

PONTIFICIA UNIVERSIDAD CATÓLICA DEL PERÚ

Facultad de Ciencias e Ingeniería



PONTIFICIA
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CATÓLICA
DEL PERÚ

**Diseño e Implementación de una Red Indoor basada
en Femtoceldas para una Agencia de Viajes en
Miraflores**

Anexos

ANEXO 01: ANEXO DE MEDICIONES PREVIAS PARA ANÁLISIS DE LA COBERTURA ACTUAL

El presente anexo contiene las mediciones de cobertura realizadas a la agencia de viajes de Miraflores, estas mediciones han sido tomadas antes de la instalación de la solución *indoor*. Se tomaron medidas de RSCP, EcNo y Scrambling code.

1. Plots de cobertura de RSCP

Se muestran los niveles de RSCP para los ambientes del Edificio CEM2 y CEM 1 de la Agencia de viajes

1.1 Edificio CEM 2:

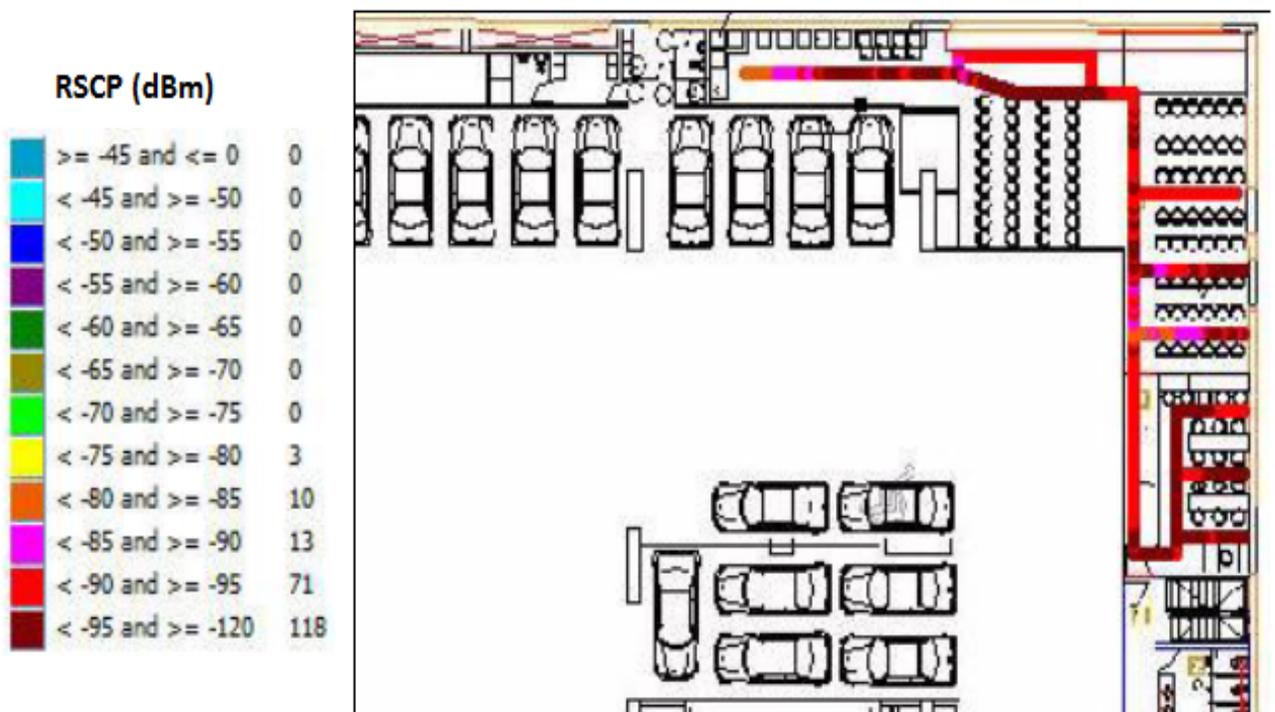


Figura 1.1: RSCP indoor edificio CEM2 sótano 1.

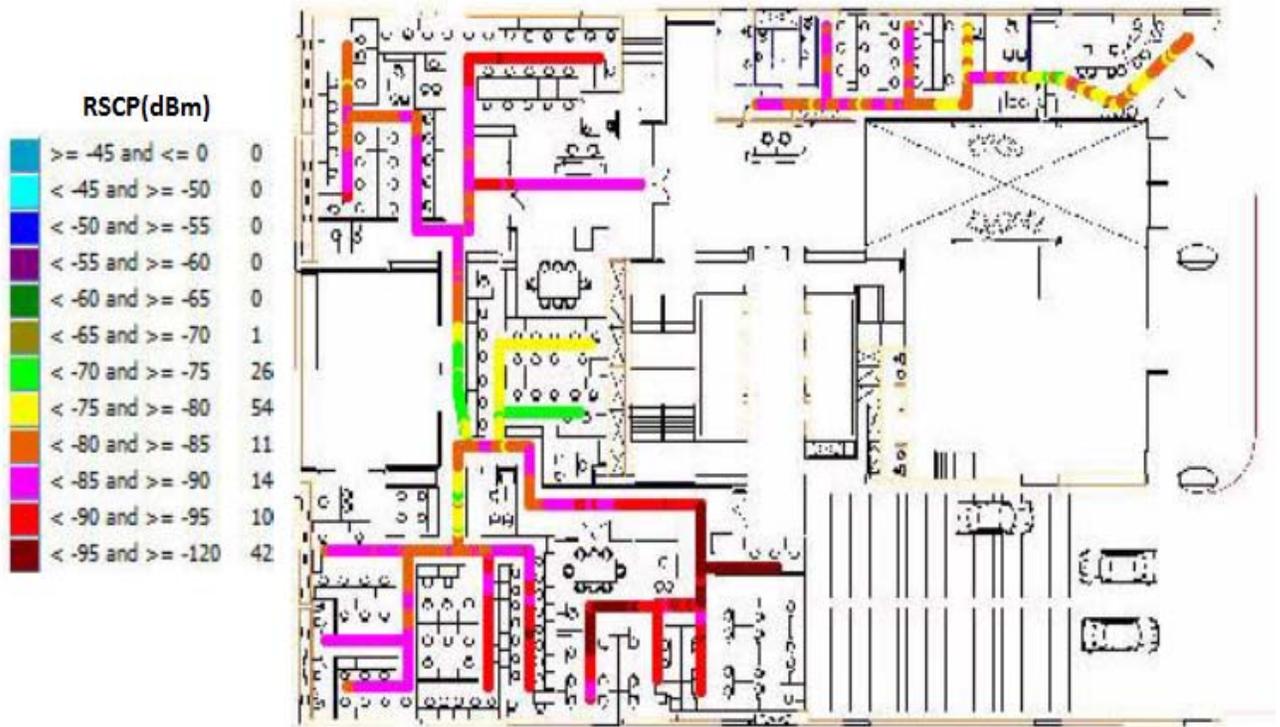


Figura 1.2: RSCP indoor edificio CEM2 piso 1

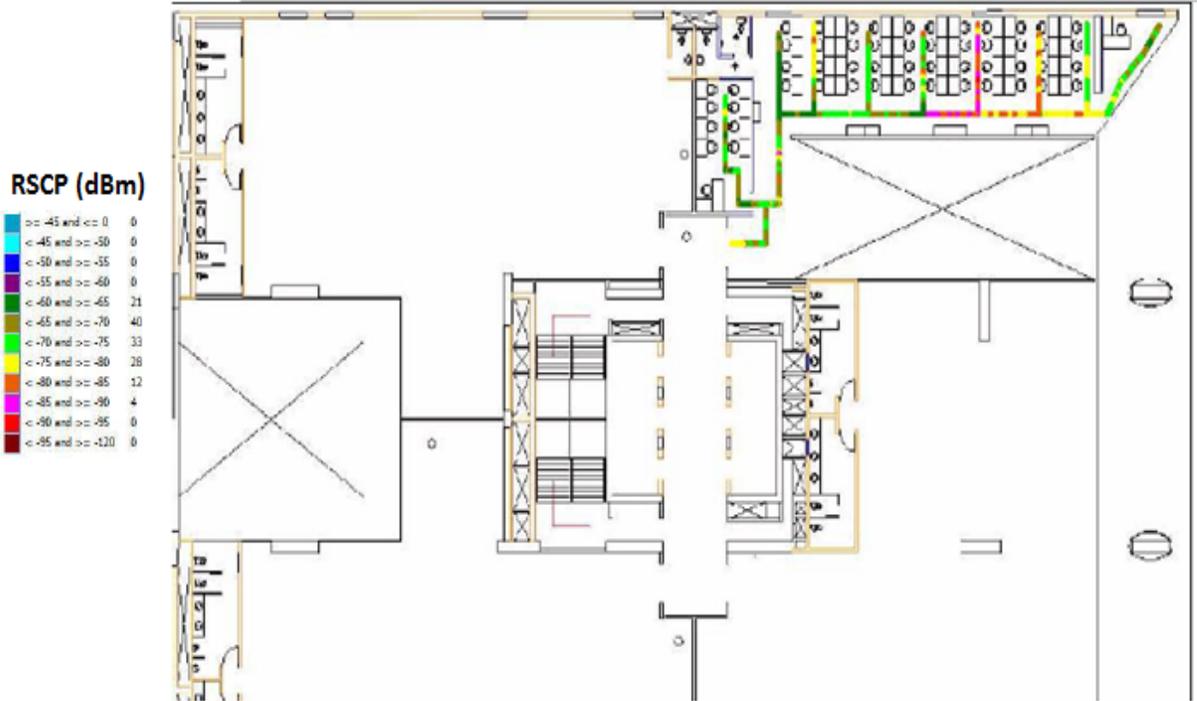


Figura 1.3: RSCP indoor edificio CEM2 piso 2

1.2 Edificio CEM 1:



Figura 1.4: RSCP indoor edificio CEM1 piso 1



Figura 1.5: RSCP indoor edificio CEM1 piso 2

2. Plots de cobertura de EcNo (dB)

Se muestran los niveles de EcNo para los ambientes del Edificio CEM2 y CEM1 de la Agencia de viajes.

