

Practical experience of application of Recommendation ITU-T E.806 “Measurement campaigns, monitoring systems and sampling methodologies to monitor the quality of service in mobile networks”

ITU Workshop on Performance, Quality of Service and Quality of Experience

8 - 9 September 2021

Miguel Sánchez Meraz
Instituto Politécnico Nacional - México

Application Case of E.806

The “**Shared Network (SN)**” is a LTE network with nationwide coverage in Mexico and wholesale service. It operates under a Public-Private partnership scheme. **PROMTEL**, a federal agency, provides the use of the 700 MHz band and **Altan Redes**, the private developer, deploys the network.

The contract includes population coverage obligations where minimum DL/UL rates must be met. According to a deployment calendar included in the contract, coverage milestones must be verified.



Binding Evaluation: verify compliance of the SN obligations, 4 Mbps of download and 1 Mbps of upload within its coverage area.

Non-Binding evaluation: integral evaluation of the coverage, quality and competition of the Shared Network

SIECD (Integral Service for Digital Connectivity Evaluation)

SIECD is a project performed by the IPN for PROMTEL

Binding Tests (IFT Methodology)



Tamaño de la Muestra, Ejercicio de Medición 2021

Este tablero de control cuenta con la siguiente información disponible:

- Muestras DL/UL
- Localización de Municipios por Estrato
- Muestras Totales
- Distribución Total de Municipios por Estrato

Sample Size

Actualización: Lunes, 05 de Abril de 2021

Hora Pico Matutina	Volumen de Tráfico (GB)
Hora Pico Vespertina	Volumen de Tráfico (GB)

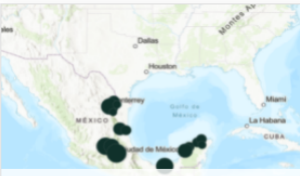
Determinación de Horas Pico

Este tablero de control cuenta con la siguiente información disponible:

- Tráfico Acumulado por (GB)
- Hora Pico, Matutina y Vespertina
- Sumatoria Semanal de Tráfico por Hora

Peak hour calculation

Actualización: Lunes, 31 de Mayo de 2021



Avance de Ejecución del Ejercicio de Medición 2021

Este tablero de control cuenta con la siguiente información disponible:

- Plan de Trabajo
- Tasa de Transmisión Promedio
- Mediciones Exitosas y Requeridas
- Porcentajes de Completación

Measurement campaign

Actualización: Lunes, 05 de Abril de 2021

Non Binding Tests

Cobertura (Coverage)



Evolución de Cobertura Poblacional RCM v2.0

Este tablero de control cuenta con la siguiente información disponible:

Mediante este tablero se indica un comparativo de los resultados de mediciones de cobertura respecto a los otros operadores LTE presentes en el mismo municipio. Los resultados se actualizan trimestralmente.

Período de Análisis: 1T2021 (Enero - Marzo 2021)

Calidad (Quality)



QoS Sondas

Este tablero de control cuenta con la siguiente información disponible:

- DL (Mbps), UL (Mbps).
- Latencia (ms), Jitter (ms).
- RSRP (dBm), RSRQ (dB), RSI (dBm).

Período de Análisis: 01 de Abril de 2021 al 19 de Junio de 2021

Categorías de Calidad de Servicio RCM v2.0

En este tablero se presenta la calidad de servicio (QoS) ofrecida por la RCM i resultado de las mediciones obtenidas a través de crowdsourcing: i. Tasa de descarga (DL) expresada en Mbps, ii. Tasa de transmisión de datos en el en la Latencia obtenida mediante la prueba de ping enfocada en medir cuánto tiempo la prueba más cercano al usuario que ejecuta la prueba, este tiempo se expresará en milisegundos. Los resultados se actualizan trimestralmente.

Última Actualización: Lunes, 31 de Mayo de 2021

Competencia (Competition)



Comparativo (benchmark) - Calidad de Servicio QoS

Mediante este tablero se indica un comparativo de los resultados de mediciones de calidad de servicio respecto a los otros operadores LTE presentes en el mismo municipio. Los resultados se actualizan trimestralmente.

