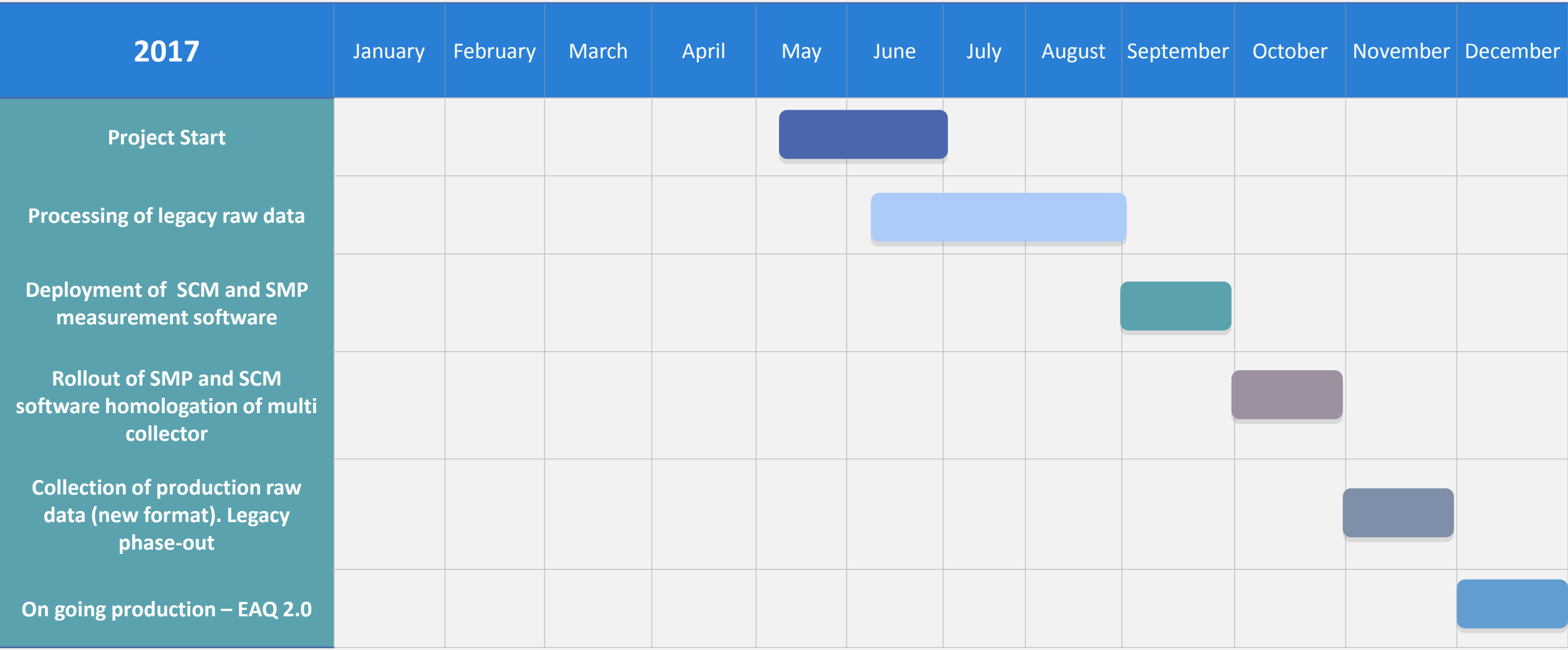
deviceID	bwDown	concurrentTrafficDown	minRTT
sourceIPv4	CEP	warmTime	maxRTT
sourceIPv6	address	warmBytes	Jitter
location	dateTime	warmIntervals	latencyPacketSize
lastMessage	speedTestInterval	speedUp	Packet Loss Failure
serialNumber	speedTestCounter	speedDown	Packet Loss Successes
macAddress	testPoint	availSuccesses	bwUp
manufacturer	speedTestTimeUp	availFails	bytesDown
modelName	speedTestTimeDown	availInterval	avgRTT
softwareVersion	bytesUp	listRTT	


Carrier Domain
EAQ - ABR Telecom Domain
Carrier A
CPE #1
Anatel Probe
CPE #2
Carrier Probe
Carrier A
Internet
Smart #1
Smart#2
PTT Server #1
Carrier B
CPE #1
Anatel Probe
CPE #2
Carrier Probe
Carrier B
Internet
Smart #A1
PTT Server #2
Volunteers database
Statistical engine
Axtract
Measurement Middleware
Definition of Measurement Campaigns
Execution of Measurement Campaign
Collection of Measurements
Creation of raw-data
Statistical validation
Geographical Attribution
Raw
Data
MOP Rules
Rules Engine
Anatel Indexes
Dashboard
LDAP
Anatel
Carriers

Heat Maps


Actions
Histórico de Força de Sinal
Queimados
Nova Iguaçu
Duque de Caxias
Jaguar
Leaflet | © Elastic Tile Service

EAQ Model Implementation - Timelines (The Brazilian Model)



Thank you!

Any question?

Al. Rio Negro, 585 , Edifício Padauiri 12º
Andar. Alphaville - Barueri | São Paulo.

@ClearTech_BR

CleartechBrasil

contato@cleartech.com.br

11 3576-4500