2.1 Edificio CEM 2:

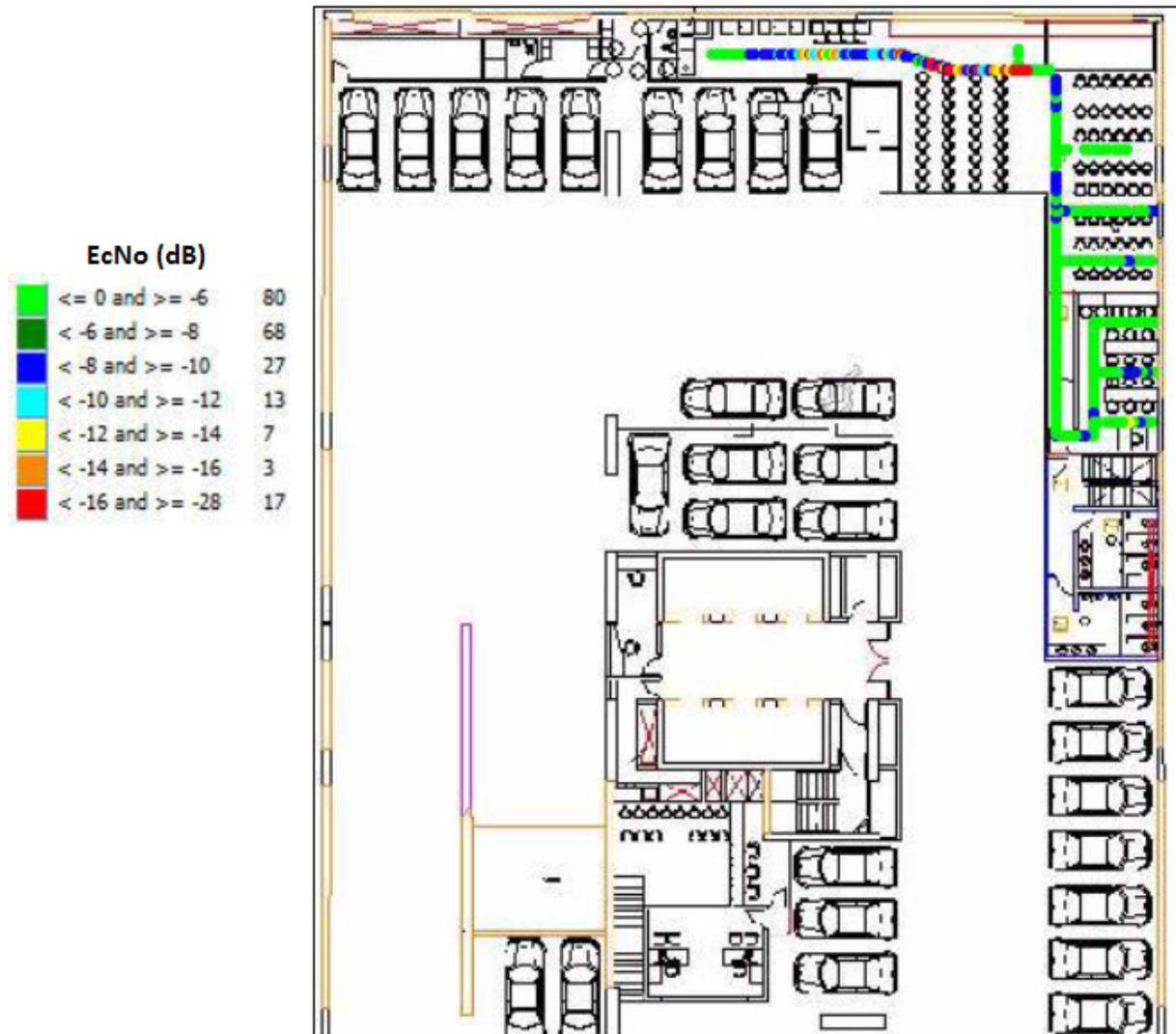


Figura 1.6: EcNo indoor edificio CEM2 sótano 1

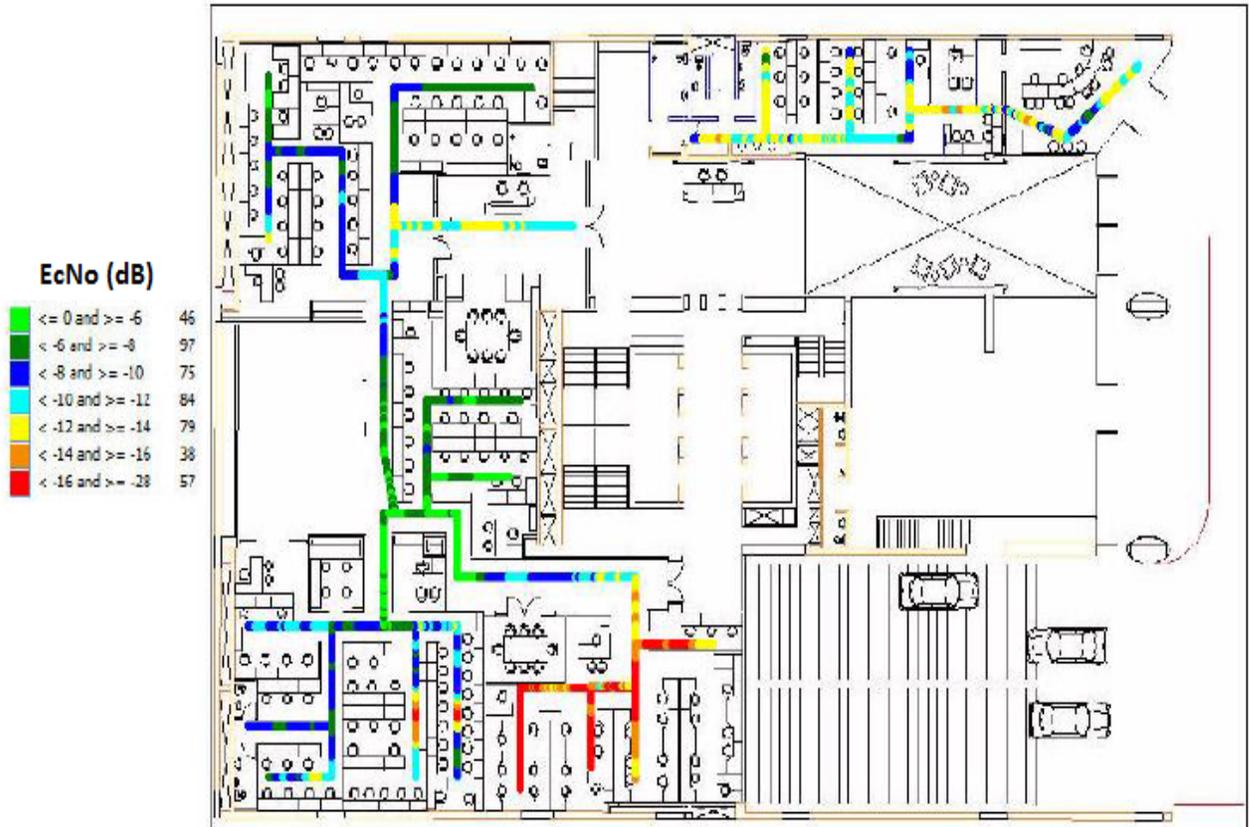


Figura 1.7: EcNo indoor edificio CEM2 piso 1

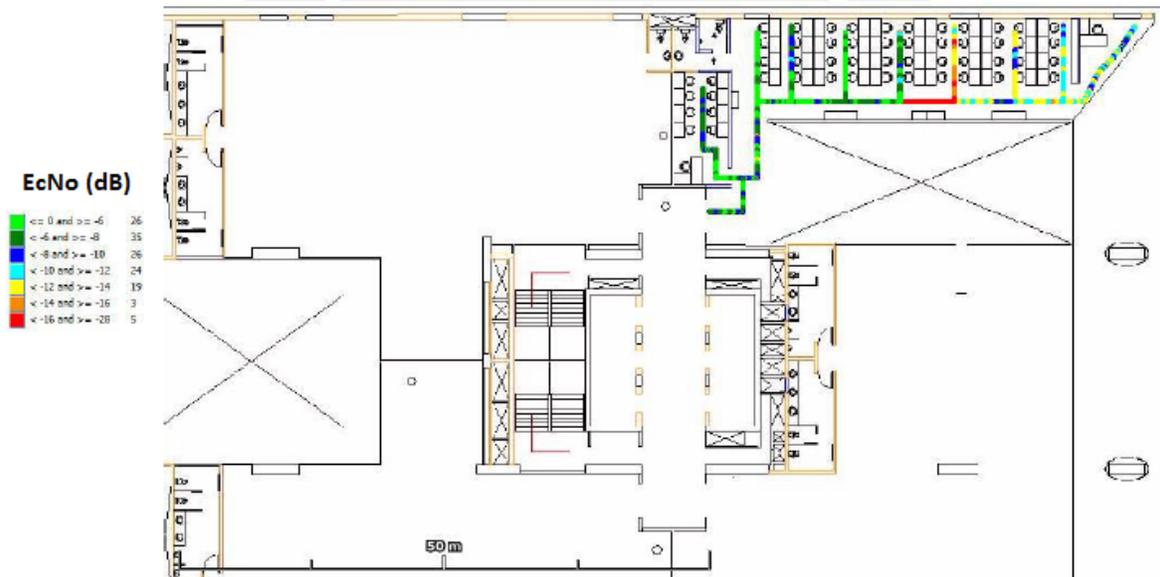


Figura 1.8: EcNo indoor edificio CEM2 piso 2

2.2 Edificio CEM 1:

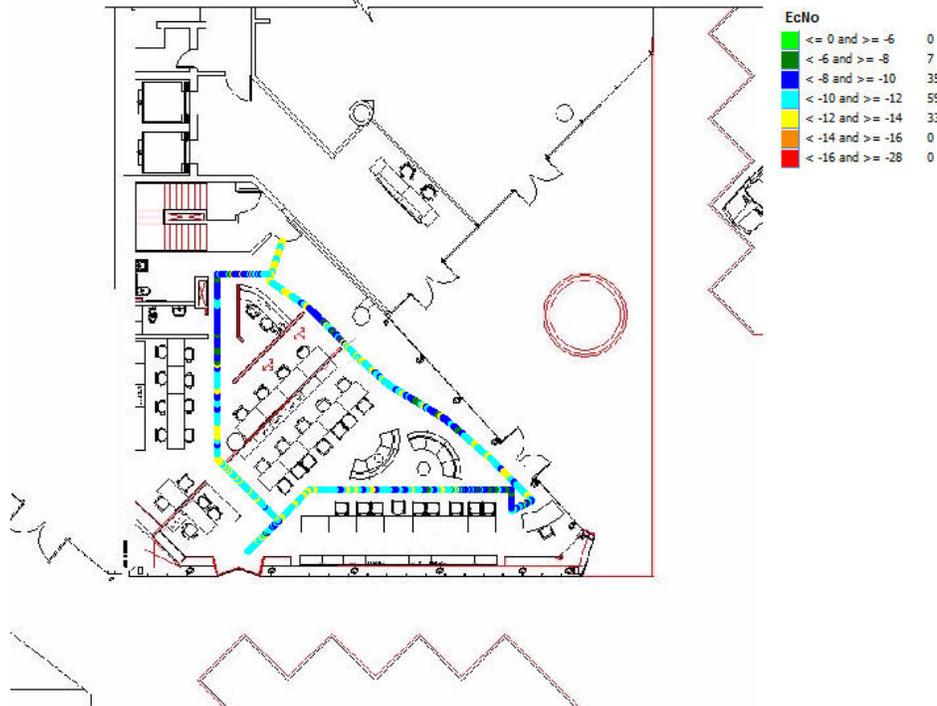


Figura 1.9: EcNo indoor edificio CEM1 piso 1

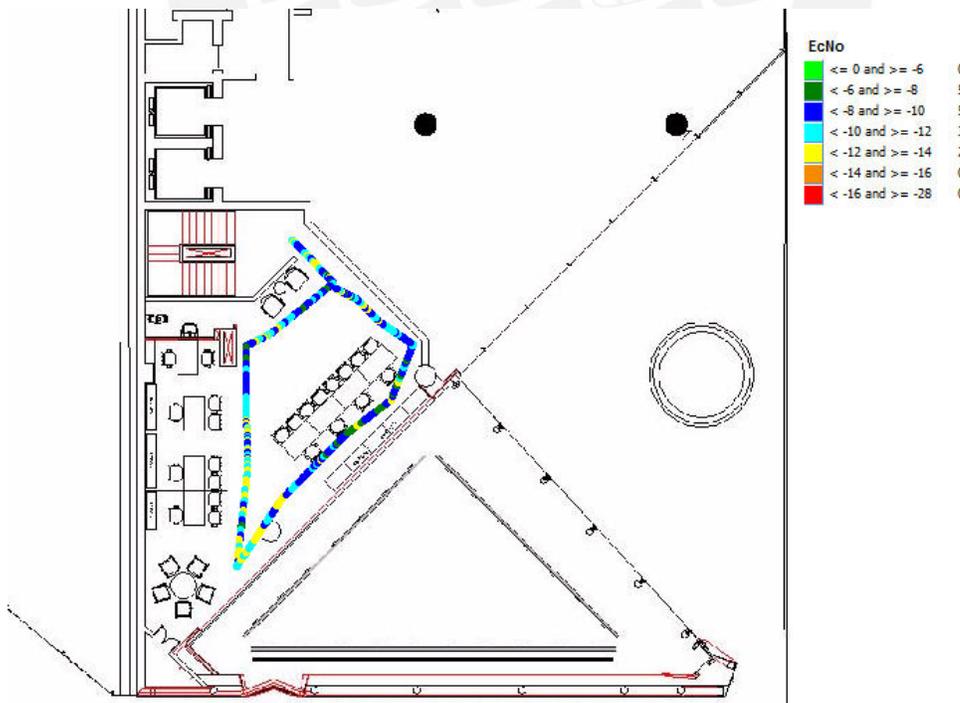


Figura 1.10: EcNo indoor edificio CEM1 piso 2

3. Plots de cobertura de Scrambling Code

Se muestran las mediciones de *Scrambling Code* para los ambientes del Edificio CEM2 y CEM1 de la Agencia de viajes.

3.1 Edificio CEM 2:

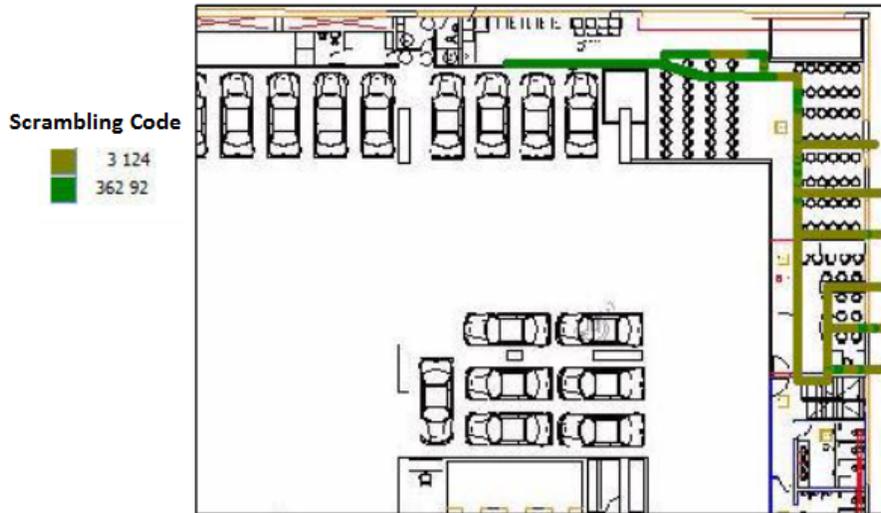


Figura 1.11: Scrambling Code indoor edificio CEM2 sótano 1

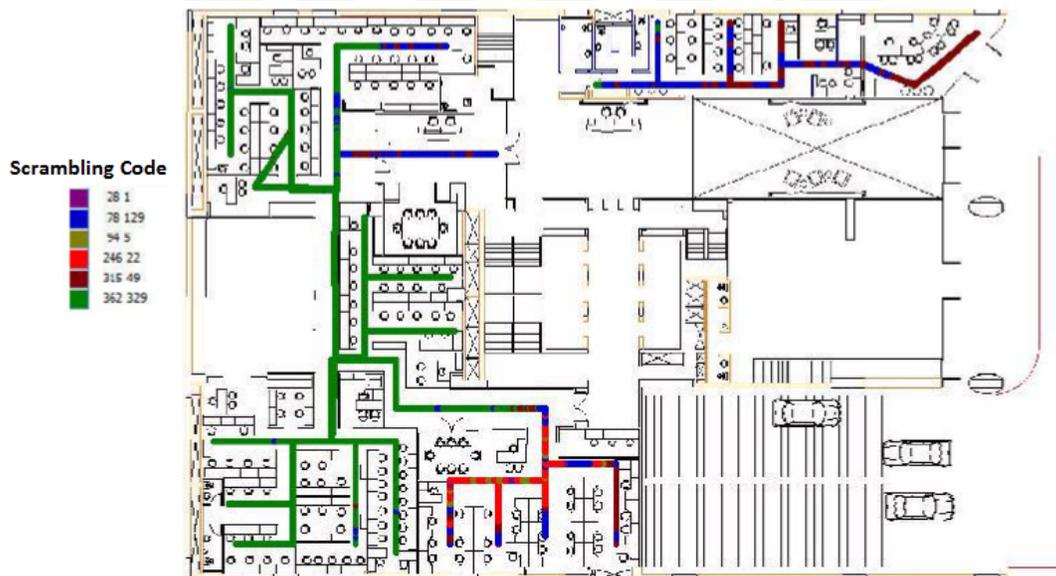


Figura 1.12: Scrambling Code indoor edificio CEM2 piso 1

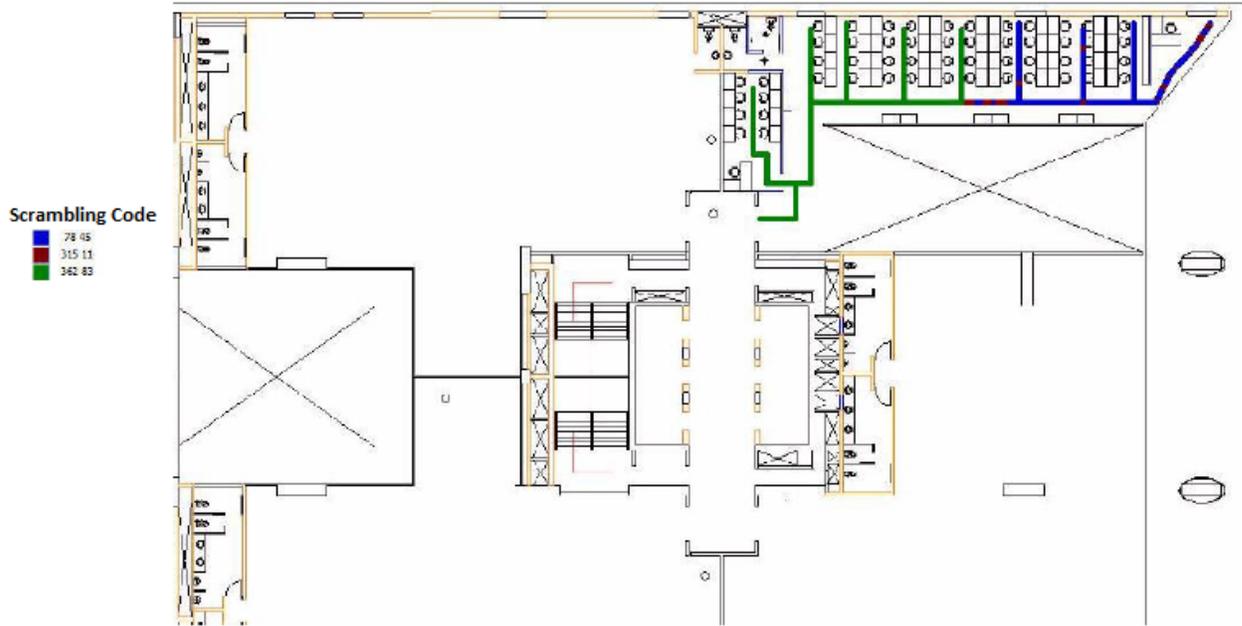


Figura 1.13: Scrambling Code indoor edificio CEM2 piso 2

3.2 Edificio CEM 1:

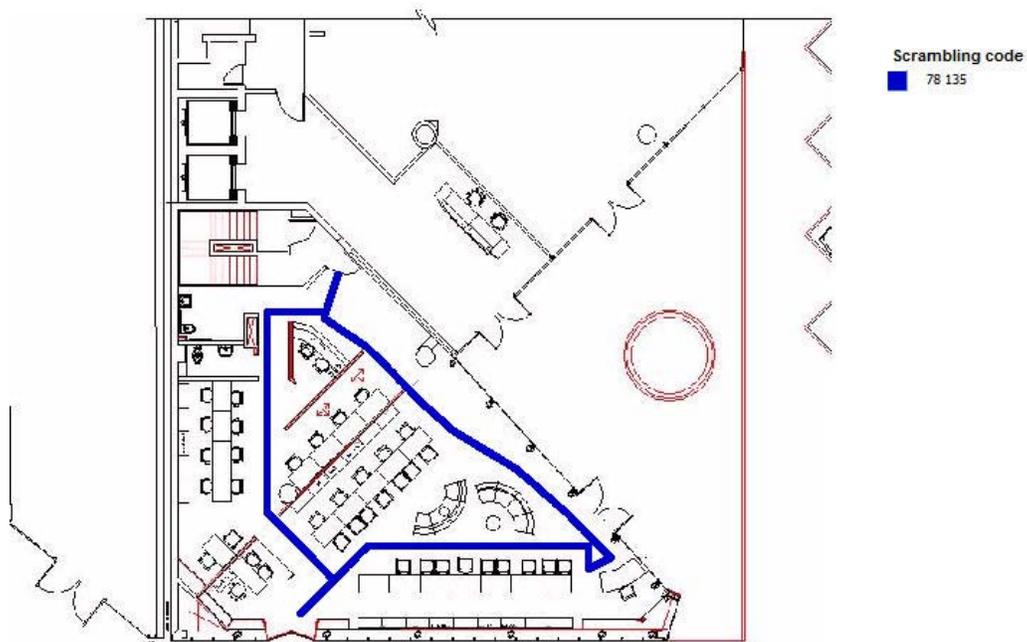


Figura 1.14: Scrambling Code indoor edificio CEM1 piso 1

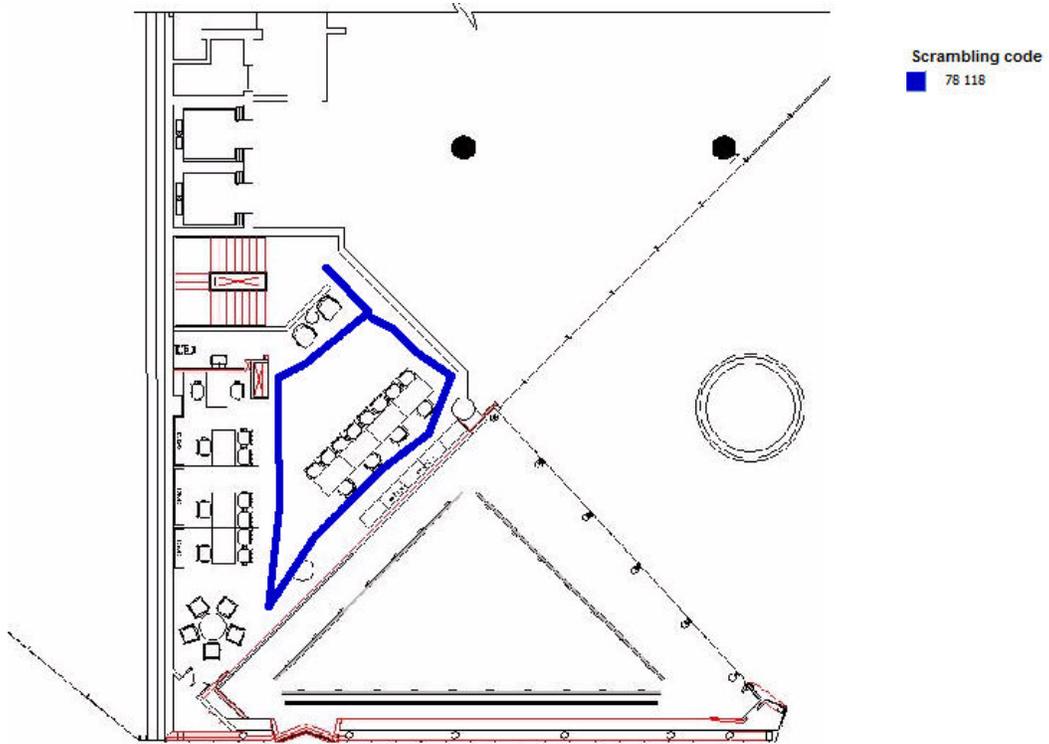


Figura 1.15: Scrambling Code indoor edificio CEM1 piso 2

ANEXO 02: ANÁLISIS DE DISTANCIA RELATIVA DE LAS ESTACIONES BASES CERCANAS

El presente anexo contiene las mediciones de nivel de señal RSCP a nivel externo hacia las estaciones bases cercanas a la Agencia de viajes, del mismo modo; contiene las mediciones de nivel de señal promedio a nivel interno.

1. Niveles de señal externa

1.1 Recorrido hacia estación Pardo

Se muestran los niveles de cobertura y fotos de las características externas hacia la estación Pardo



Figura 1.1: Niveles de señal hacia estación Pardo.

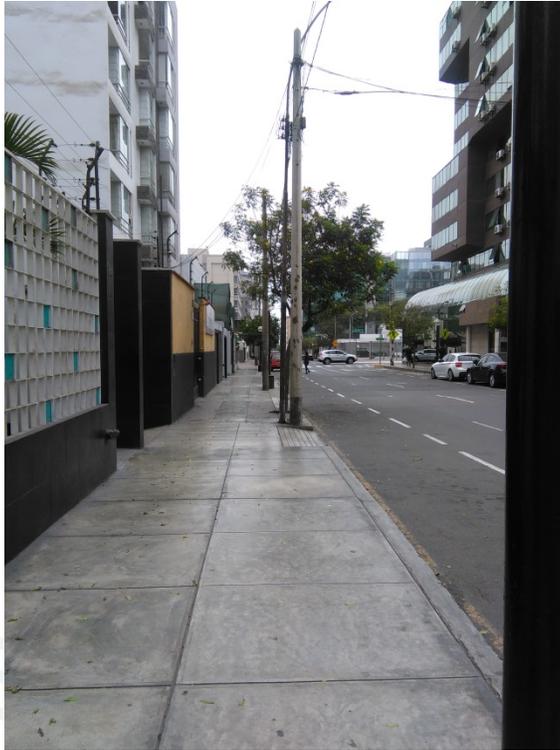


Figura 1.2: Toma 1 hacia estación Pardo.



Figura 1.3: Toma 2 hacia estación Pardo.



Figura 1.4: Toma 3 hacia estación Pardo.

1.2 Recorrido hacia estación Berlín

Se muestran los niveles de cobertura y fotos de las características externas hacia la estación Berlín

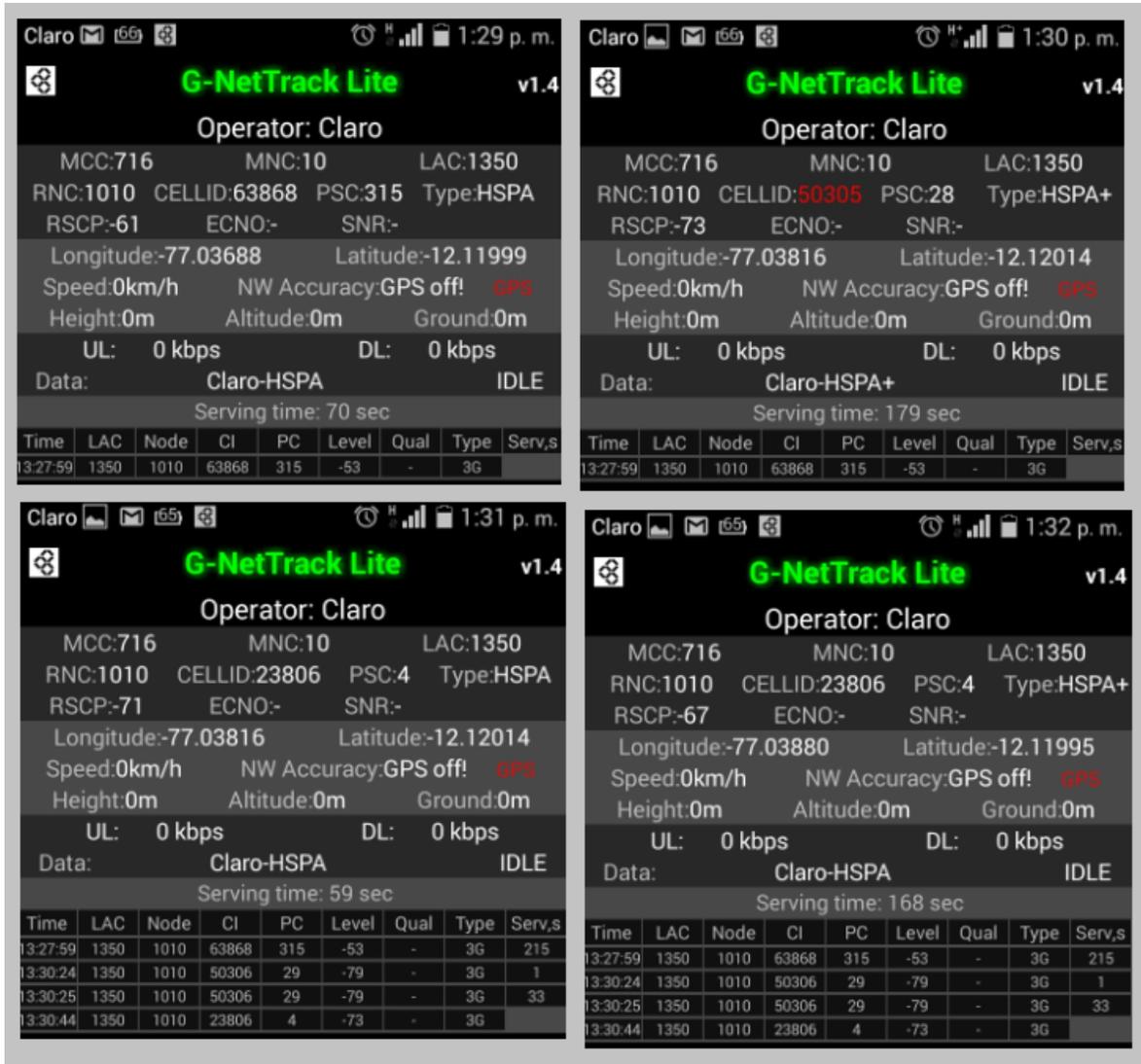


Figura 1.5: Niveles de señal hacia estación Berlín

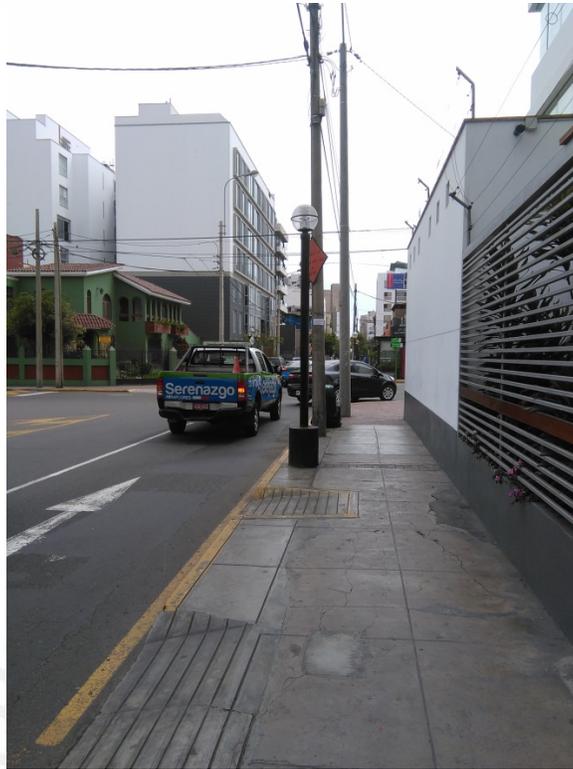


Figura 1.6: Toma 1 hacia estación Berlín



Figura 1.7: Toma 2 hacia estación Berlín

1.3 Recorrido afuera de la Agencia de viajes

Se muestran los niveles de cobertura y fotos de las características externas en las afueras de la agencia de viajes.