Última Actualización: Lunes, 31 de Mayo de 2021

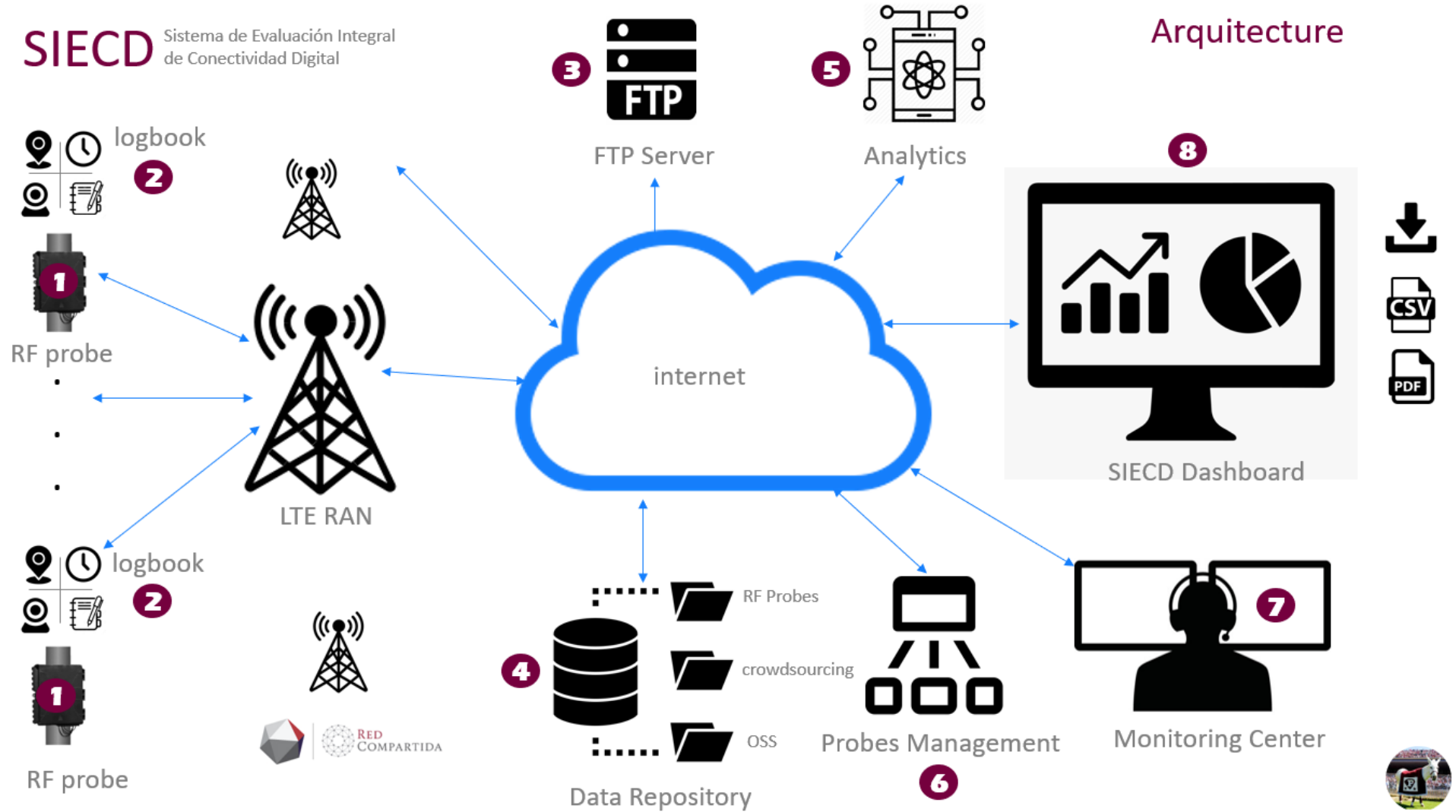
Número de Operadores y Cobertura por Municipio

Mediante este tablero se indica el número de operadores LTE que tienen presencia en cada municipio. Los resultados se actualizan trimestralmente.

Actualización: Lunes, 31 de Mayo de 2021

SIECD Monitoring System

SIECD Sistema de Evaluación Integral de Conectividad Digital



ITU-T E.806

- Describes a best practices framework for quality of service (QoS) measurement
 - Measurement campaigns to monitor QoS
 - Characteristics and requirements for monitoring systems
 - General recommendations for post-processing
 - **Sampling methodologies** used by regulators, manufacturers, service providers to monitor QoS nationwide



International Telecommunication Union

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

E.806

(06/2019)

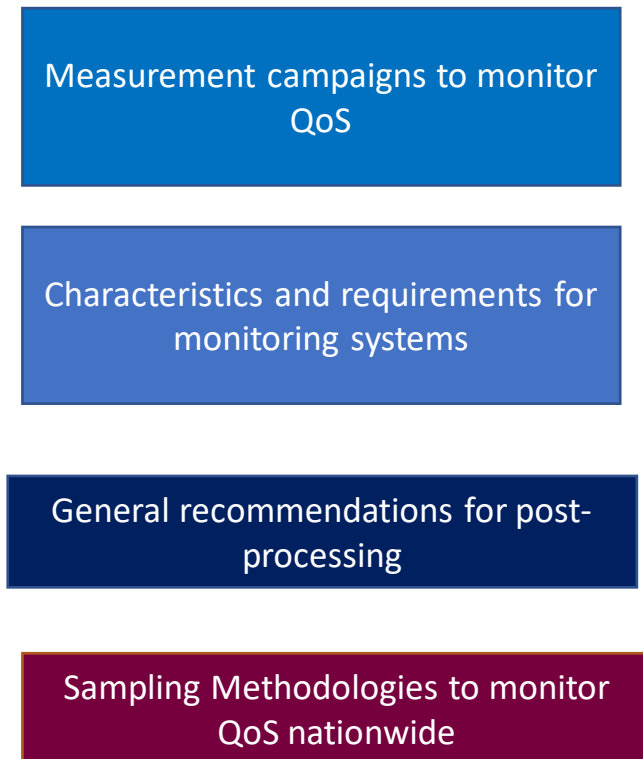
SERIES E: OVERALL NETWORK OPERATION,
TELEPHONE SERVICE, SERVICE OPERATION AND
HUMAN FACTORS

Quality of telecommunication services: concepts, models,
objectives and dependability planning – Terms and
definitions related to the quality of telecommunication
services

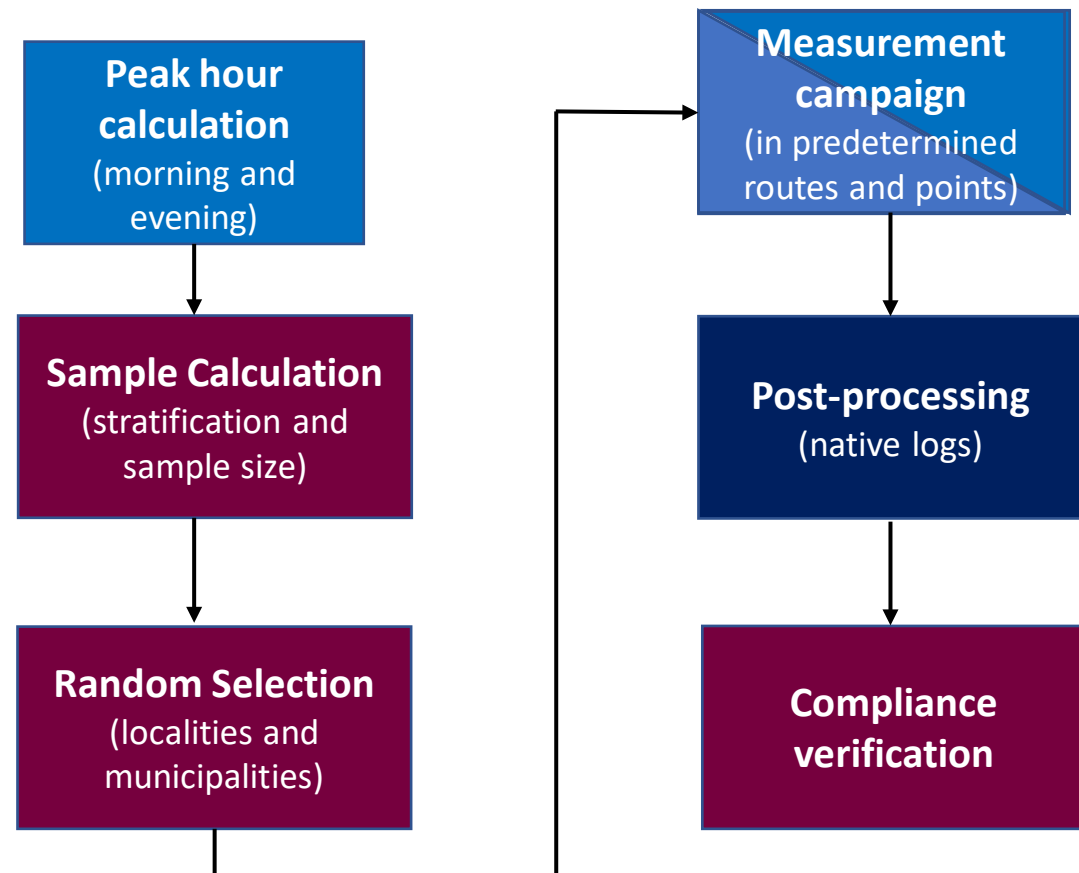
**Measurement campaigns, monitoring systems
and sampling methodologies to monitor the
quality of service in mobile networks**