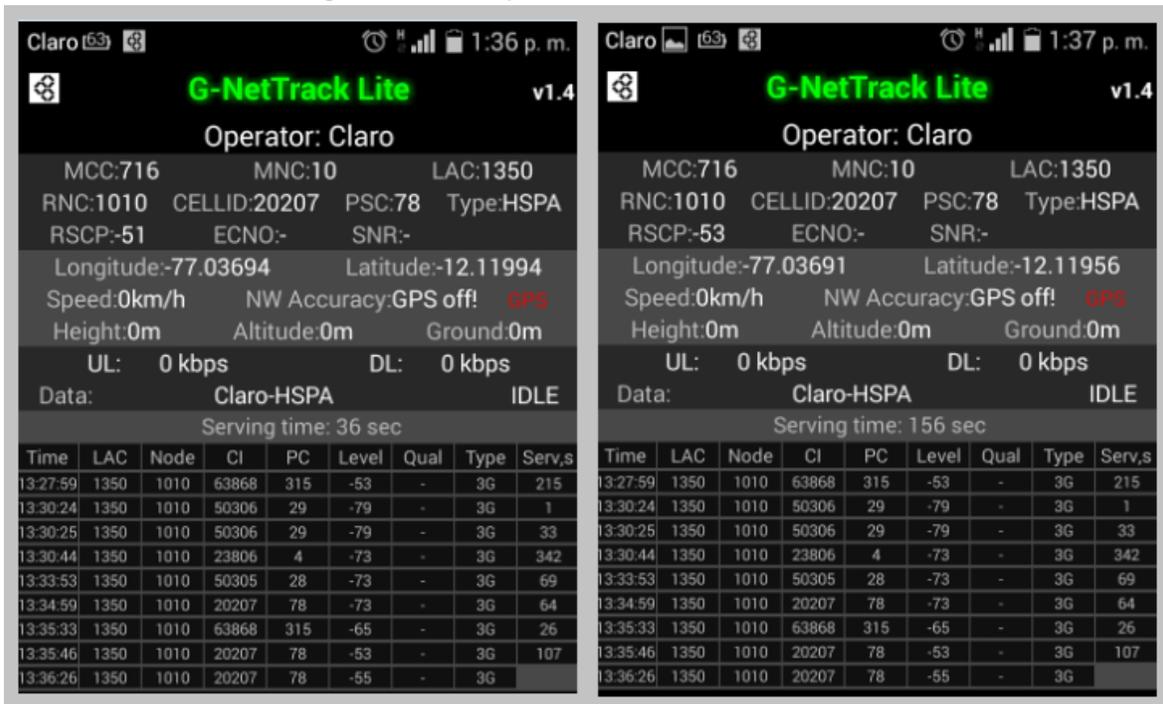


Figura 1.8: Niveles de señal en las afueras de la agencia de viajes



Figura 1.9: Toma 1 afueras de la agencia de viajes



Figura 1.10: Toma 2 afueras de la agencia de viajes

2. Nivel de señal promedio a nivel interno

Se muestran los niveles de señal para los diferentes ambientes a nivel interno de la Agencia de viajes.

Jorge Chavez 154 – CEM 2					
NOMBRE DE LA EMPRESA	AMBIENTES DE LA EMPRESA	Piso/Sotano	3G dato en Dbm	ECIO Solo 3G	Llamada 1 min. Procede en 3G?
AGENCIA DE VIAJES	Recepcion - 1	1	-100	-13	Mala
AGENCIA DE VIAJES	Administracion - 2	1	-100	-12	Mala
AGENCIA DE VIAJES	Sistemas - 3	1	-99	-14	Mala
AGENCIA DE VIAJES	Cuentas Comerciales - 4	1	-94	-16	Regular
AGENCIA DE VIAJES	Contabilidad - 5	1	-100	-10	Mala
AGENCIA DE VIAJES	Recepcion - 6	1	-72	-11	Buena
AGENCIA DE VIAJES	Interagencias Counter - 7	1	-84	-14	Regular
AGENCIA DE VIAJES	Counter Administrativo Web - 8	1	-72	-10	Buena
AGENCIA DE VIAJES	Operaciones - 9	sotano 1	-104	-8	Mala
AGENCIA DE VIAJES	Administracion - 10	sotano 1	-92	-14	Regular
AGENCIA DE VIAJES	Seguridad - 11	sotano 1	-90	-15	Regular
AGENCIA DE VIAJES	Data Center - 12	sotano 3	no	no	no
AGENCIA DE VIAJES	Reservas Interagencias - 13	2	-72	-12	Buena
AGENCIA DE VIAJES	Promociones - 14	2	-86	-12	Regular
AGENCIA DE VIAJES	Reservas - 15	2	-70	-9	Buena
AGENCIA DE VIAJES	Entrada - 16	1	-72	-10	Buena
	Promedio		-87		

Figura 1.11: Niveles de Señal Edificio Jorge Chavez 154

Jorge Chavez 162 – CEM 1					
NOMBRE DE LA EMPRESA	AMBIENTES DE LA EMPRESA	Piso/Sotano	3G dato en Dbm	ECIO Solo 3G	Llamada 1 min. Procede en 3G?
AGENCIA DE VIAJES	Ventas - 1	1	-73	-10	Buena
AGENCIA DE VIAJES	Productos - 2	1	-76	-12	Buena
AGENCIA DE VIAJES	Hall - 3	1	-82	-14	Regular
AGENCIA DE VIAJES	Entrada - 4	1	-100	-16	Mala
	Promedio		-83		

Figura 1.12: Niveles de Señal Edificio Jorge Chavez 162



ANEXO 03: ANEXO DE EQUIPOS

Se presenta en este anexo las hojas de datos de los equipos utilizados en el despliegue de la red.

Product Data Sheet

I-ATP1-698/2700

Indoor Panel Antenna 698-2700 MHz

Product Description

This panel antenna is specifically designed for broadband in-building distribution of LTE/CDMA800/GSM900/GSM1800/3G and WLAN services. The antenna is constructed from lightweight materials suitable for wall mounting. The off-white radome blends easily into most building aesthetics.

Indoor Panel Antenna

Features/Benefits

- LTE ready (700MHz and 2600MHz bands)
- Broadband, coverage 698 to 2700MHz
- U/ stable ABS radome
- Aesthetically designed, compact and light weight
- Low VSWR, High gain, Stable performance
- NF connector with pigtail

Technical Specifications

Product type	Indoor Panel Antenna
Application	Indoor
Frequency Range, MHz	698-960/1710-2700
Number of Input Ports	1
Connectors	N
Input Connector Type	N female
Impedance, Ohm	50
VSWR (50 Ohm)	≤ 2.0 (698-896), ≤ 2.2 (896-960), ≤ 1.5 (1710-2700)
Total Input Power, W	50, max.
Gain, dBi	7.0 (698-960), 10 (1710-2700)
Polarization	Vertical
Horizontal Beamwidth, deg	70/60
Vertical Beamwidth, deg	55/45
Connector Cable, mm (in)	150 (5.90)
Radome Material	ABS
Radome Color	White
Mounting Hardware included	Wall bracket, screws
Height (Less Connectors), mm (in)	44 (1.73)
Width (Less Connectors), mm (in)	180 (7.09)
Length (Less Connectors), mm (in)	210 (8.27)
Weight, kg (lb)	0.4 (0.89)
Environmental Class	Indoor

Data is subject to confirmation at time of ordering

Figura 1: Antena *Indoor Panel*.

Product Data Sheet I-ATO1-698/2700



Indoor Omnidirectional Antenna 698-2700 MHz

Product Description

This omnidirectional antenna is specifically designed for broadband in-building distribution of LTE, GSM, CDMA, PCS, 3G, WiFi, WLAN services. The antenna is constructed from lightweight materials suitable for ceiling mounting. The off-white radome blends easily into most building aesthetics.



Indoor Omnidirectional Antenna

Features/Benefits

- LTE ready (700MHz and 2600MHz bands)
- Input power 100Watt maximum
- Broadband, Low VSWR
- Support current main popular communication system
- Aesthetically designed, compact and light weight
- Off-white (ABS) radome
- Extend a Low Loss Cable

Technical Specifications

Product Type	Indoor Omnidirectional Antenna
Application	Indoor
Frequency Range, MHz	698-960/1710-2700
Number of Input Ports	1
Connectors	N
Input Connector Type	N female
Impedance, Ohm	50
VSWR (50 Ohm)	≤ 2.0 (698-808), ≤ 1.5 (808-960/1710-2700).
Total Input Power, W	100 max.
Gain, dBi	2.0 (698-960), 5.0 (1700-2700)
Polarization	Vertical
Connector Cable, mm (in)	185 (7.28)
Radome Material	ABS
Radome Color	White
Mounting Hardware included	Ceiling mount, fixed with nut
Height (Less Connectors), mm (in)	72 (2.82)
Width (Less Connectors), mm (in)	Ø 170 (6.69)
Weight, kg (lb)	0.4 (0.89)
Environmental Class	Indoor

Simulation at time of ordering

Figura 2: Antena Indoor Omnidireccional.

Product Data Sheet		SCF12-50J		
1/2" CELLFLEX® Superflexible Foam-Dielectric Coaxial Cable				
Product Description				
CELLFLEX® 1/2" superflexible cable				
Application: OEM jumpers, Main feed transitions to equipment, GPS lines				
1/2" CELLFLEX® Superflexible Foam Dielectric Coaxial Cable				
Features/Benefits				
<ul style="list-style-type: none"> Low Attenuation The low attenuation of CELLFLEX® coaxial cable results in highly efficient signal transfer in your RF system. Complete Shielding The solid outer conductor of CELLFLEX® coaxial cable creates a continuous RFEMM shield that minimizes system interference. Low VSWR Special low VSWR versions of CELLFLEX® coaxial cables contribute to low system noise. Outstanding Intermodulation Performance CELLFLEX® coaxial cable's solid inner and outer conductors virtually eliminate intermods. Intermodulation performance is also confirmed with state-of-the-art equipment at the RFS factory. High Power Rating Due to their low attenuation, outstanding heat transfer properties and temperature stabilized dielectric materials, CELLFLEX® cable provides safe long term operating life at high transmit power levels. Wide Range of Application Typical areas of application are: feedlines for broadcast and terrestrial microwave antennas, wireless cellular, PCS and ESMR base stations, cabling of antenna arrays, and radio equipment interconnects. 				
Technical Features				
Structure				
Inner conductor:	Copper-Clad Aluminum Wire	[mm (in)]	3.56 (0.14)	
Dielectric:	Foam Polyethylene	[mm (in)]	9.3 (0.366)	
Outer conductor:	Corrugated Copper	[mm (in)]	12.3 (0.48)	
Jacket:	Polyethylene, PE	[mm (in)]	13.75 (0.54)	
Mechanical Properties				
Weight, approximately		[kg/m (lbf/ft)]	0.17 (0.11)	
Minimum bending radius, single bending		[mm (in)]		
Minimum bending radius, repeated bending		[mm (in)]	32 (1.3)	
Bending moment		[Nm (ft-lb)]	1.8 (1.33)	
Max. tensile force		[N (lb)]	650 (146)	
Recommended / maximum clamp spacing		[m (ft)]	0.3 / 0.3 (1 / 1)	
Electrical Properties				
Characteristic impedance		[Ω]	50 +/- 1	
Relative propagation velocity		[%]	77	
Capacitance		[pF/m (pF/ft)]	86 (26)	
Inductance		[μH/m (μH/ft)]	0.215 (0.066)	
Max. operating frequency		[GHz]	10.6	
Jacket spark test RMS		[V]	5000	
Peak power rating		[kW]	24	
RF Peak voltage rating		[V]	1550	
DC-resistance inner conductor		[Ω/km (Ω/1000ft)]	2.9 (0.88)	
DC-resistance outer conductor		[Ω/km (Ω/1000ft)]	4.5 (1.37)	
Recommended Temperature Range				
Storage temperature		[°C (°F)]	-70 to 85 (-94 to 185)	
Installation temperature		[°C (°F)]	-40 to 60 (-40 to 140)	
Operation temperature		[°C (°F)]	-50 to 85 (-58 to 185)	
Other Characteristics				
Fire Performance:	Halogen Free			
VSWR Performance:	Standard	Contact RFS for your VSWR performance specification for your required frequency band.		
Other Options:	Phase stabilized and phase matched cables and assemblies are available upon request.			
RFS The Clear Choice®		SCF12-50J	Rev: D / 22.Nov.2013	Print Date: 27.09.2015

Figura 3: Cable SCF1/2.

Product Data Sheet

PDS2E-698/2700



2 Way Power Divider

Product Description

This PDS'E series are Power Splitters, designed to evenly split high power cellular signals with minimal reflections or loss. They are specified to cover 698- 2700 MHz. The wide frequency ranges of these models allow use with multiband antennas and leaky cable systems. With few solder joints and an air dielectric, the loss is minimal and reliability enhanced.



form as shown or similar

Features/Benefits

- Multiple-Band Frequency Ranges
- 200 Watt Power Rating
- High Reliability
- Low Cost Design for Outdoor Application
- Low Specified PIM
- N-female Connectors

Technical Specifications

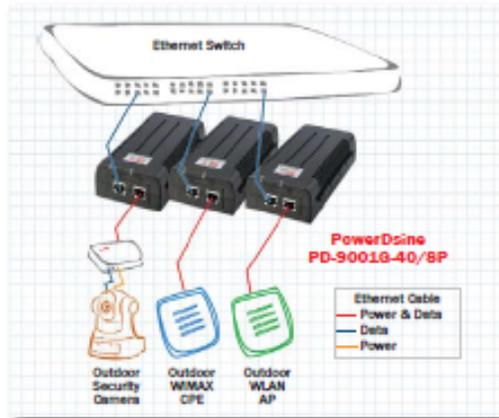
Product Type	Power Divider
Application	Outdoor
Frequency Range, MHz	698-2700
Number of Input Ports	1
Number of Output Ports	2
Connectors	N-female
Impedance, Ohm	50
Insertion Loss, dB	≤ 3.3
VSWR (50 Ohm)	≤ 1.25
Intermodulation (IM3)	-150 dBc with 2 x 43 dBm tones
Total Input Power, W	200
Temperature Range, °C (°F)	-25 to +65 (-13 to 149)
Height (Less Connectors), mm (in)	25.0 (0.98)
Width (Less Connectors), mm (in)	25.0 (0.98)
Length (Less Connectors), mm (in)	198.0 (7.80)
Weight, kg (lb)	0.30 (0.65)
Environmental Class	IP65

Notes

Figura 4: Splitter de 2 vías.

PowerDsine® 9001G-40/SP Midspan

High Power, 802.3af and 802.3at Compliant, Single Port, Gigabit Midspan with Surge Protection



Overview

The PowerDsine 9001G-40/SP is a single port, high-power solution for remote powering of current and emerging high power applications. In addition to PoE midspan functionality, the PD-9001G-40/SP provides Surge Protection functionality optimal for the installation of outdoor PDs.

Generating up to 40W, the 9001G-40/SP enables remote power for a new range of applications including 802.11 Access Points, pan-tilt-zoom (PTZ) cameras and WiMAX CPE. It complies with IEEE 802.3at and is backward compatible with the IEEE802.3af PoE standard. It can power both existing 10/100Base-T network devices and emerging wireless 1000Base-T devices such as Wi-MAX and wireless IEEE 802.11n access points.

PD-9001G-40/SP Features

- Up to 40W of Power on 2-pairs
- IEEE 802.3at Compliant with 2-event classification
- IEEE 802.3af backward compatible
- Surge protection according to GR 1089
- Safe and Reliable Power to WLAN Access Points
- Supports 10/100/1000Base-T applications
- Compact Design with 1U height

PD-9001G-40/SP Specifications

No. of Ports	1
Pass Through Data Rates	10/100/1000 Mbps
Power over Ethernet Output	Pin Assignment and Polarity: 4/5 (+), 7/8 (-) Output Power Voltage: 55Vdc User Port Power: 40Watts
Input Power Requirements	AC Input Voltage: 100 to 240 Vac AC Input Current: 0.8A @ 100-240 Vac AC Frequency: 50 to 60 Hz
Dimensions	87.9 mm x 43 mm x 188 mm 3.48 in. x 1.69 in. x 6.53 in
Weight	.881 lbs (400g)
Indicators	System Indicator: AC Power (Green) User Indicator: Channel Power (Green)
Connectors	Shielded RJ-45, EIA 588A and 588B
Environmental Conditions	Operating Ambient Temperature: 14° to 113°F (-10 to 45°C) Operating Humidity: Maximum 80%, Non-condensing Storage Temperature: -4° to 158°F (-20° to 70°C) Storage Humidity: Maximum 85%, Non-condensing Operating Altitude: -1000 to 10,000 ft. (-304.8 to 3048 m)
Reliability	MTBF: 100,000 hrs. @25°C
Thermal Rating	27 BTU/Hr (@240VAC)
Warranty	1-year
Regulatory Compliance	IEEE 802.3af (PoE), RoHS Compliant WEEE Compliant, CE
Electromagnetic Emission & Immunity	FCC Part 15, Class B EN 55022 Class B (Emissions) EN 55024 (Immunity), VCCI
Surge Protection	Meets Surge Protection as specified in GR-1089-Core Criteria B: ± 1000V/100A @10/1000 [µs] Waveform ± 2500V/500A @2/10 [µs] Waveform ± 1000V/25A @10/380 [µs] Waveform
Safety Approvals	UL/cUL Per EN 60950-1 GS Mark Per EN 60950-1

Figura 5: Inyector PoE.

ALCATEL-LUCENT 9363 METRO CELL INDOOR V2

1900/850 MHZ FOR THE AMERICAN MARKET | RELEASE BCR 3.0

The Alcatel-Lucent 9363 Metro Cell Indoor (MC ID) V2 is a low power, high capacity device that cost-effectively extends Wideband Code Division Multiple Access (W-CDMA) coverage and high-speed packet access (HSPA) capacity to public indoor places, delivering fast, responsive data service, and crystal-clear voice. With the Alcatel-Lucent 9363 MC ID's unique capability to form autonomous self-organizing groups, large areas are as easy to cover as smaller ones requiring only a single cell. The Alcatel-Lucent 9363 MC ID is well-suited for filling in coverage holes within buildings, providing coverage for high-use hotspots such as hotel lobbies, railway stations and airports, or for wholly blanketing a mall with superior Third Generation (3G) coverage. With the Alcatel-Lucent 9363 MC ID application enablement application programming Interfaces (APIs), mobile service providers can leverage unique network capabilities, such as location and presence, for the creation of revenue-generating, innovative public localized services.

BENEFITS

- Easily deployed almost anywhere
- Network deployment flexibility
- Fast and reliable data connections and high data throughput
- Extends W-CDMA coverage and HSDPA/ high-speed uplink packet access (HSUPA) capacity to public indoor locations with a low total cost of ownership (TCO)
- Provides secure access to the MSP's network
- Supports emergency calling and other location-associated services with accurate location-based information
- Enhanced performance and fault management for public, operator-owned small cells
- Seamless mobility with simultaneous voice and data service continuity within metro cell group and with the macro network
- Enables the development of value-added, innovative services based on location, presence, QoS, and trusted security



TECHNICAL SPECIFICATIONS

Dimensions (HxWxD)

- 241x241x53 mm
- 9.48x9.48x2.08 in

Weight

- <2 kg
- <4.4 lb

Mount

- Ceiling or wall mountable
- Horizontal or vertical orientation

Power

- Supply
 - Power over Ethernet (PoE+)
 - 48-V DC
- Supply options
 - External AC/DC adaptor - 110/240-V AC to 48-V DC
 - External power injector
- Consumption
 - Typical: 20 W
 - Maximum: 25 W

Interface

- Transmission and PoE+: 10/100Base T RJ45
- Local connection: 10/100Base T RJ45

Certification

- UL
- FCC

Temperature Range

- -5°C to +45°C
- 23°F to 113°F

Safety

- UL60950-1
- UL60950-22

Electromagnetic Compatibility (EMC)

- 47CFR FCC Parts 15 (Class B)
- OET-65

Radio Characteristics

- Operating band: 1900/850 MHz
- Listening bands
 - 1900/850 MHz UMTS
 - 1900/850 MHz GSM sniffing bands
- Baseband capacity: up to 32 devices with each connection supporting a simultaneous voice call and data session
- Maximum bearers
 - 14.4 Mb/s L1 High-speed Downlink Packet Access (HSDPA) bearer
 - 21 Mb/s L1 HSDPA bearer with optional 64 QAM for HSDPA feature
 - 5.7 Mb/s L1 High-speed Uplink Packet Access (HSUPA) bearer
- Transmission power
 - Minimum: 0.016 mW
 - Maximum: 250 mW
 - Step: 1 dB
- Sensitivity: -107 dBm

Figura 6: Femtocelda modelo 9363

Alcatel-Lucent Home Cell V2

1900/850 MHz AND AWS VARIANTS FOR THE AMERICAN MARKET

RELEASE BCR 2.4.1

The Alcatel-Lucent 9361 Home Cell (HC) V2 is a low power, high capacity wireless device that cost-effectively extends Wideband Code Division Multiple Access (W-CDMA) and high-speed packet access (HSPA) coverage and capacity to the home, delivering fast, responsive data service, and crystal-clear voice. The end user simply connects the 9361 HC to power and broadband Internet service, and the 9361 HC automatically comes into service without any additional user intervention. The 9361 HC not only increases the uptake of 3G services, generating additional revenue from services mobile service providers (MSP) already offer, but also provides application programming interfaces (APIs) that enable MSPs to leverage unique network capabilities, such as location and presence, to develop new, innovative applications.

- Seamless services and mobility with macro network
- Support for open, prioritized open, or closed access modes
- Application enablement with presence API, network local routing, and Internet traffic breakout

Benefits

- Extends W-CDMA coverage and high-speed downlink packet access (HSDPA)/high-speed uplink packet access (HSUPA) capacity to residences with a low total cost of ownership (TCO)
- Improves end user quality of experience (QoE) with a higher quality air interface that provides crystal clear voice, faster and more reliable data connections, and higher data throughput
- Enables end user self-installation with plug-and-play
- Eliminates special backhaul requirements by using an existing broadband Internet connection
- Enables the development of value-added, innovative services based on location, presence, quality of service (QoS), and trusted security
- Simplifies network management with a single integrated system that combines the strengths of the Alcatel-Lucent Wireless Management and Provisioning Systems and the Motive Home Device Manager — a leading solution for the management of TR-069 devices with over 40 million devices under active management

Technical Specifications

Dimensions (HxWxD)

- 162x105x50 mm
- 6.38x7.68x1.97 in

Weight (without power supply)

- < 350g
- < 0.88 lb

Mount

- Free standing or wall mountable
- Vertical orientation

Power

- Supply:
 - AC/DC adaptor – 110/240-VAC to 12-V DC
- Consumption:
 - Maximum: < 10 W

Interface

- Transmission:
 - 10/100Base T RJ45
- Local connection:
 - 10/100Base T RJ45

Certification

- UL
- FCC

Temperature Range

- -5°C to +45°C
- 23°F to 113°F

Safety

- UL60950
- UL1310

Electromagnetic Compatibility (EMC)

- 47CFR FCC Part 15 (Class B)
- OET-65

Radio Characteristics

- 1900 or 850 MHz variant:
 - Operating band: 1900 or 850 MHz, depending on configured frequency band
 - Uplinking bands:
 - 1900/850 MHz UMTS
 - 1900/850 MHz GSM
- AWS variant:
 - Operating band:
 - 1700 MHz
 - Uplinking bands:
 - 1900 and 1700 MHz UMTS
 - 1900 and 1700 MHz GSM
- Baseband capacity:
 - Four devices with each connection supporting a simultaneous voice call and data session
- Maximum bearers:
 - 14.4 Mbit/s L1 HSDPA bearer
 - 5.7 Mbit/s L1 HSUPA bearer
- Maximum transmission power:
 - 100 mW variant:
 - 100 mW output power
 - 20 mW variant:
 - 20 mW output power
- Sensitivity:
 - -107 dBm

Figura 7: Femtocelda modelo 9361

ANEXO 04: ANEXO DE PREDICCIONES DE COBERTURA

El presente anexo contiene las predicciones de cobertura realizada a los ambientes descritos de la agencia de viajes de Miraflores, estas mediciones han sido proporcionadas por el software de diseño IBWDesign.

1. Plots de cobertura de RSCP

Se muestran los niveles de RSCP para los ambientes del Edificio CEM2 y CEM 1 de la Agencia de viajes

1.1 Edificio CEM 2:

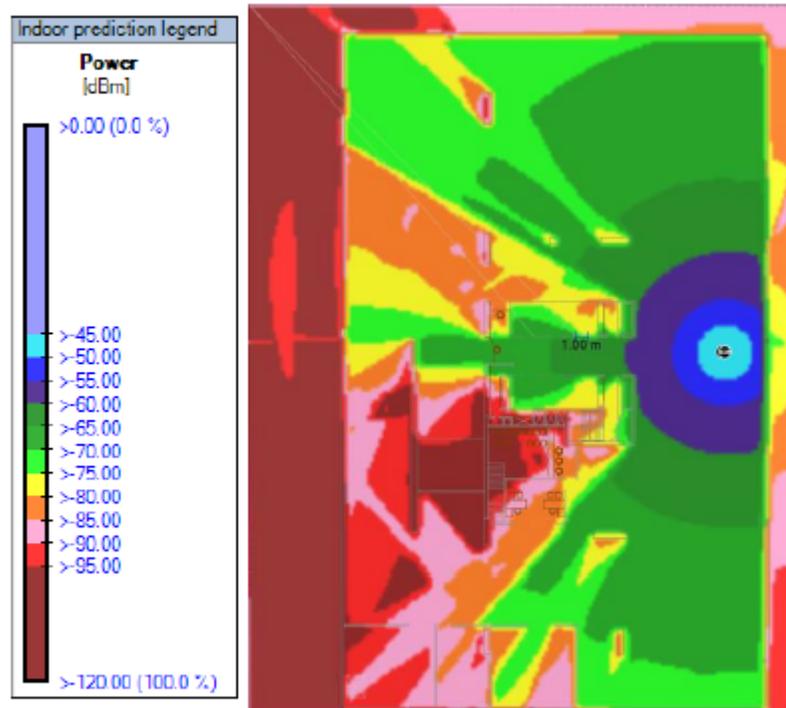


Figura 1.1: RSCP indoor edificio CEM2 sótano 3

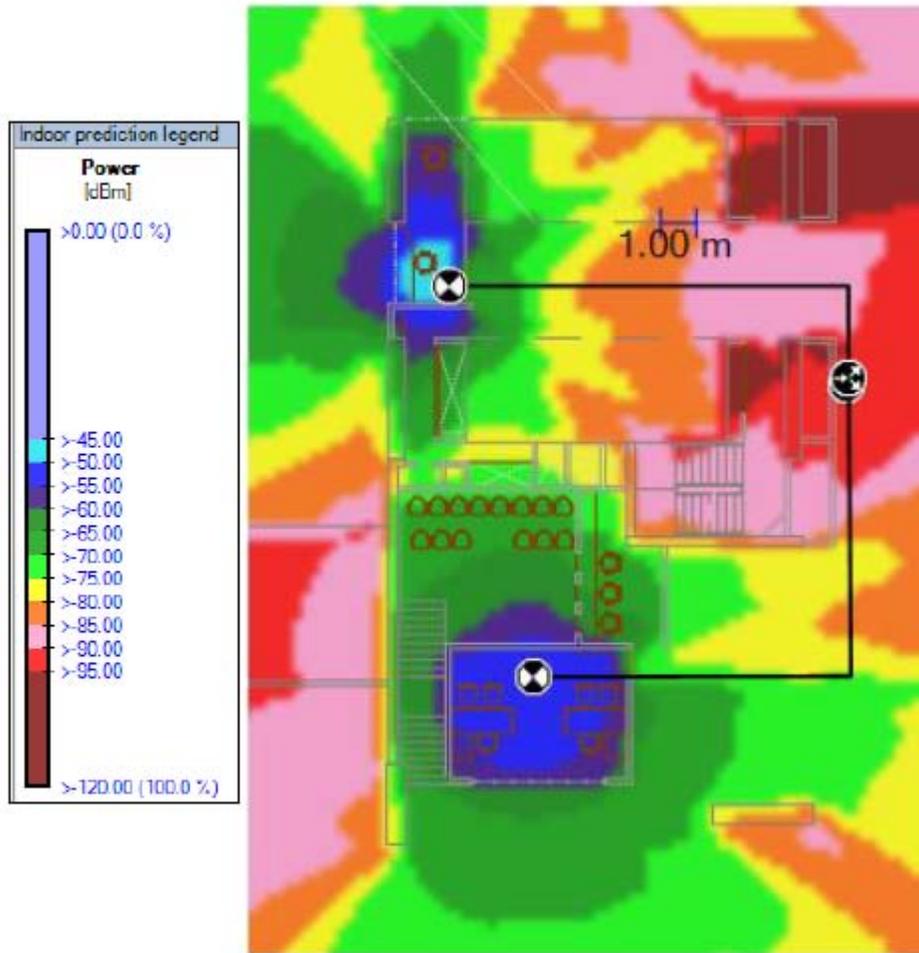


Figura 1.2: RSCP indoor edificio CEM2 Sótano 1

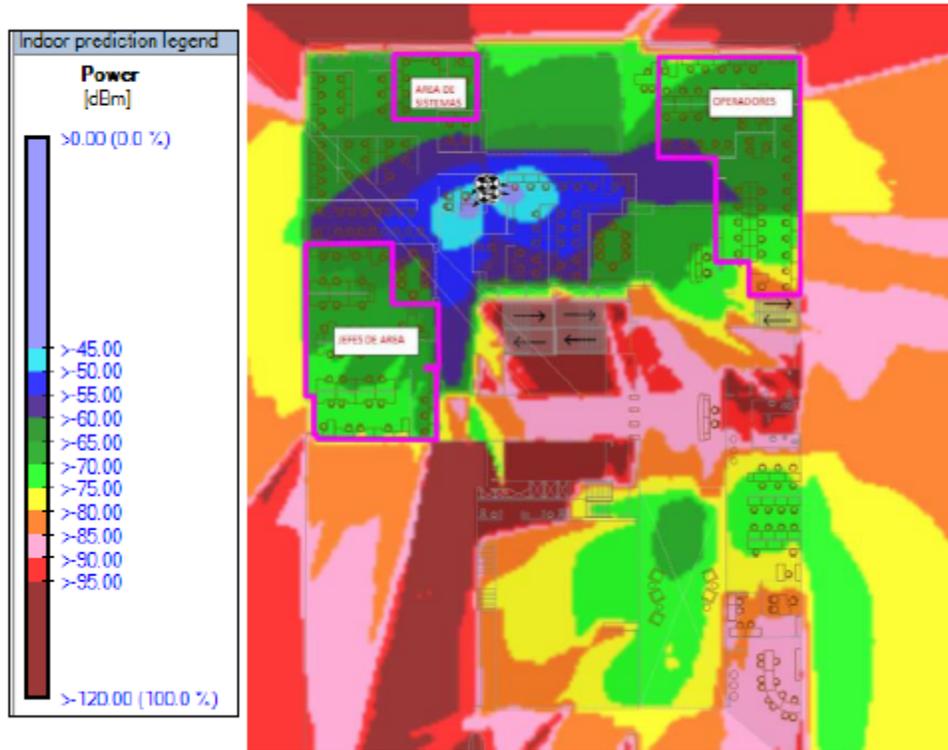


Figura 1.3: RSCP indoor edificio CEM2 piso 1

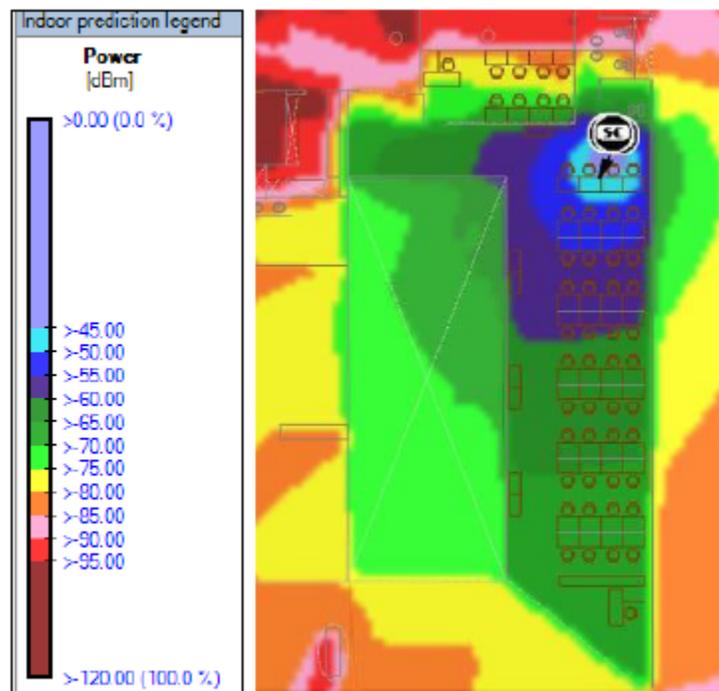


Figura 1.4: RSCP indoor edificio CEM2 piso 2

1.2 Edificio CEM 1:

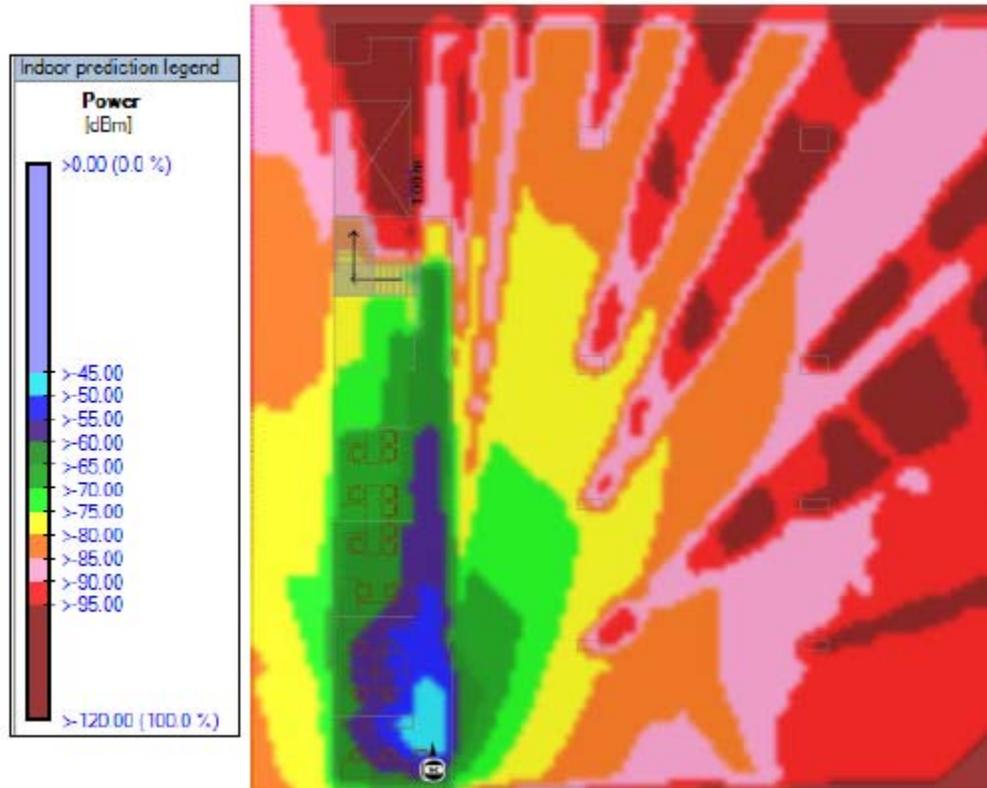


Figura 1.5: RSCP indoor edificio CEM1 sótano 1

2. Plots de cobertura de EcNo (dB)

Se muestran los niveles de EcNo para los ambientes del Edificio CEM2 y CEM1 de la Agencia de viajes.