Evaluation Methodology for Binding Tests

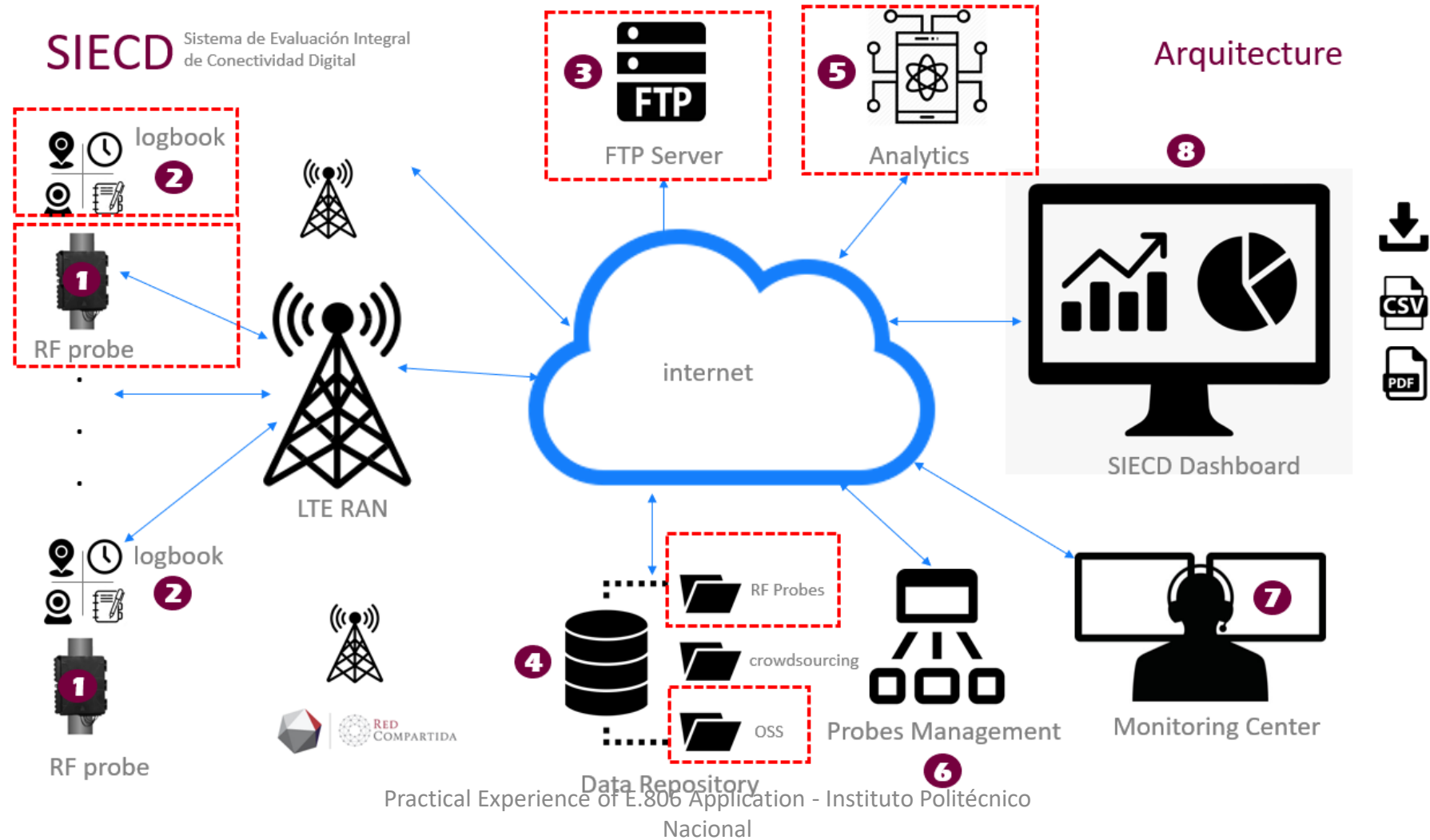
ITU-T E.806 Framework



IFT* Methodology for Shared Network evaluation



SIECD Monitoring System for Binding Tests



Peak hour Calculation



ENTIDAD Todas **MUNICIPIO** Todas **AÑO** Todas **MES** Todas



Determinación de Horas Pico ← Inicio

Hora Pico Matutina

11:00 Hrs.

Volumen de Tráfico (GB)

196.762,05

Hora Pico Vespertina

22:00 Hrs.

Volumen de Tráfico (GB)

243.709,14

48.038,61

Tráfico Mínimo

Sumatoria Semanal de Tráfico por Hora

243.709,14

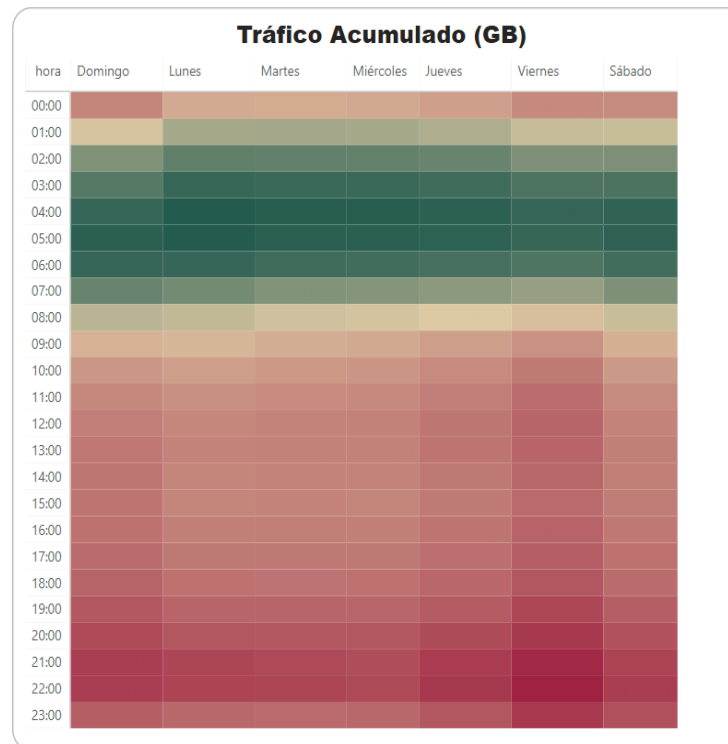
Tráfico Máximo



Fuente de Datos: Contadores de Desempeño (Tráfico Mensual)

SIECD ver 1.0

Última Fecha de Actualización: viernes, 30 de abril de 2021



Most recent quarter traffic data obtained from the Altán Operation Support System is used.

Statistical analysis is performed to calculate morning and evening peak hour

Peak hour dashboard

Sample Calculation

1. Identify the total number of municipalities (n) in which measurements must be carried out, based on the following formula

$$n = \frac{(\sum_{i=1}^L N_i \sigma_i)^2}{N^2 D + \sum_{i=1}^L N_i \sigma_i^2}$$

2. Identify the number of municipalities to measure for each stratum (n_i),

$$n_i = n \left(\frac{N_i \sigma_i}{\sum_{i=1}^L N_i \sigma_i} \right) \quad i = 1, 2, 3$$

Where:

- σ_i standard deviation of the transmission rate in each stratum,
- N_i number of municipalities classified in each stratum,
- N the total number of municipalities covered by the network
- L total number of strata (3)
- D a factor that is calculated from the estimation error bound

Stratification:

The coverage area was divided into municipalities urban, suburban and rural depending on its number of inhabitants.

3. The following table shows the number of municipalities by stratum that were evaluated, as well as the total significant sample that was used during the measurements.