2.1 Edificio CEM 2:

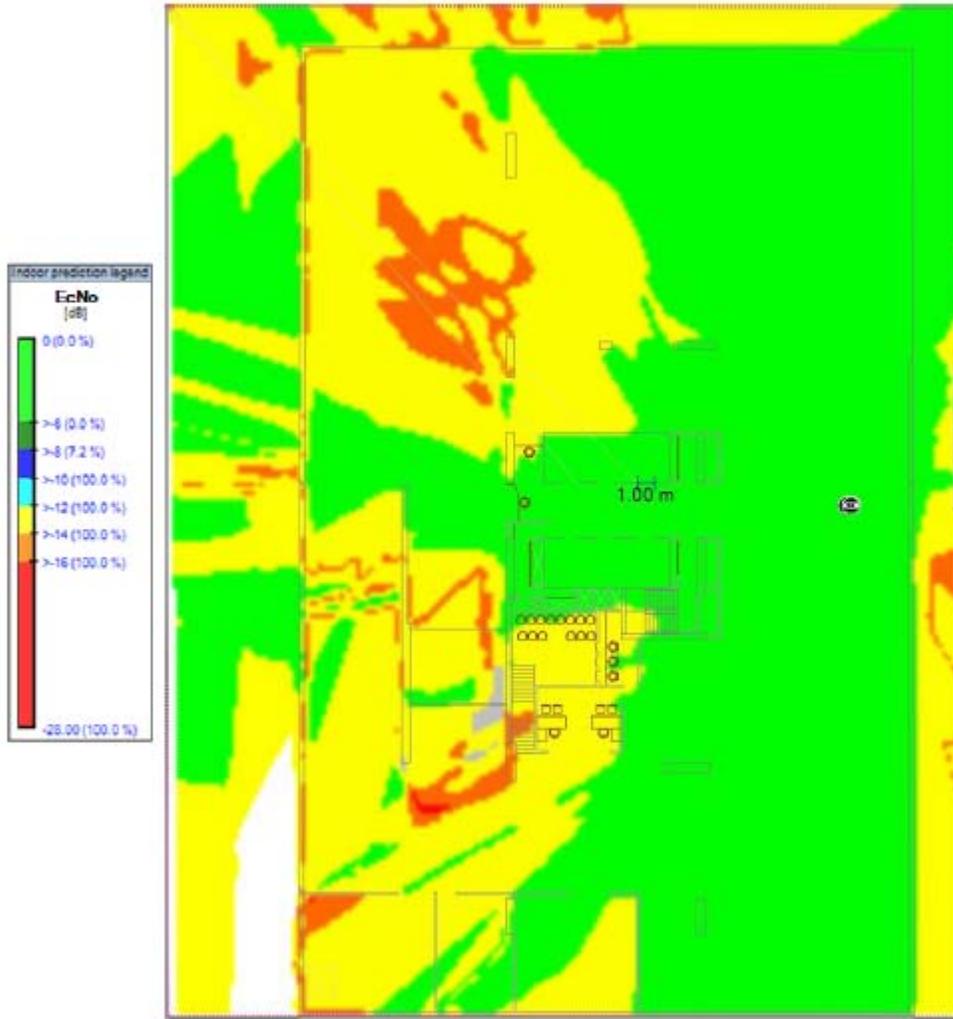


Figura 1.6: EcNo indoor edificio CEM2 sótano 3

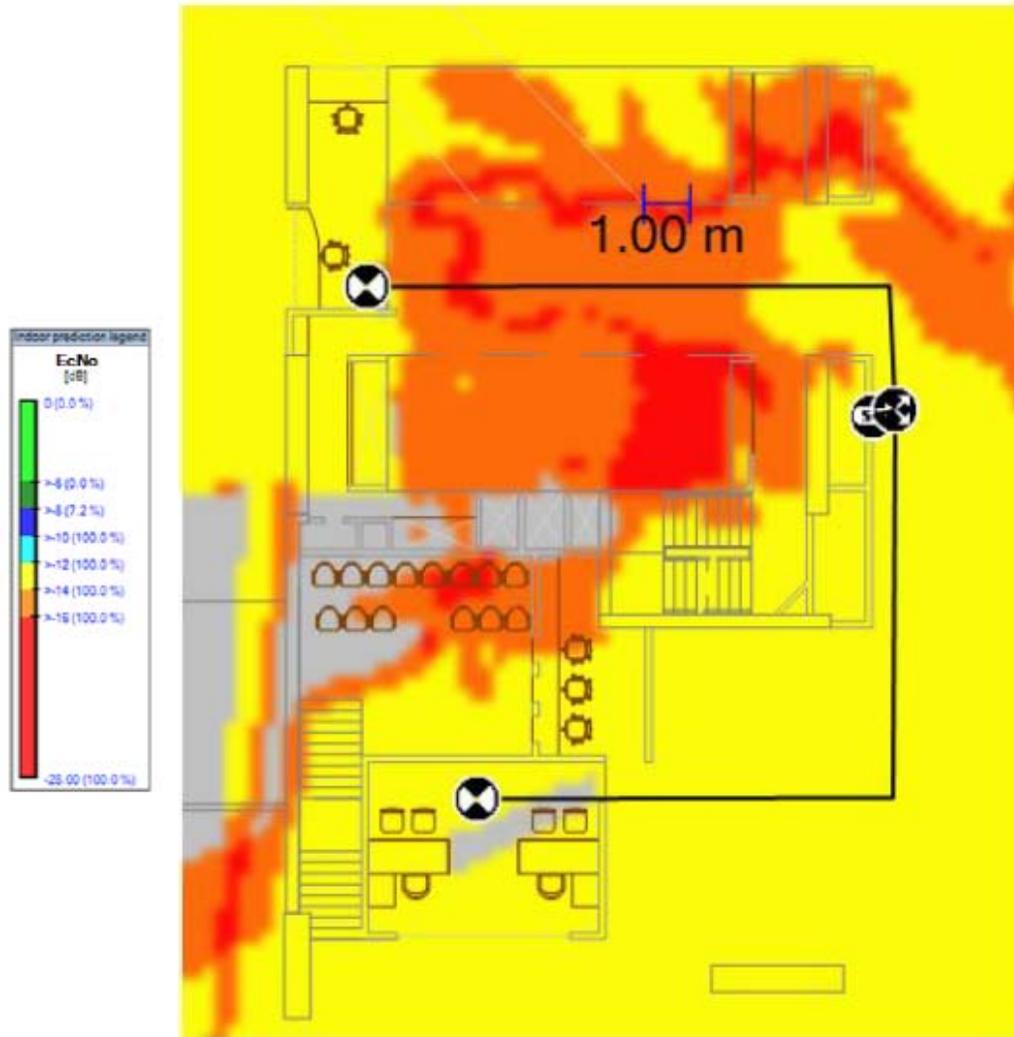


Figura 1.7: EcNo indoor edificio CEM2 sótano 1

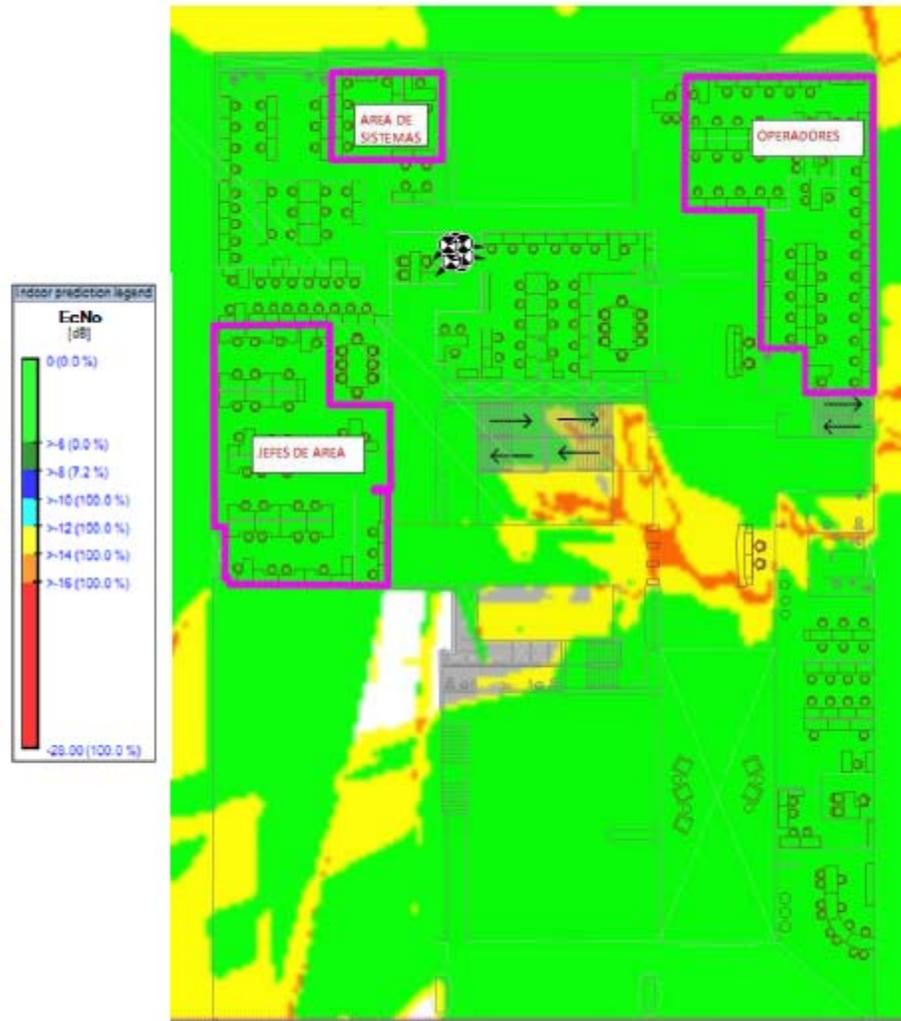


Figura 1.8: EcNo indoor edificio CEM2 piso1

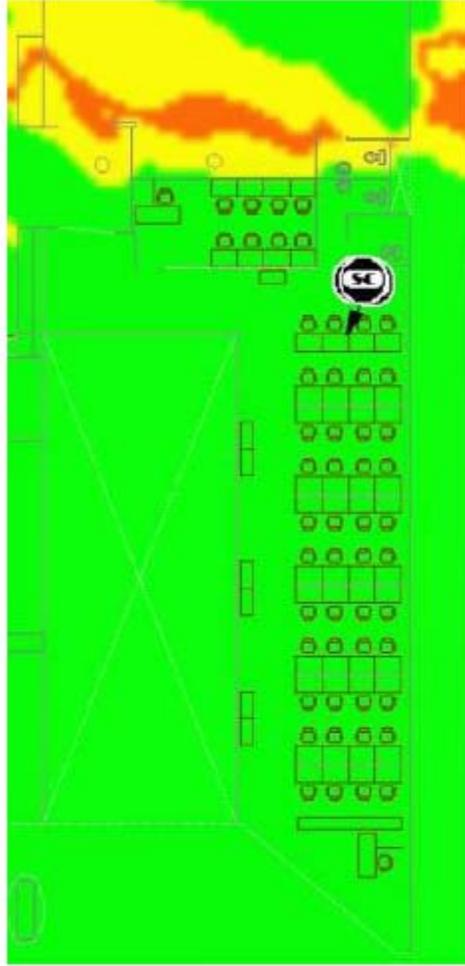


Figura 1.9: EcNo indoor edificio CEM2 piso 2

2.2 Edificio CEM 1:

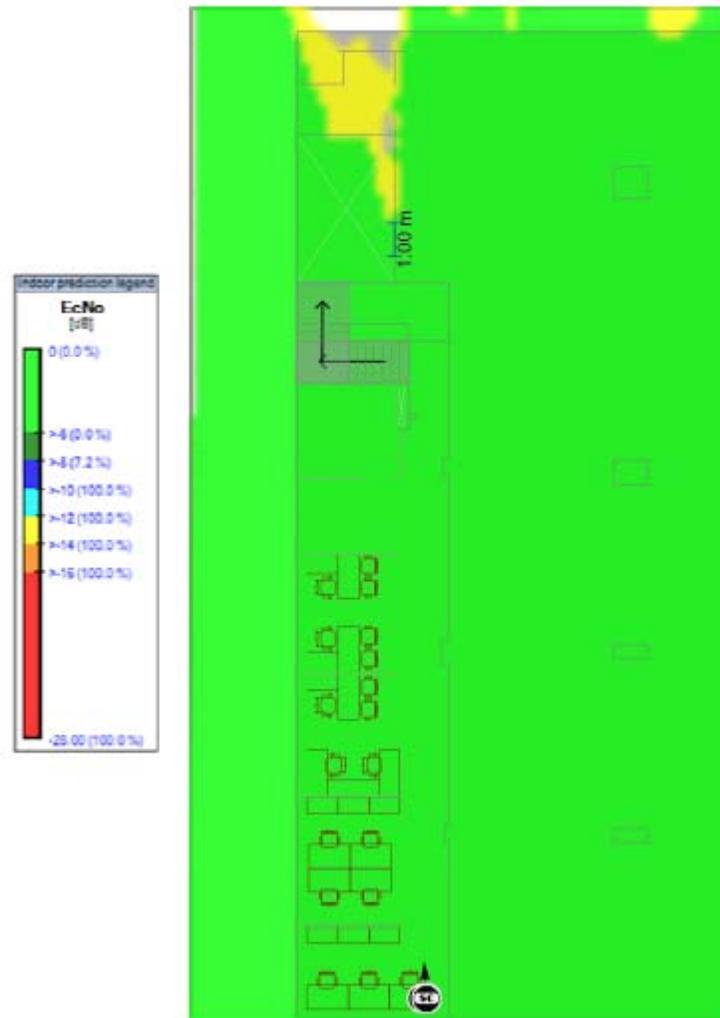


Figura 1.10: EcNo indoor edificio CEM1 sótano 1

3. Plots de Best Server

Se muestran los plots de los *Best Server*, que permite identificar la dominancia al servidor que proporciona la red para los ambientes del Edificio CEM2 y CEM1 de la Agencia de viajes.

3.1 Edificio CEM 2:

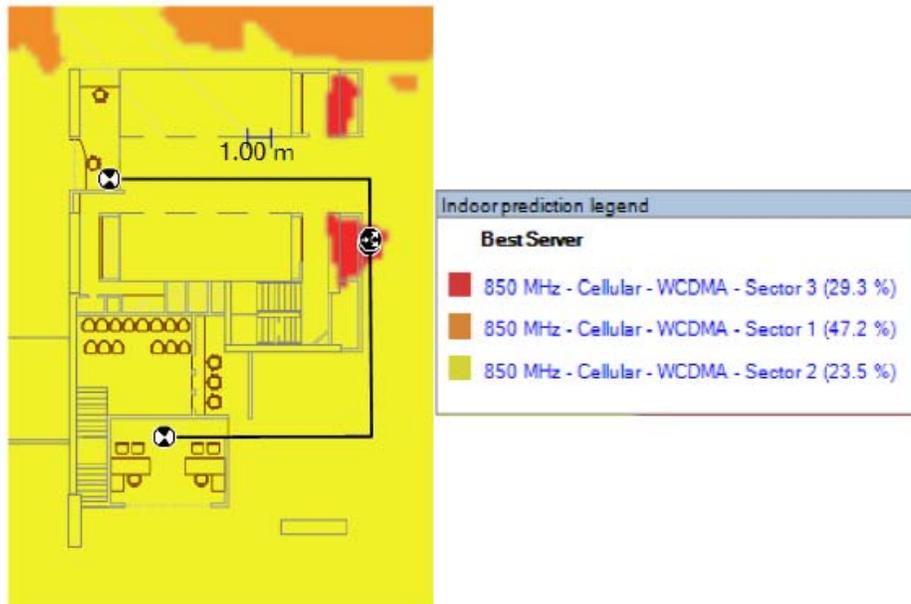




Figura 1.13: Best Server edificio CEM2 Piso 1

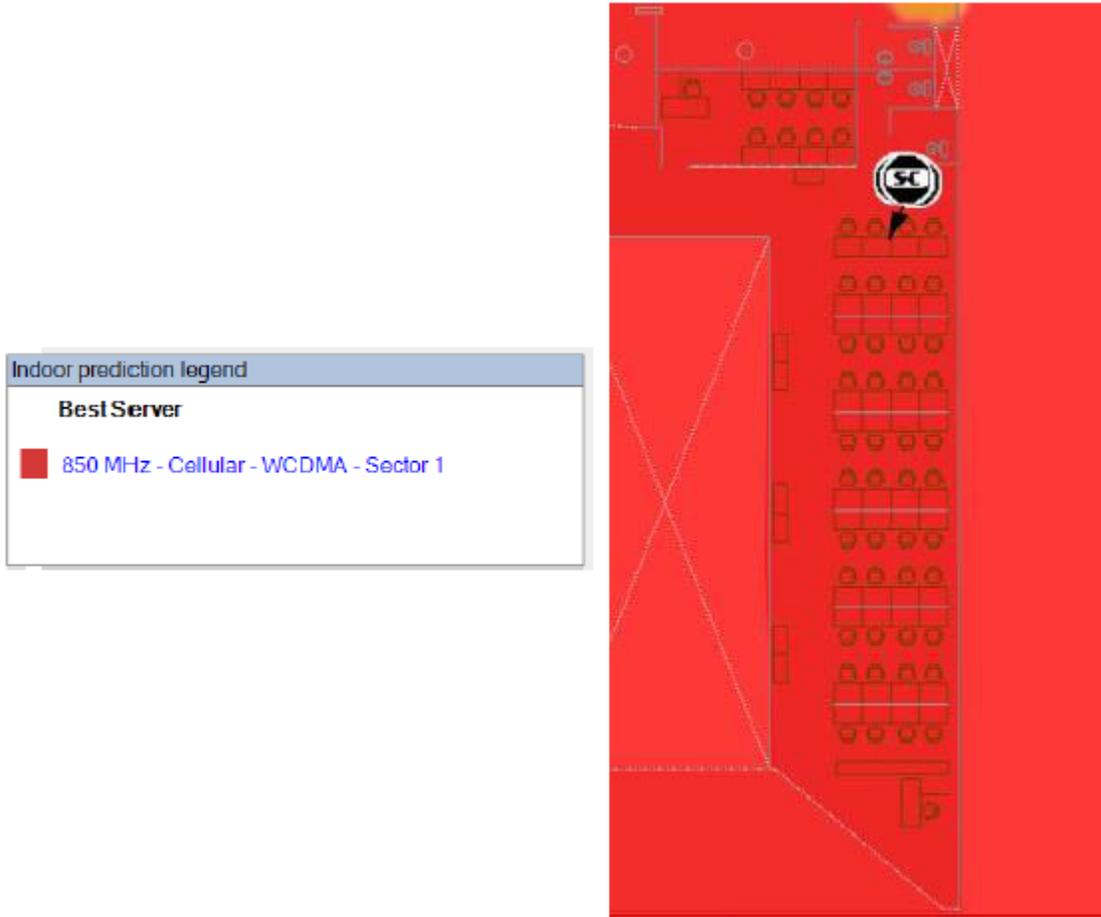


Figura 1.13: Best Server edificio CEM2 Piso 2

3.2 Edificio CEM 1:

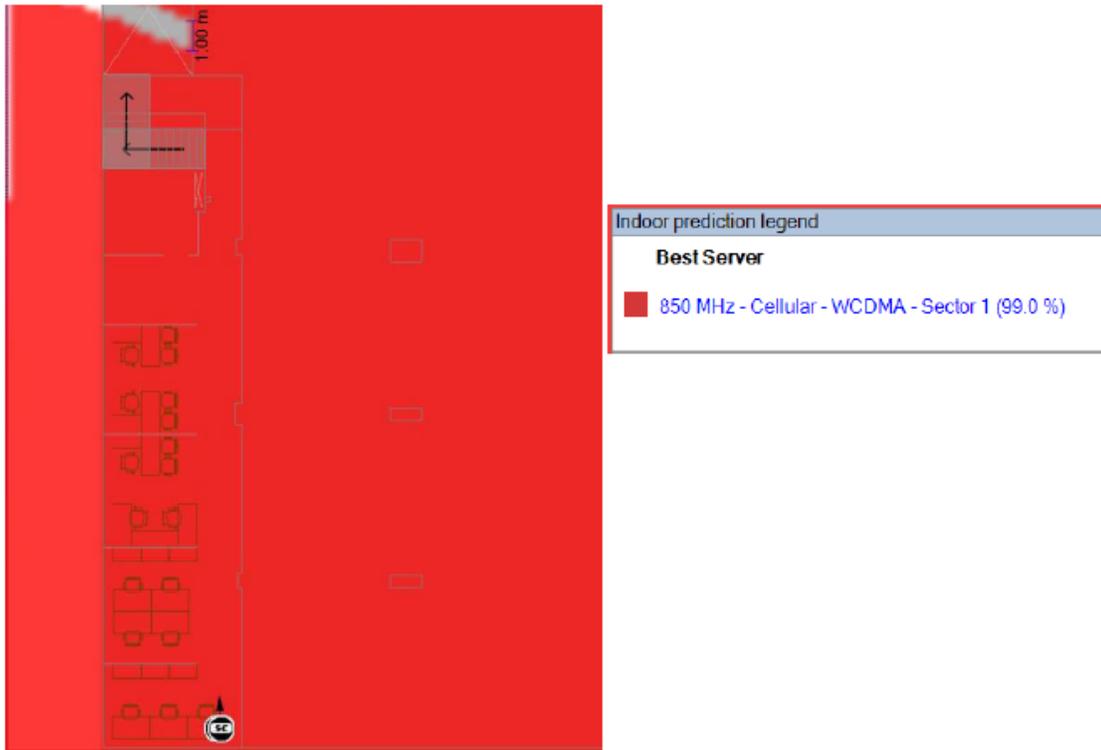


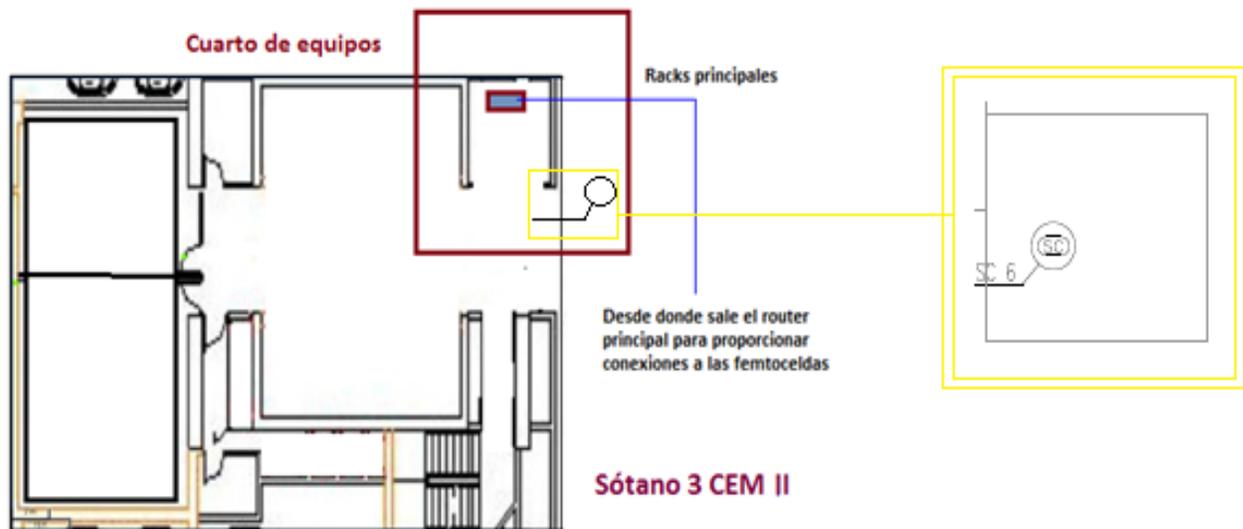
Figura 1.14: Best Server edificio CEM2 Sótano 1

ANEXO 05: ANEXO DE INSTALACIÓN

En el presente anexo se tiene las fotografías de los equipos y el sistema distribuido de antenas instalados.