Stratum	Municipalities within coverage	Municipalities to run tests	
		UL	DL
Urban	253	2	6
Suburban	308	2	8
Rural	797	3	17
TOTAL	1,358	7	31

Random Selection

- Once the number of municipalities has been calculated, the number of measurements to be carried out per municipality is calculated, both for uplink and downlink, through the following formula.

$$m_i = \frac{z_{1-\alpha/2}^2}{a^2} \cdot \left(\frac{\sigma_i}{\bar{x}_i}\right)^2$$

- σ_i standard deviation of the transmission rate in each stratum
- \bar{x}_i is the mean of the average data transmission rate.
- a is the estimation error (2%)
- $z_{1-\alpha/2}$ is the percentile of the standard normal distribution obtained from the confidence level (95%).

- The total samples (number of measurements) are the product of the number of samples from each stratum by the number of municipalities to be measured.

UPLINK			DOWNLINK		
STRATUM	REQUIRED SAMPLES	TOTAL SAMPLES	STRATUM	REQUIERED SAMPLES	TOTAL SAMPLES
Urbano	376	752	Urbano	538	3, 228
Suburbano	251	502	Suburbano	219	1, 752
Rural	179	537	Rural	303	5, 151
	Total	1,791		Total	10,131

Minimum number of samples to obtain representativeness at the national level

Measurement Campaign



ENTIDAD

Todas

ESTRATO

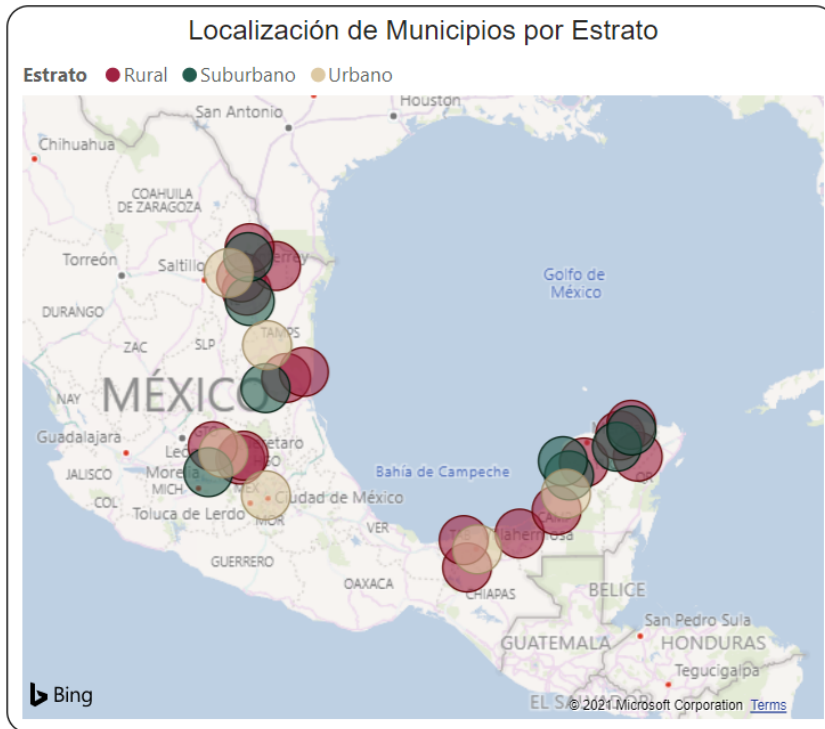
Todas

ENLACE

Todas



Tamaño de la Muestra-Ejercicio de Medición 2021 [Inicio](#)

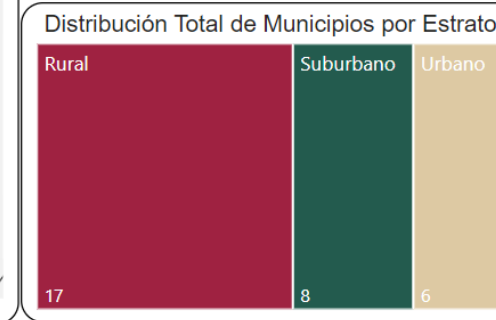


Nombre de municipio	DL	UL	Total
Agualeguas	303		303
Aldama	303		303
Apaseo el Grande	303		303
Buctzotz	303		303
Cadereyta Jiménez	303	303	606
Calkiní	219		219
Campeche	538		538
Centro	538	538	1.076
Cerralvo	251	251	502
El Mante	538		538
Ezequiel Montes	303		303
General Bravo	303		303
González	303		303
Hecelchakán	251	251	502
Hualahuises	219		219
Huichapan	303		303
Montemorelos	303		303
Total	10.195	2.487	12.682

12.682
Muestras Totales

DL
10.195
Muestras DL/UL

UL
2.487
Muestras DL/UL



Additional measurements are considered to have backup samples.

Compliance Verification

- The objective is to determine whether the minimum transmission rates established by the IFT Methodology of 4 Mbps for the downlink and 1 Mbps for the uplink are met by accepting or rejecting a hypothesis.