Edificio CEM II:

SÓTANO 3



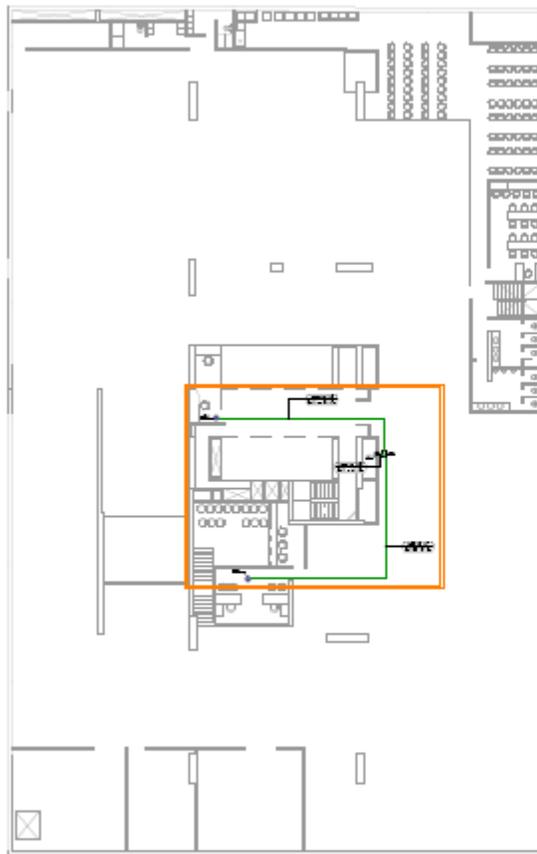
GABINETE PRINCIPAL DE DISTRIBUCIÓN DE EQUIPOS



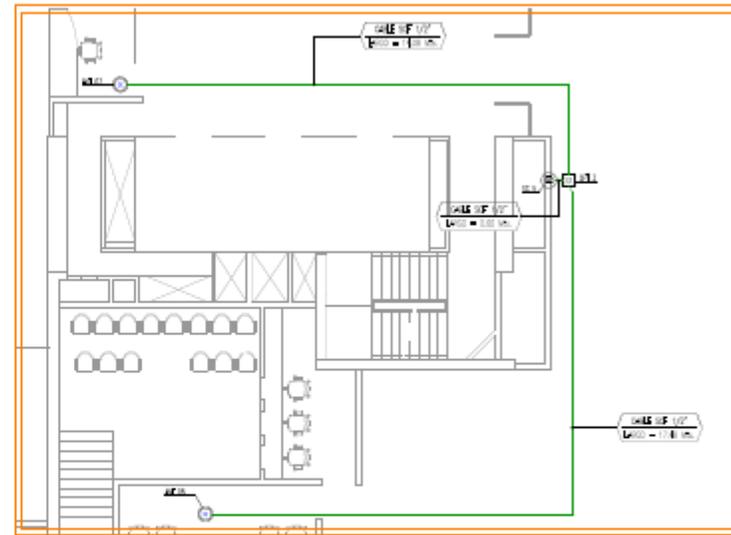
VISTA GENERAL DEL CUARTO DE EQUIPOS DEL SÓTANO 3



SÓTANO 1



PLANTA SÓTANO 1 (CEM 2)

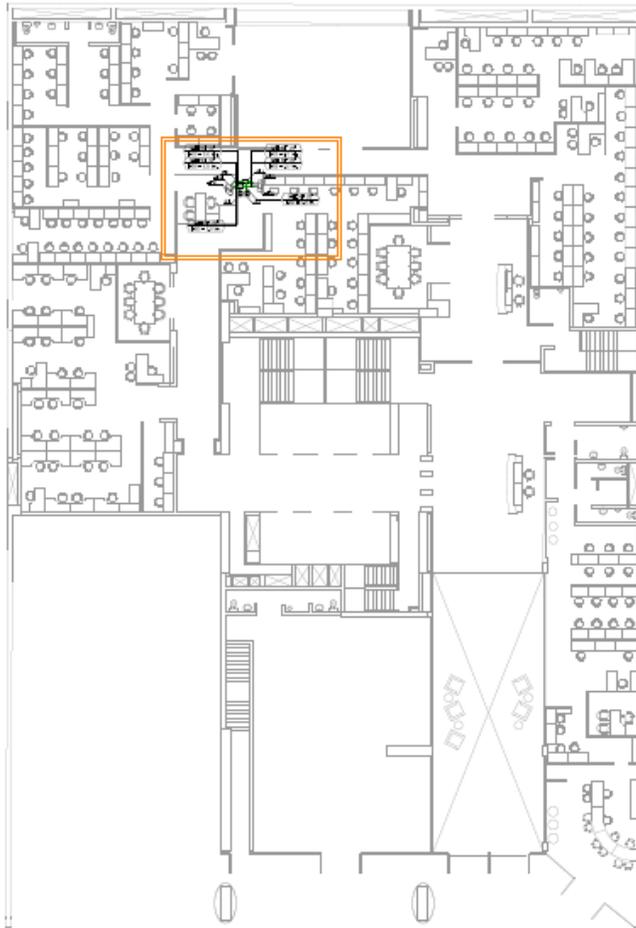


ZOOM
ESCALA: 1/150

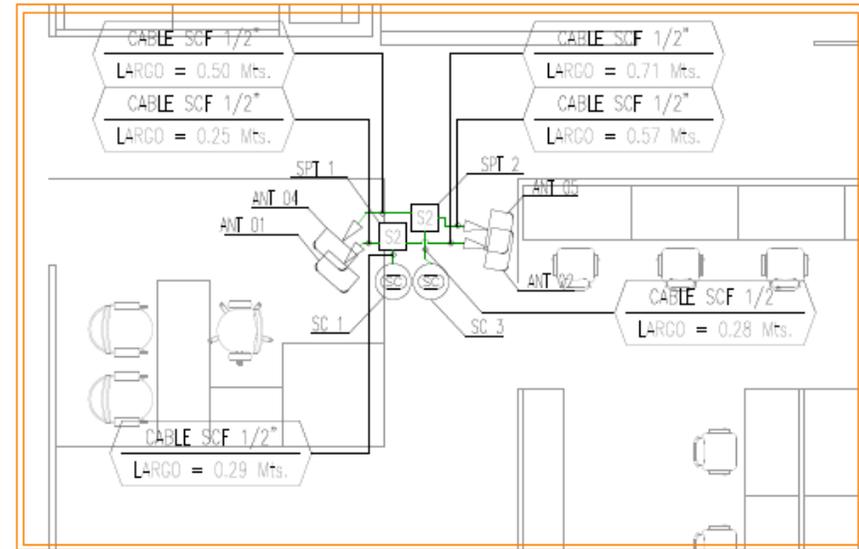
Tomas de Instalaciones en el Sótano 1



PISO 1



PLANTA PISO 1 (CEM 2)



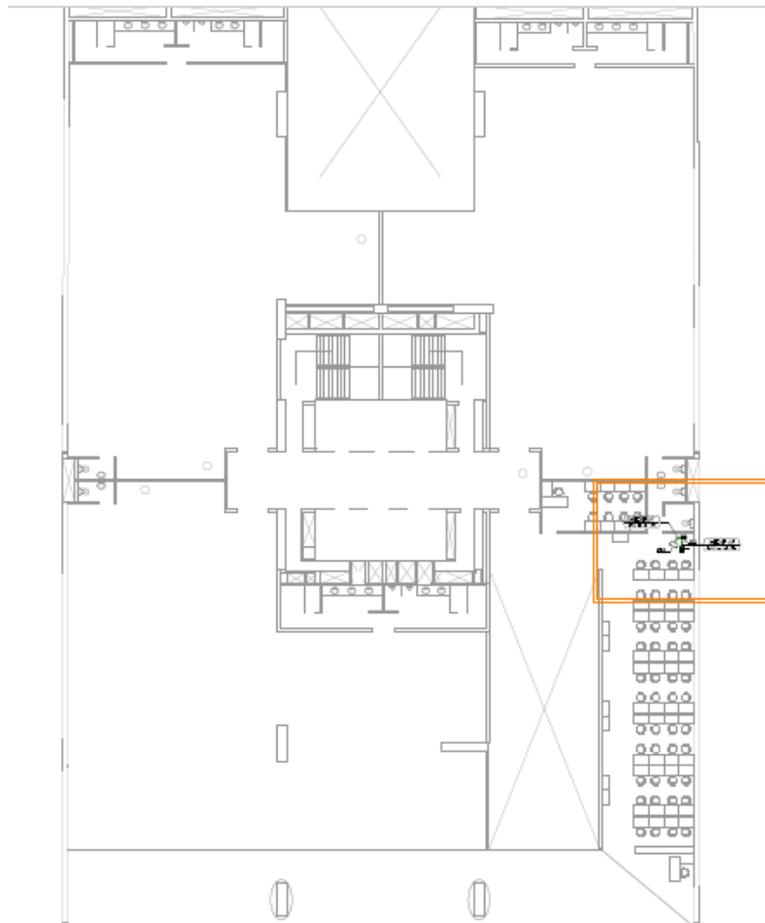
ZOOM

ESCALA: 1/75

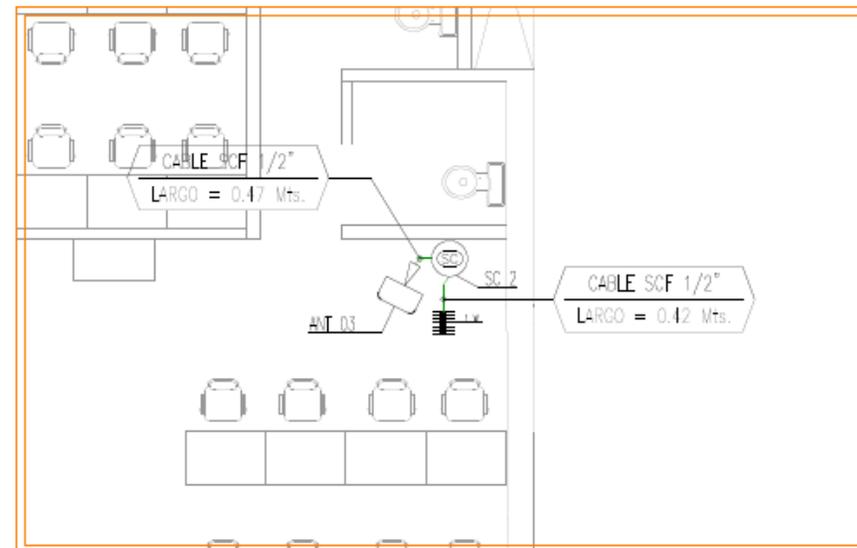
Tomas de Instalaciones en el Piso 1



PISO 2



PLANTA PISO 2 (CEM 2)



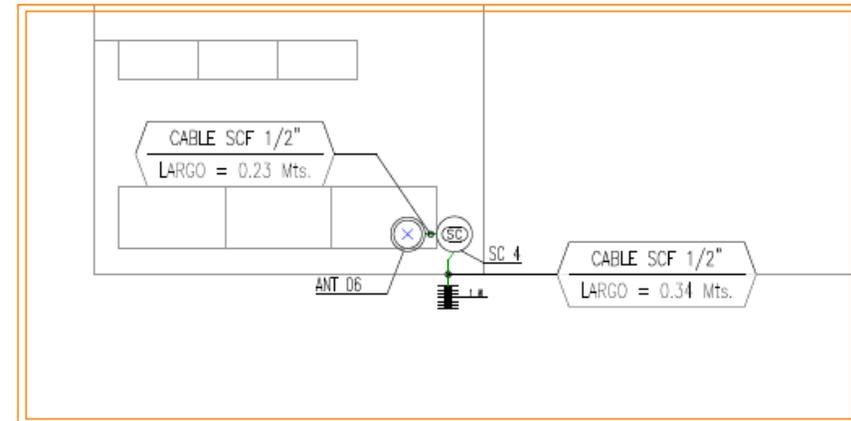
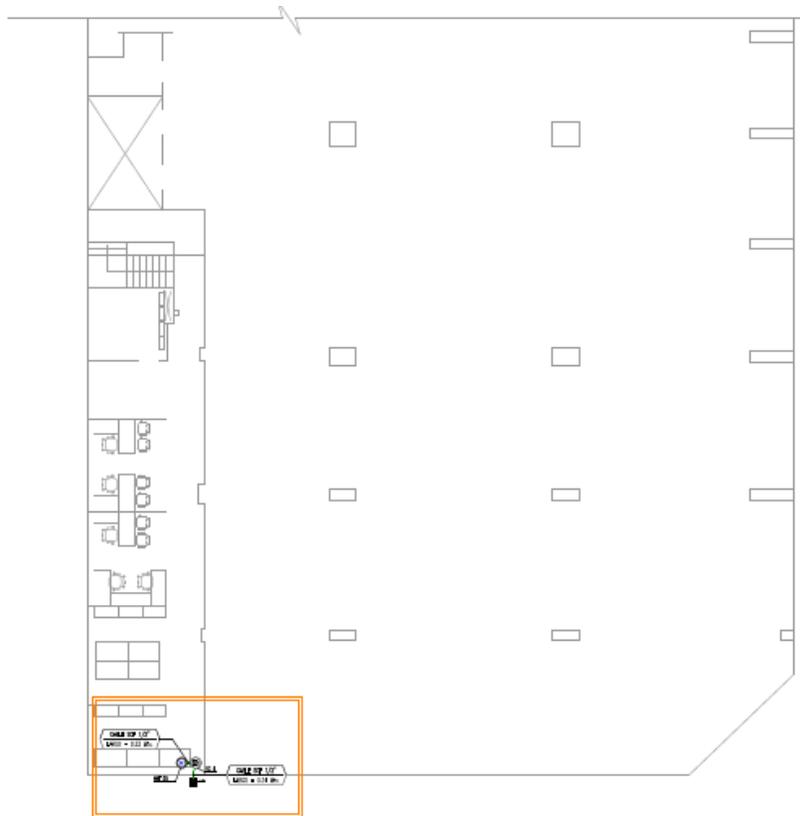
ZOOM
ESCALA: 1/75

Tomas de Instalaciones en el Piso 2



EDIFICIO CEM I

SÓTANO 1



ZOOM
ESCALA: 1/75

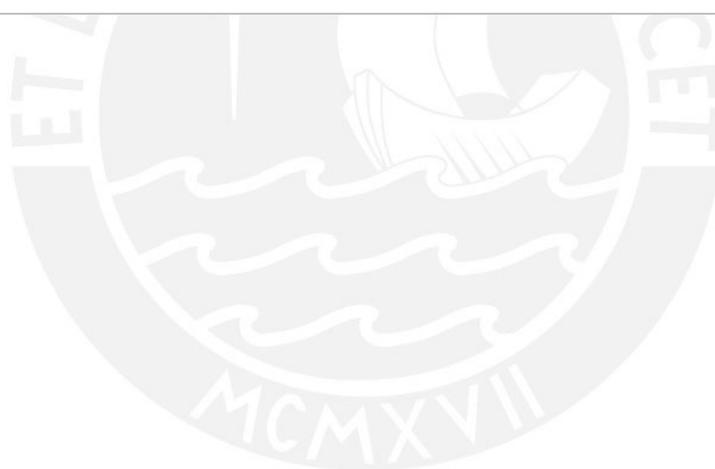
PLANTA SÓTANO (CEM 1)

Tomas de Instalaciones en el Sótano 1



ANEXO 06: Cálculo de Backhaul

El presente anexo muestra en detalle los datos calculados para el backhaul mínimo de la solución



Perfiles de tráfico

	Usuario Empresarial	Usuario Promedio	Usuario Intensivo	
<i>Metro OAM traffic (kbps)</i>	50	50	50	Mínimo tráfico que necesita la femtocelda para empezar a gestionar
<i>Average to Peak data ratio</i>	2	2	2	
<i>Bloqueo</i>	2.00%	2.00%	2.00%	
<i>% Usuarios que utilizarán datos</i>	100.00%	80.00%	100.00%	Capacidad de un canal de voz
<i>Throughput per voice channel (kbps)</i>	65	65	65	
<i>Voice activity Busy Hour / User (mErl)</i>	33	28	37	
<i>DL Data activity Busy Hour / User (kbps)</i>	17.78	0.00	0.00	
<i>Data service penetration</i>	100%	80.00%	100.00%	
<i>Nominal Data Bit Rate (kbps) DL</i>	2000 Kbps	2000 Kbps	5000 Kbps	
<i>Nominal Data Bit Rate (kbps) UL</i>	1000 Kbps	1000 Kbps	2000 Kbps	
<i>Busy Hour data consumption (kBytes, DL)</i>	4000	2000	8000	
<i>Busy Hour data consumption (kBytes, UL)</i>	800	400	1600	
<i>Femtoceldas en el Proyecto</i>	6	6	6	
<i>Número de Lineas o Clientes</i>	200	0	0	
<i>Backhaul Mínimo para Datos (Downlink) kbps</i>	3556	0	0	
<i>Backhaul Mínimo para Datos (Uplink) kbps</i>	711	0	0	
<i>Backhaul Mínimo para Voz (Downlink) kbps</i>	780	0	0	
<i>Backhaul Mínimo para Voz (Uplink) kbps</i>	780	0	0	
<i>Backhaul Mínimo Downlink (kbps)</i>	4636	0	0	
<i>Backhaul Mínimo Uplink (kbps)</i>	1791	0	0	

Inputs que maneja el operador

Fórmulas

$$\text{Backhaul Mínimo para datos DL Kbps} = \# \text{líneas} \times \% \text{de usuarios que usan datos} \times \text{Busy HourData} \times \frac{8}{3600} \times \text{average to peak DataRatio}$$

*Se multiplica x 8/3600, ya que el dato Busy Hour está en KB

$$\text{DL Data Activity Busy Hour/User (Kbps)} = \frac{\text{Backhaul mínimo para datos DL Kbps}}{\# \text{líneas}}$$

$$\text{Backhaul Mínimo para datos UL Kbps} = \# \text{líneas} \times \% \text{de usuarios que usan datos} \times \text{Busy HourData} \times \frac{8}{3600} \times \text{average to peak DataRatio}$$

*Se multiplica x 8/3600, ya que el dato Busy Hour está en KB

$$\text{tráfico en Erl.} = \# \text{líneas} \times \frac{(\text{Voice activity Busy HourUser (mErl)})}{1000} = 6.6$$

Se hace uso de la tabla Erlang B para la cantidad de líneas para el tráfico cursado hallar el número de canales

#de canales halladas con Erlang B = 12 canales

Cada canal es de 65 Kbps, ya que se usa un códec para voz HD

$$\text{Backhaul Mínimo para Voz (Downlink) kbps} = \# \text{de canales halladas con Erlang B} \times 65 \text{ kbps} = 780 \text{ Kbps}$$

$$\text{Backhaul Mínimo Downlink (kbps)} = \text{Backhaul Mínimo para Voz (DL) kbps} + \text{Backhaul Mínimo para datos DL Kbps} + (\# \text{de femtoceldas} \times \text{Metro OAM traffic (kbps)})$$

$$\text{Backhaul Mínimo Uplink (kbps)} = \text{Backhaul Mínimo para Voz (UL) kbps} + \text{Backhaul Mínimo para datos UL Kbps} + (\# \text{de femtoceldas} \times \text{Metro OAM traffic (kbps)})$$

Requerimientos de Backhaul Mínimo para Femtoceldas (por Proyecto)

Número de Femtoceldas a Desplegar en el Proyecto	6
Número de Líneas o Clientes Intensivos (>1GB al mes)	0
Número de Líneas o Clientes Empresariales (aprox 300 MB al mes)	200
Número de Líneas o Clientes Promedio (< 100 MB al mes)	0

Capacidad en Backhaul Mínimo Uplink TOTAL por Proyecto	2.2 Mbps
Capacidad en Backhaul Mínimo Downlink TOTAL por Proyecto	5.6 Mbps

Esta opción solo ofrece cobertura para escenarios de voz

Capacidad en Backhaul Mínimo Requerido Uplink POR METRO	0.4 Mbps
Capacidad en Backhaul Mínimo Requerido Downlink POR METRO	0.9 Mbps

Capacidad en Backhaul Mínimo Recomendado Uplink POR METRO	1.0 Mbps
Capacidad en Backhaul Mínimo Recomendado Downlink POR METRO	4.0 Mbps

Capacidad en Backhaul Uplink POR SC	2,4Mbps
Capacidad en Backhaul Downlink POR SC	6Mbps

Valores
recomendados

Esta opción es el mínimo recomendado en los escenarios de alta capacidad

Capacidad en Backhaul Máximo Uplink POR METRO Mbps	5.8 Mbps
Capacidad en Backhaul Máximo Downlink POR METRO Mbps	18.6 Mbps

Máximo x femtocelda para garantizar los usuarios alcancen velocidades pico que ofrece HSPA+ (horas no pico)

ANEXO 07: ANEXO DE ESTUDIO DE INGENIERÍA

El presente anexo contiene información acerca de lo abarcado por el estudio de ingeniería

1. TSS

Technical Site Survey, consiste en una visita técnica para poder evaluar el estado del sitio. El objetivo de la visita técnica es recolectar datos acerca de la infraestructura y de todos aquellos detalles de instalación necesarios para la implementación de un proyecto de femtoceldas. Esta visita técnica sirve para tener un esquema tentativo de la ubicación de cada equipo acorde a las indicaciones de la infraestructura del ambiente e identificar toda el área a cubrir.

2. Elaboración del primer diseño

El diseño está a cargo de un ingeniero RF, el cual será abastecido con todas las herramientas necesarias para poder modelar el edificio, generar las posiciones finales de las femtoceldas y los *plots* de cobertura esperados mediante el software de diseño y predicción de cobertura.

En el diseño se deben de tener las siguientes consideraciones:

- Posición de las paredes, columnas y sus distancias y dimensiones.
- Material del piso y el techo
- Material de las paredes, columnas, puertas.
- Altura del piso al techo.
- Dimensiones de todo el piso/edificio plasmadas en el plano.
- Fotografías del sitio mostrando todo lo antes dicho
- Indicar potenciales lugares para instalación de las femtoceldas

3. Mejoras del diseño

Una vez elaborado el diseño, se realiza una evaluación del área de cobertura de predicción. Si se verifica que el diseño no cubre el área solicitada se realizan mejoras sobre el mismo con ajustes que puedan cubrir el área requerida.

Se debe revisar finalmente los siguientes puntos:

- Zonas objetivo cobertura.
- Priorizar las zonas donde se deba esperar una mejor cobertura 3G.

4. Reporte Final del Ingeniero

Consiste en el informe final presentado por el ingeniero, el cual mostrará los resultados obtenidos y evaluados. Este reporte es la referencia sobre la cual se trabaja la implementación de la solución, ya que contiene la ubicación de las femtoceldas, predicciones de cobertura y lista de materiales.

5. Optimización

Una vez realizada la implementación de la solución se evalúan los resultados obtenidos y se compara con las predicciones de cobertura del diseño elaborado.

Esta optimización consiste en verificación de la cobertura de las femtoceldas en base al diseño provisto por el ingeniero RF. Así mismo, se evalúa y valida la desviación respecto a los parámetros de cobertura y calidad esperados. De acuerdo a ello, el ingeniero RF sugiere cambios físicos o lógicos para mejorar los resultados obtenidos.



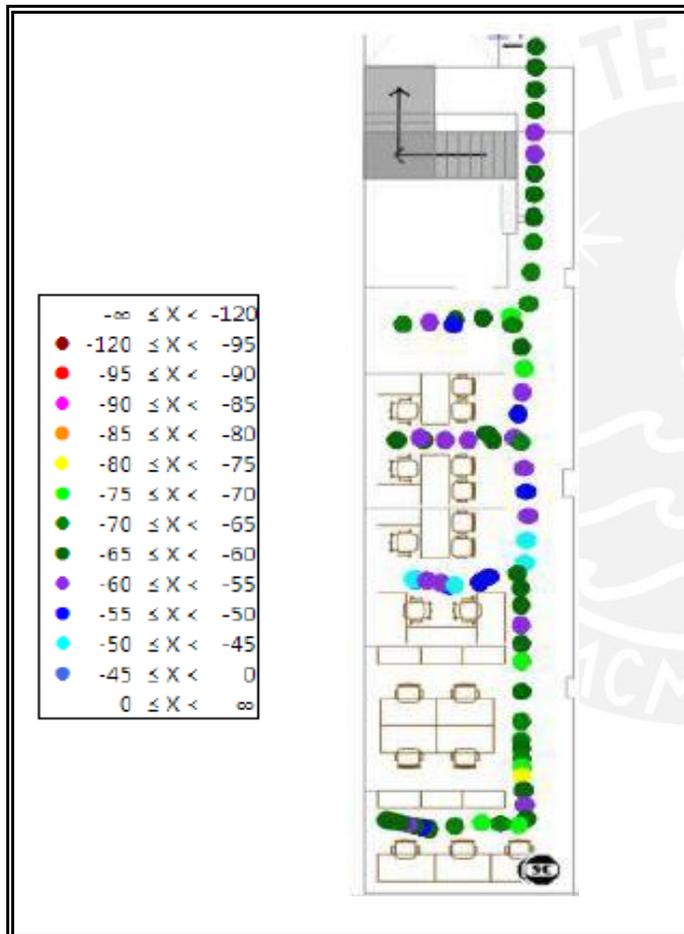
ANEXO 08: MEDICIONES FINALES



El presente anexo contiene las mediciones Finales realizadas luego de la puesta de la solución

Niveles del parámetro RSCP

Portadora 1062 sótano 1 CEM1



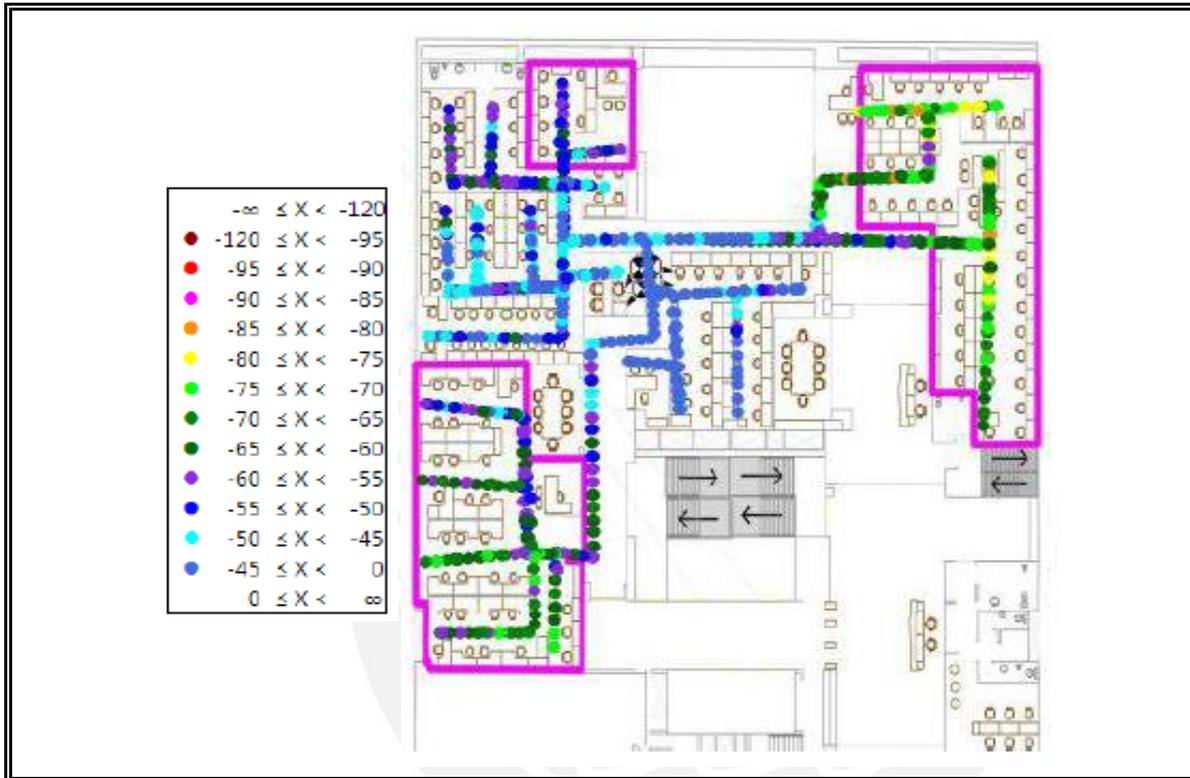
Niveles RSCP(dBm)	#Muestras	Porcentaje	KPI
[-45, 0]	1	1.27%	100.00%
[-50, -45]	4	5.06%	
[-55, -50]	7	8.86%	
[-60, -55]	19	24.05%	
[-65, -60]	30	37.97%	
[-70, -65]	11	13.92%	
[-75, -70]	6	7.59%	
[-80, -75]	1	1.27%	
[-85, -80]	0	0.00%	
[-90, -85]	0	0.00%	0.00%

Portadora 1062 sótano 3 CEM2

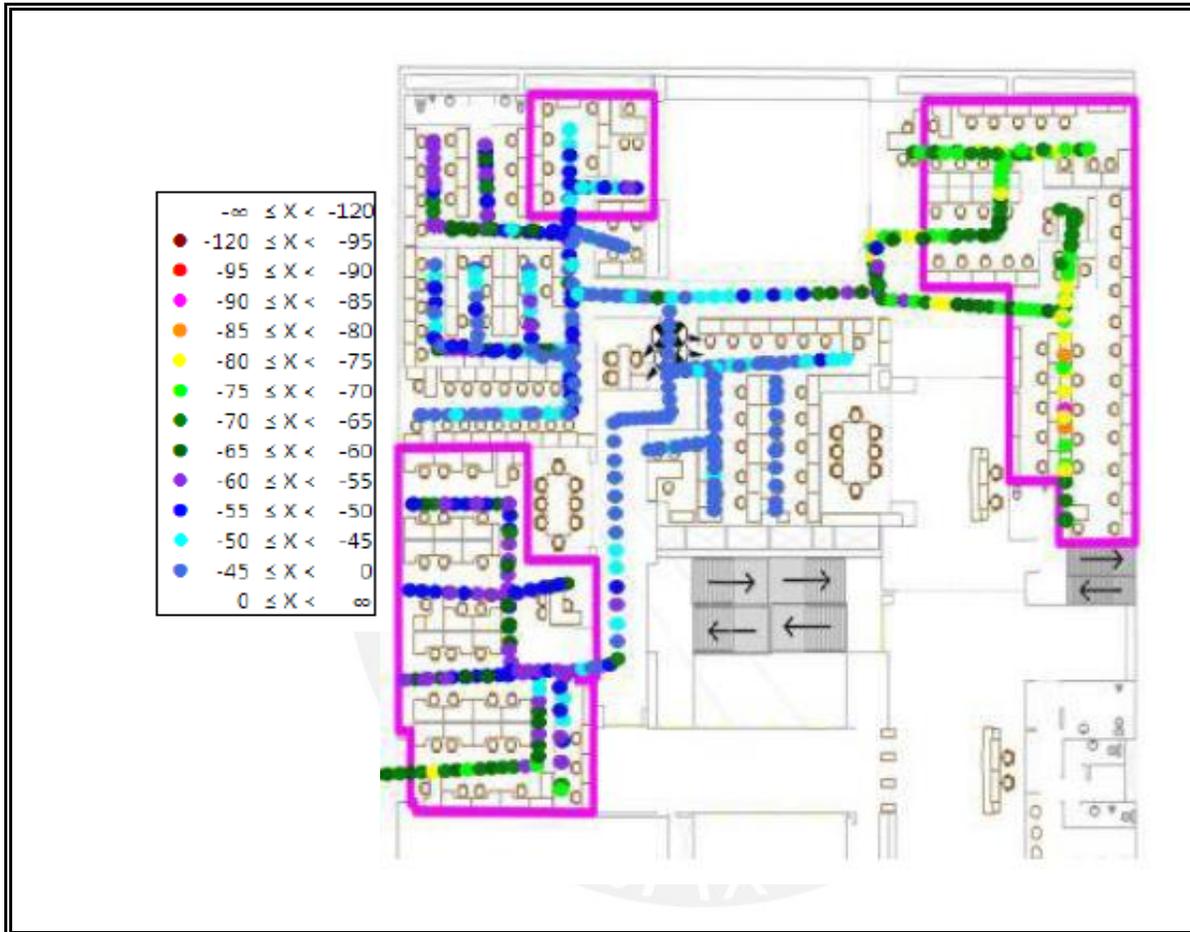


Portadora 1062 sótano 1 CEM2

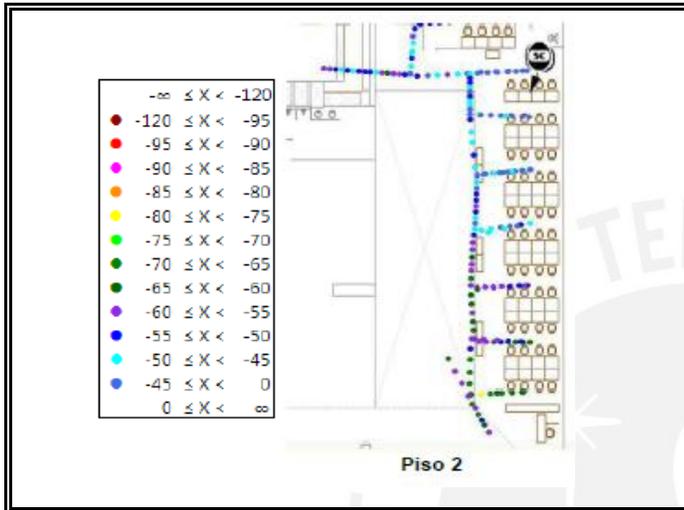




Portadora 1087 PISO 1 CEM2

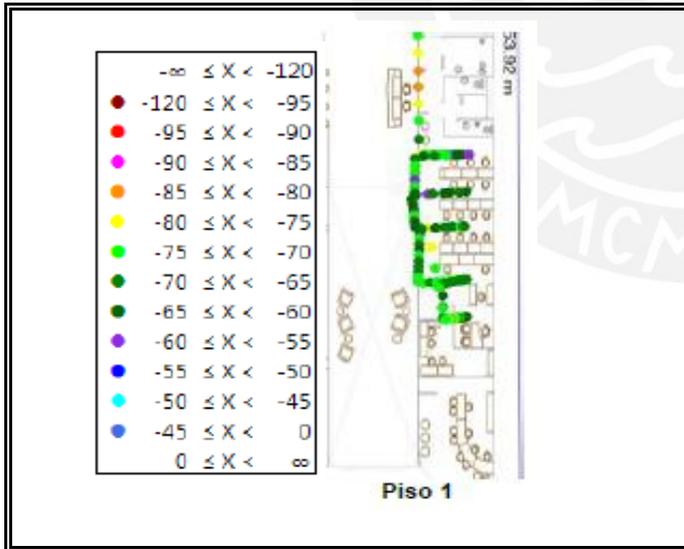


Portadora 1062 PISO 2 CEM2

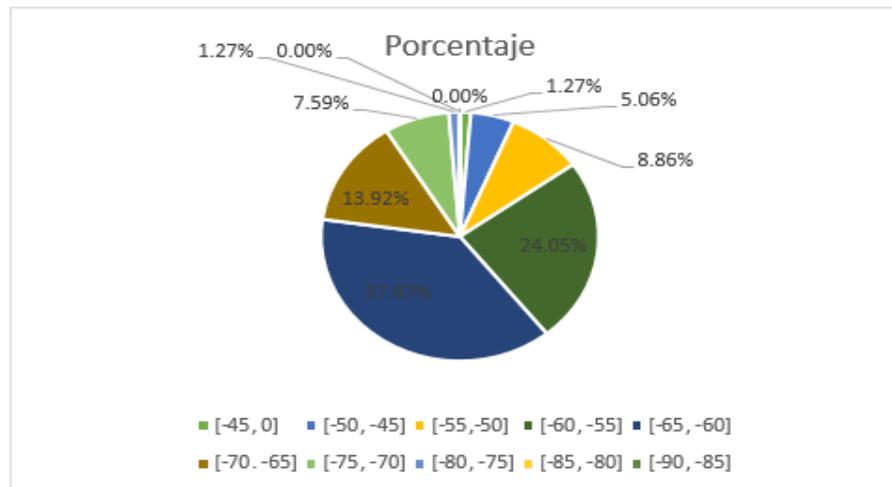
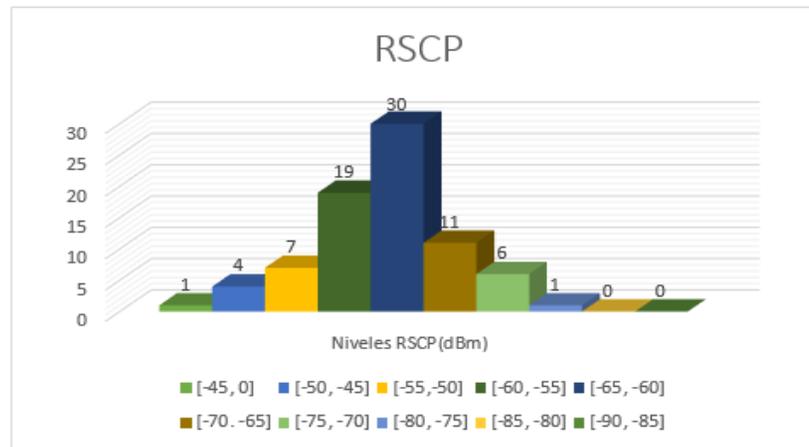


Niveles RSCP(dBm)	#Muestras	Porcentaje	KPI
[-45, 0]	39	22.81%	100.00%
[-50, -45]	34	19.88%	
[-55,-50]	35	20.47%	
[-60, -55]	34	19.88%	
[-65, -60]	18	10.53%	
[-70, -65]	10	5.85%	
[-75, -70]	0	0.00%	
[-80, -75]	1	0.58%	
[-85, -80]	0	0.00%	
[-90, -85]	0	0.00%	

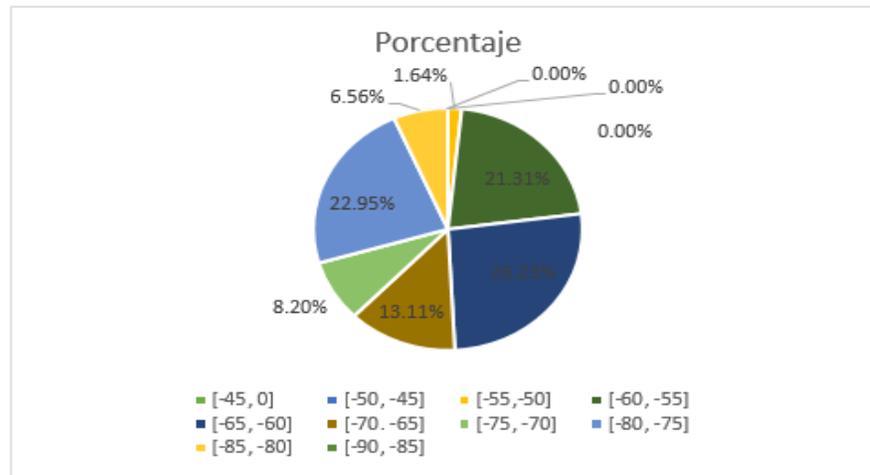
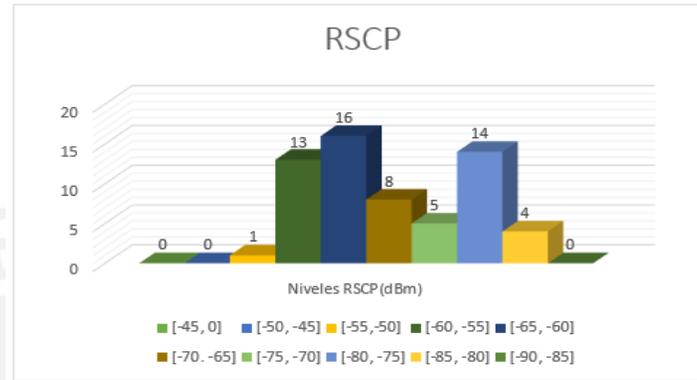
Zona que cubre la femtocelda del Piso 2 en el Piso 1



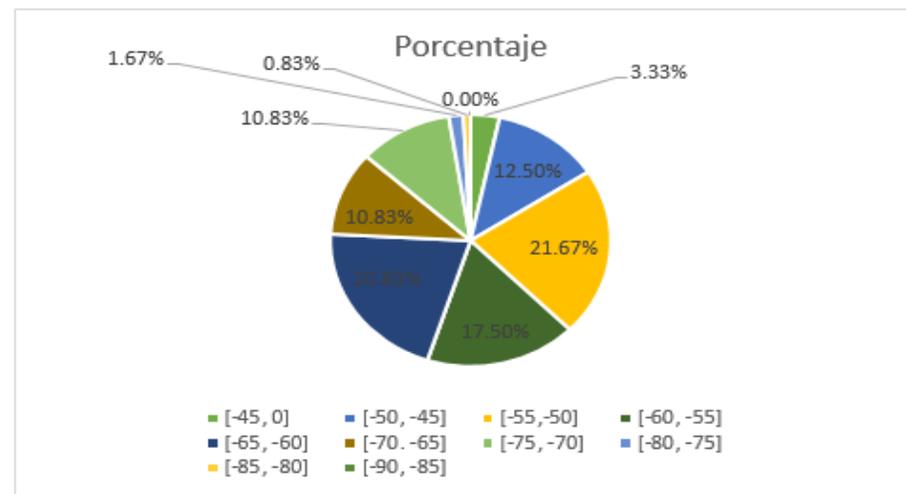
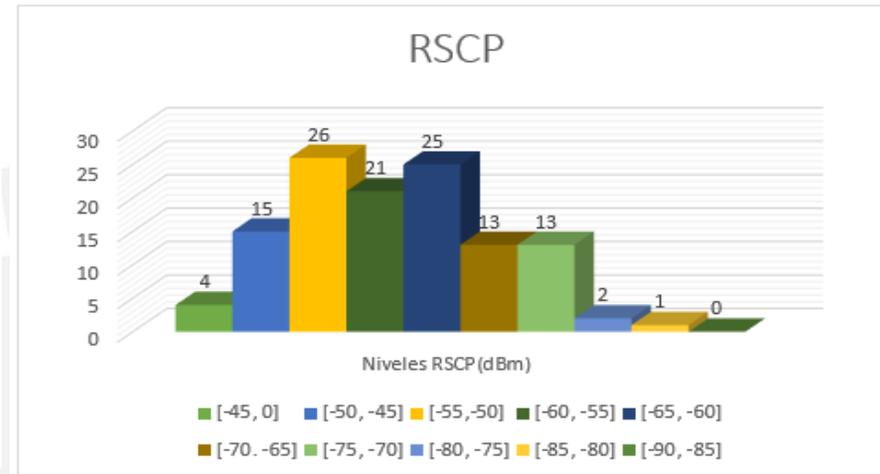
Niveles RSCP(dBm)	#Muestras	Porcentaje	KPI
[-45, 0]	0	0.00%	99.07%
[-50, -45]	0	0.00%	
[-55,-50]	0	0.00%	
[-60, -55]	4	3.74%	
[-65, -60]	25	23.36%	
[-70, -65]	31	28.97%	
[-75, -70]	32	29.91%	
[-80, -75]	10	9.35%	
[-85, -80]	4	3.74%	
[-90, -85]	1	0.93%	