1. Approach of the null and alternative hypothesis.

Hypothesis	Downlink	Uplink
Null Hypothesis (H_0)	$H_0 : x_{st} \geq 4 \text{ Mbps}$	$H_0 : x_{st} \geq 1 \text{ Mbps}$
Alternative (H_a)	$H_a : x_{st} < 4 \text{ Mbps}$	$H_a : x_{st} < 1 \text{ Mbps}$

The hypothesis tests carried out allow us to confirm that the transmission rates for both the downlink and the uplink **comply with the minimum rates established at the national level of 4 Mbps and 1 Mbps respectively.**

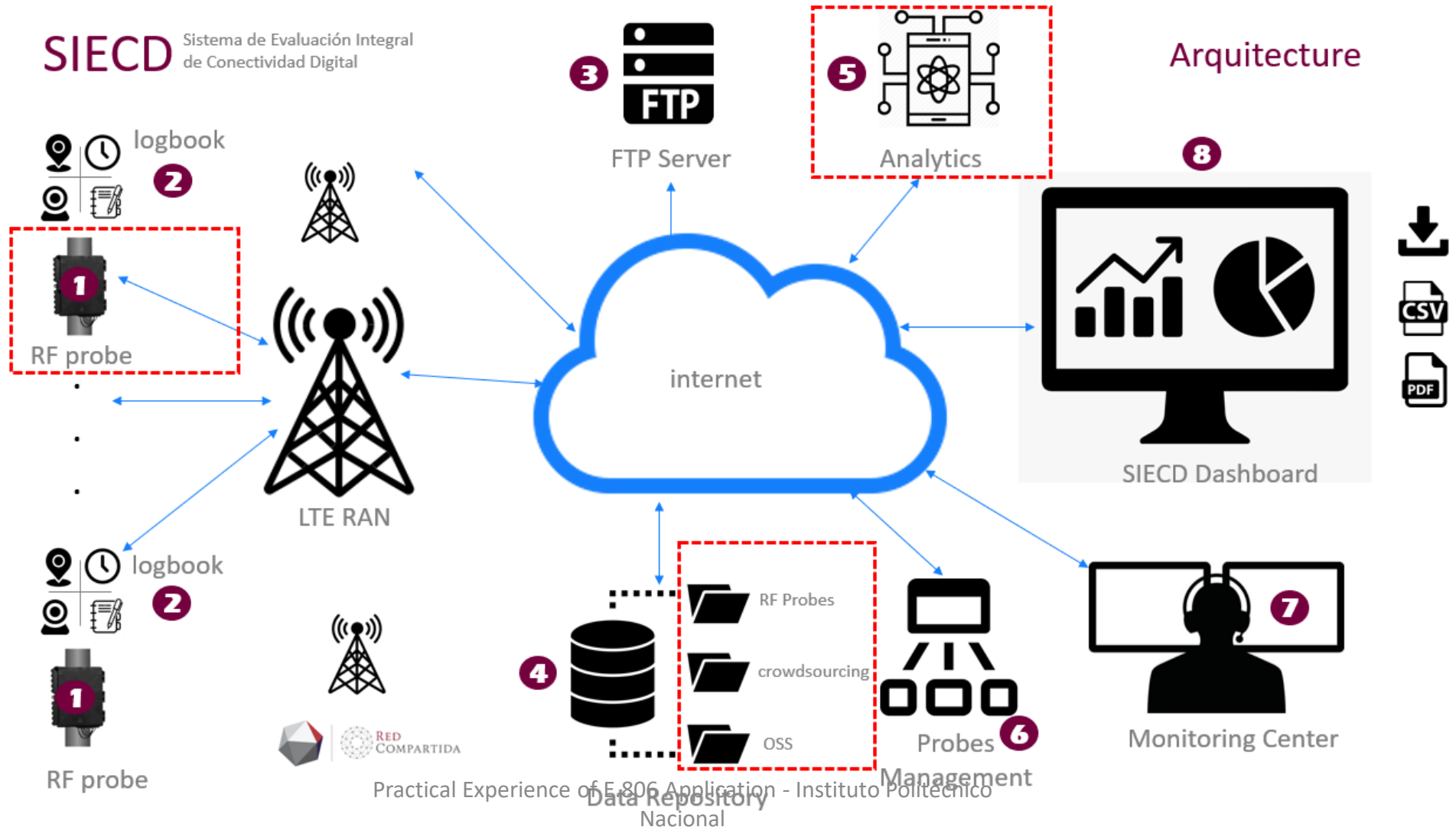
2. Choice of the confidence level of a hypothesis test (threshold that allows determining whether the result of a study can be considered statistically significant or not).

Confidence level

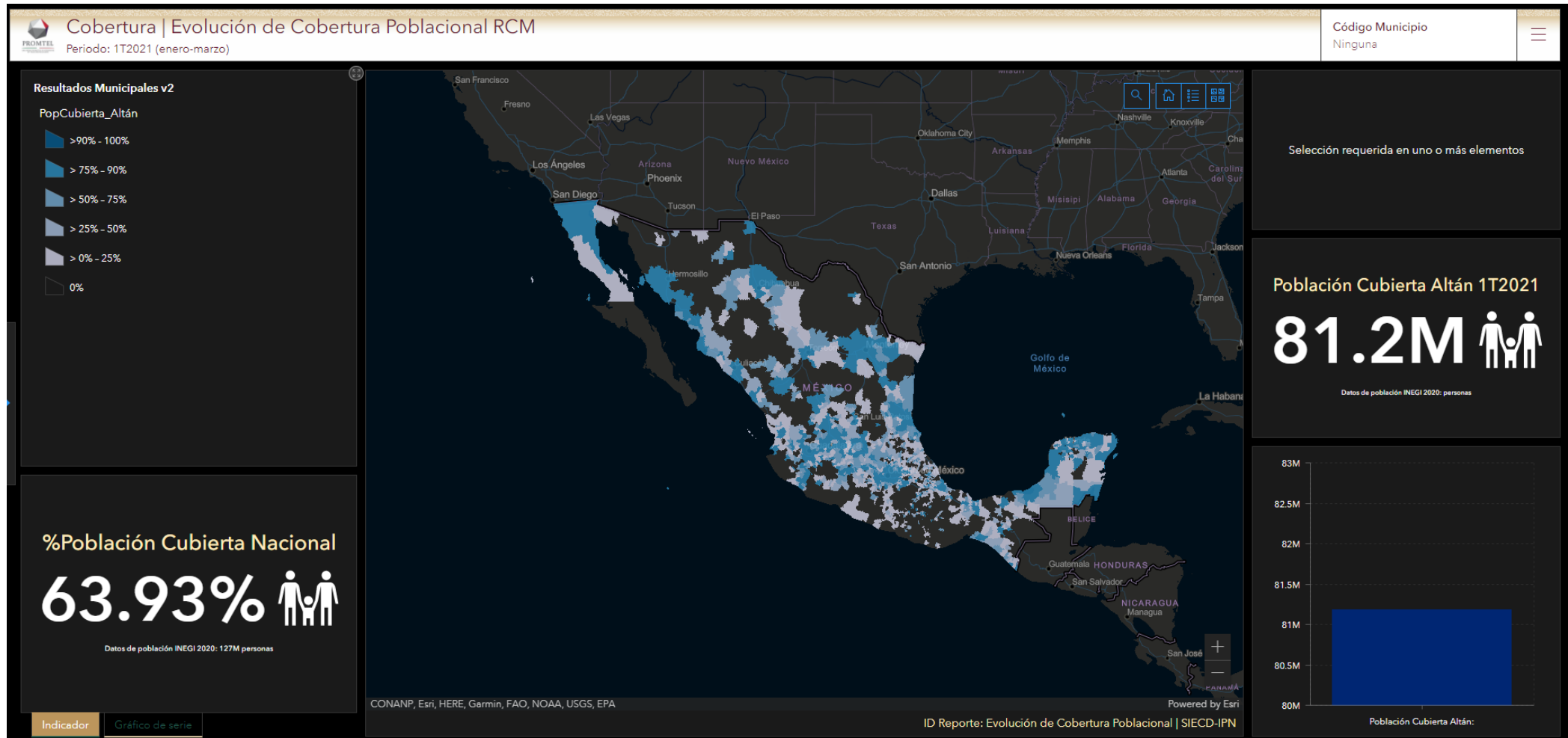
$$1 - \alpha = 95\%$$

the value of the confidence level is set by the IFT methodology

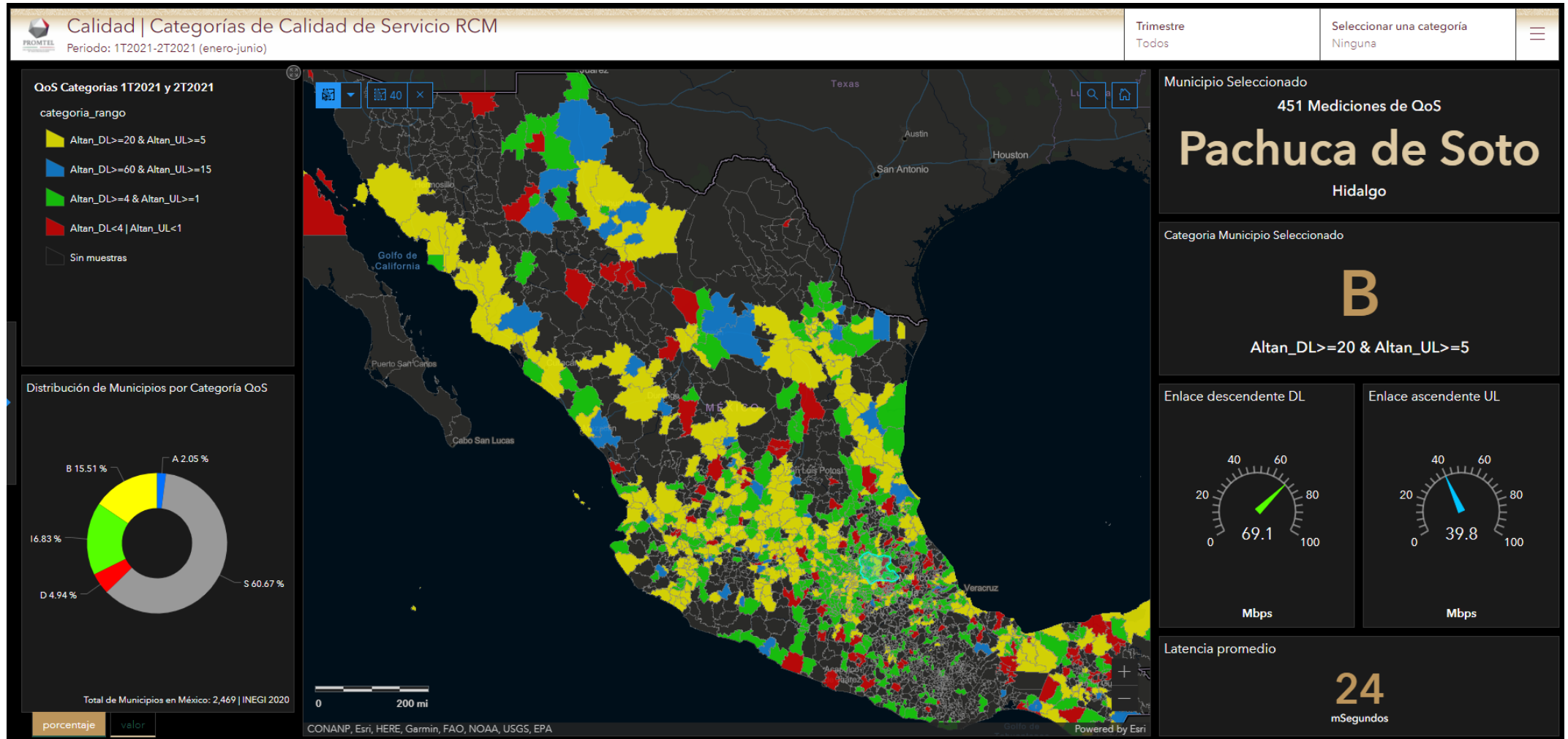
Monitoring System for Non-Binding Tests



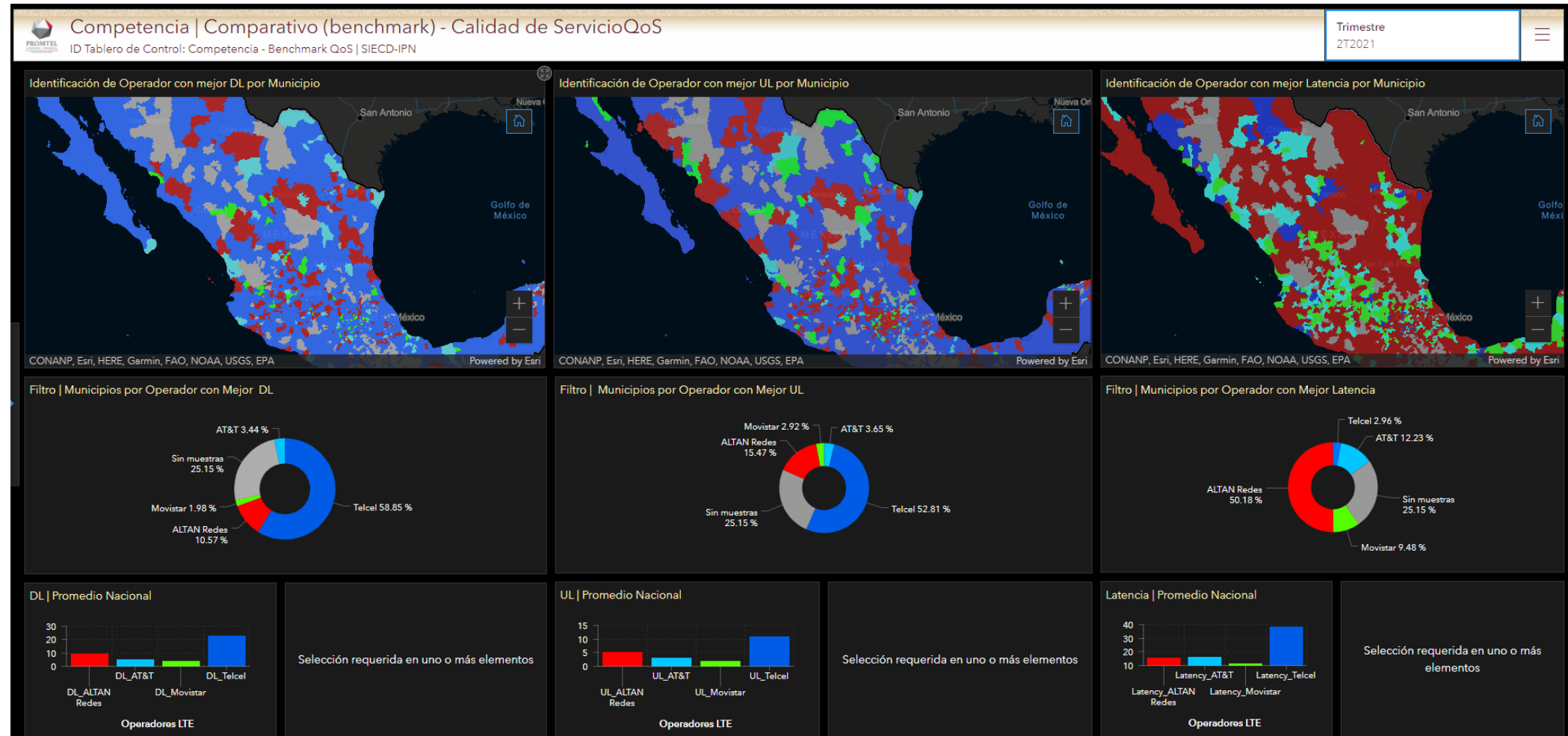
SIECD Coverage Dashboard



SIECD QoS Dashboard



SIECD Competition Dashboard



SIECD Demo

¡Thanks for your attention!
Questions and answers

Contact:

Miguel Sánchez Meraz

Instituto Politécnico Nacional

mmeraz@ipn.mx