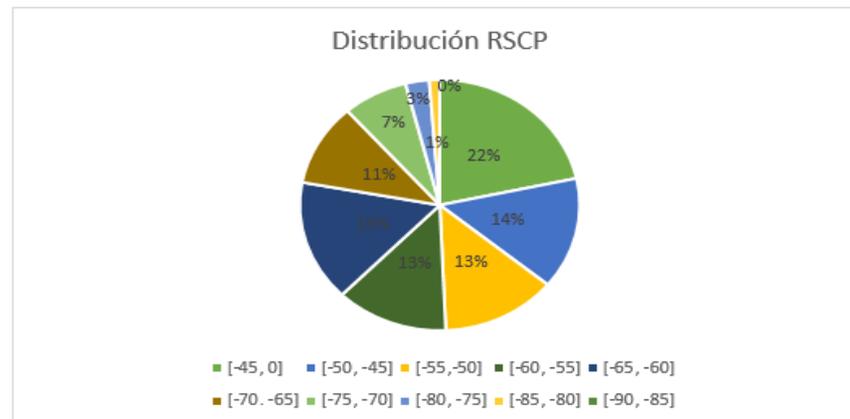
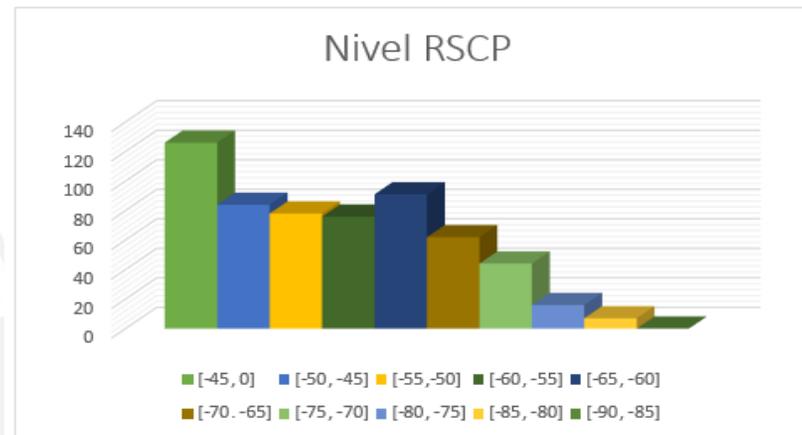
Niveles RSCP(dBm)	#Muestras	Porcentaje	KPI
[-45, 0]	0	0.00%	100.00%
[-50, -45]	0	0.00%	
[-55,-50]	1	1.64%	
[-60, -55]	13	21.31%	
[-65, -60]	16	26.23%	
[-70. -65]	8	13.11%	
[-75, -70]	5	8.20%	
[-80, -75]	14	22.95%	
[-85, -80]	4	6.56%	
[-90, -85]	0	0.00%	



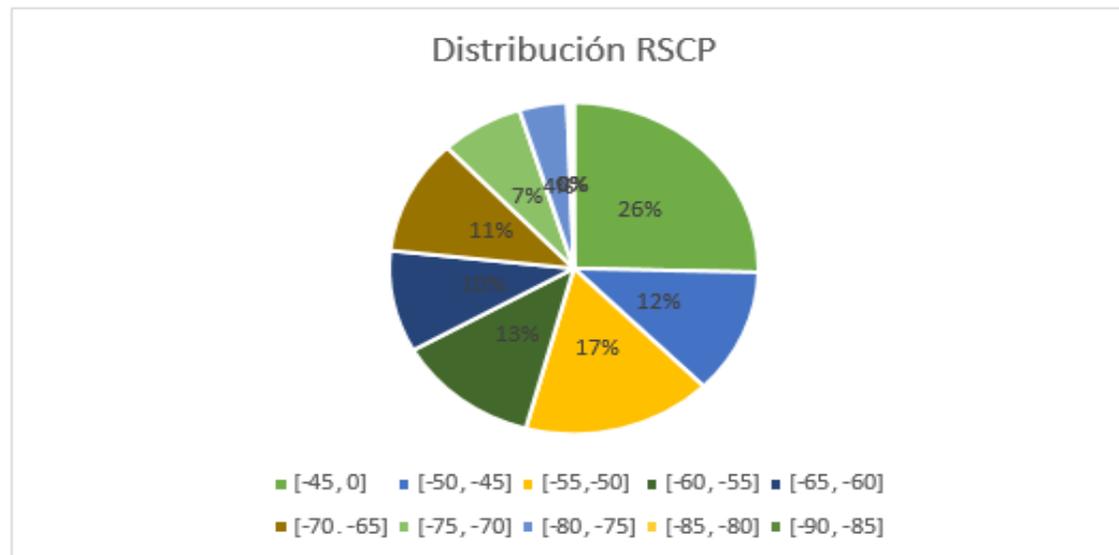
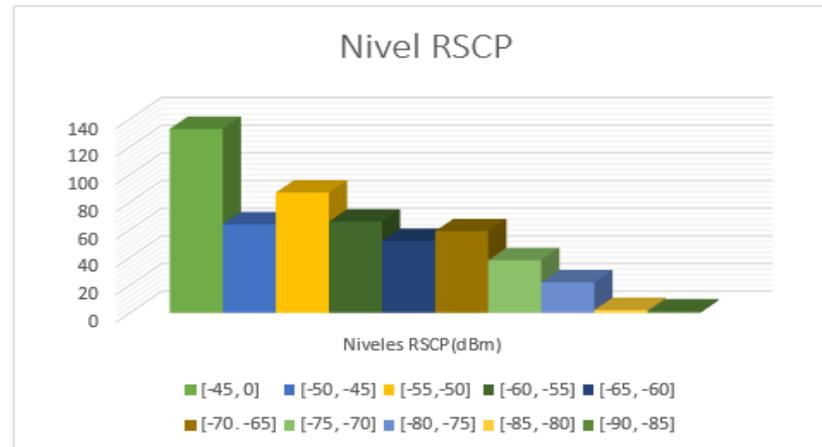
Niveles RSCP(dBm)	#Muestras	Porcentaje	KPI
[-45, 0]	4	3.33%	100.00%
[-50, -45]	15	12.50%	
[-55,-50]	26	21.67%	
[-60, -55]	21	17.50%	
[-65, -60]	25	20.83%	
[-70. -65]	13	10.83%	
[-75, -70]	13	10.83%	
[-80, -75]	2	1.67%	
[-85, -80]	1	0.83%	
[-90, -85]	0	0.00%	

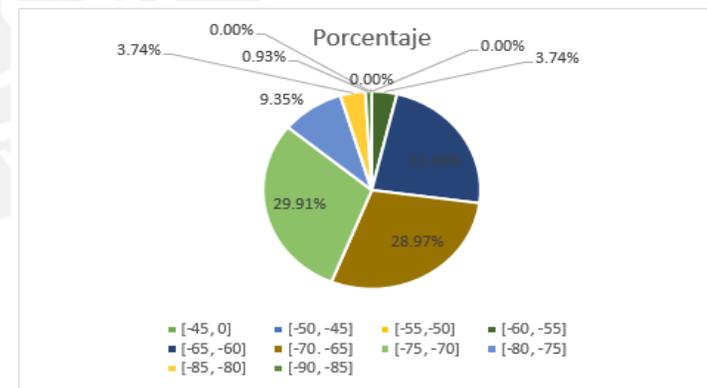
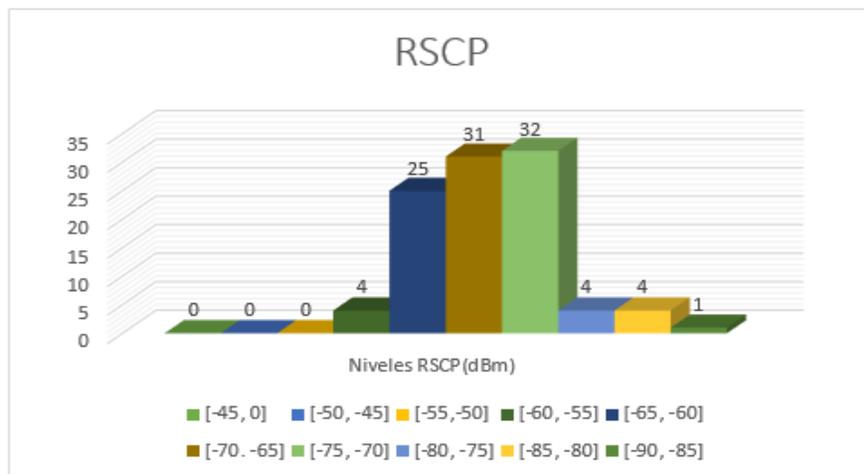
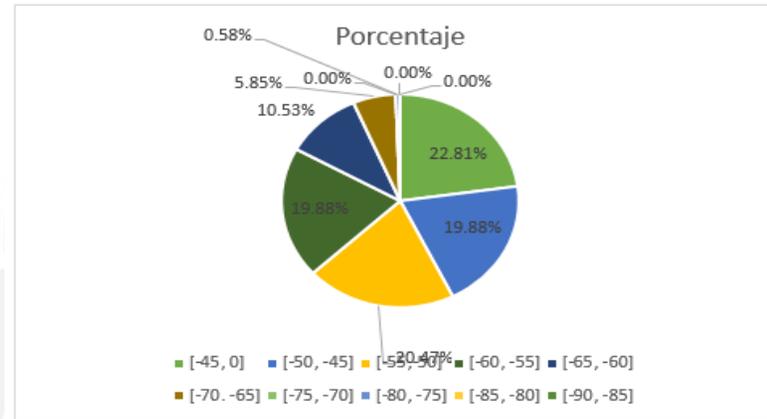
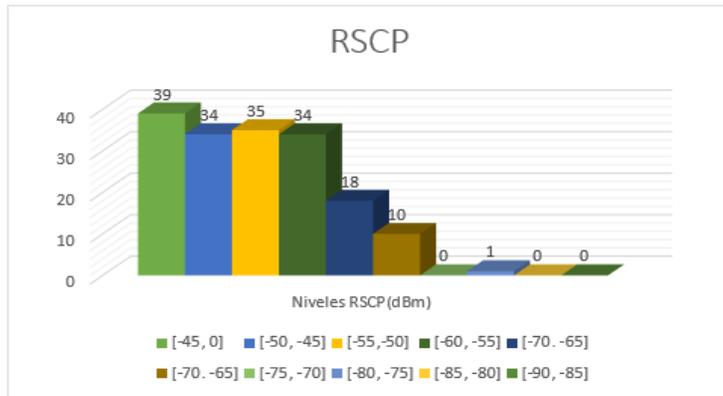


Niveles RSCP(dBm)	#Muestras	Porcentaje	KPI
[-45, 0]	126	21.58%	100.00%
[-50, -45]	84	14.38%	
[-55, -50]	78	13.36%	
[-60, -55]	76	13.01%	
[-65, -60]	91	15.58%	
[-70, -65]	62	10.62%	
[-75, -70]	44	7.53%	
[-80, -75]	16	2.74%	
[-85, -80]	7	1.20%	0.00%
[-90, -85]	0	0.00%	



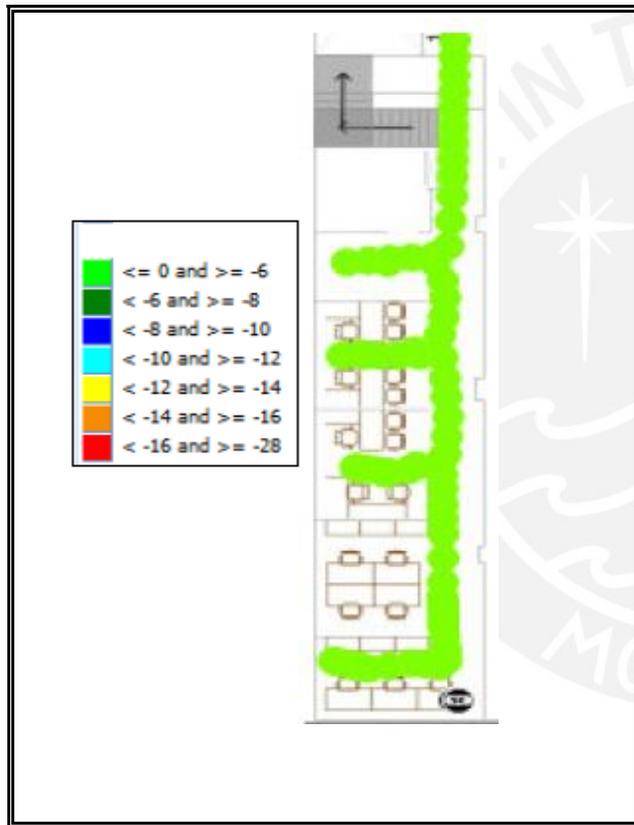
Niveles RSCP(dBm)	#Muestras	Porcentaje	KPI
[-45, 0]	133	25.38%	99.81%
[-50, -45]	64	12.21%	
[-55, -50]	87	16.60%	
[-60, -55]	66	12.60%	
[-65, -60]	52	9.92%	
[-70, -65]	59	11.26%	
[-75, -70]	38	7.25%	
[-80, -75]	22	4.20%	
[-85, -80]	2	0.38%	
[-90, -85]	1	0.19%	0.19%





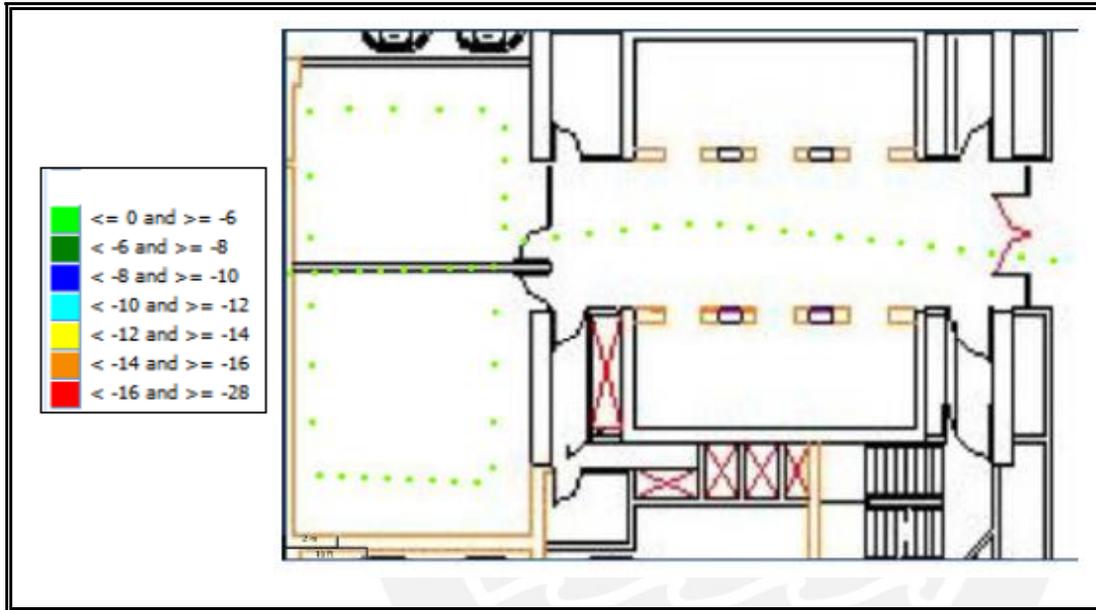
Niveles del parámetro EcNo

Portadora 1062 sótano 1 CEM1



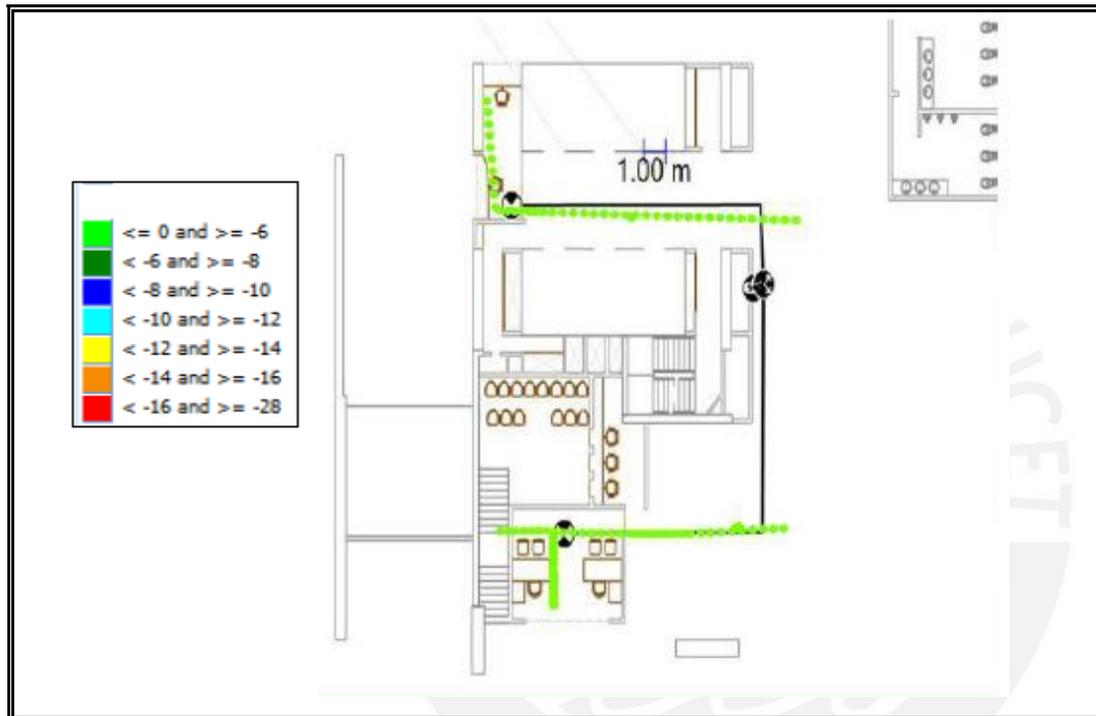
Niveles EcNo(dB)	#Muestras	Porcentaje	KPI
[-6, 0]	79	100.00%	100.00%
[-8, -6]	0	0.00%	0.00%
[-10,-8]	0	0.00%	
[-12, -10]	0	0.00%	
[-14, -12]	0	0.00%	
[-16, -14]	0	0.00%	
[-28, -16]	0	0.00%	

Portadora 1062 sótano 3 CEM2



Niveles EcNo(dB)	#Muestras	Porcentaje	KPI
[-6, 0]	61	100.00%	100.00%
[-8, -6]	0	0.00%	0.00%
[-10,-8]	0	0.00%	
[-12, -10]	0	0.00%	
[-14, -12]	0	0.00%	
[-16. -14]	0	0.00%	
[-28, -16]	0	0.00%	

Portadora 1062 sótano 1 CEM2



Niveles EcNo(dB)	#Muestras	Porcentaje	KPI
[-6, 0]	120	100.00%	100.00%
[-8, -6]	0	0.00%	0.00%
[-10, -8]	0	0.00%	
[-12, -10]	0	0.00%	
[-14, -12]	0	0.00%	
[-16, -14]	0	0.00%	
[-28, -16]	0	0.00%	

Portadora 1062 PISO 1 CEM2



Niveles EcNo(dB)	#Muestras	Porcentaje	KPI
[-6, 0]	527	90%	90%
[-8, -6]	39	7%	10%
[-10, -8]	19	3%	
[-12, -10]	1	0%	
[-14, -12]	0	0%	
[-16, -14]	0	0%	
[-28, -16]	0	0%	

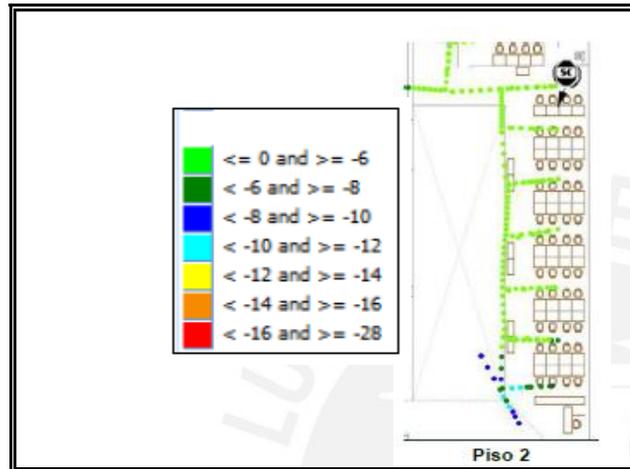
Portadora 1087 PISO 1 CEM2



■	≤ 0 and ≥ -6
■	< -6 and ≥ -8
■	< -8 and ≥ -10
■	< -10 and ≥ -12
■	< -12 and ≥ -14
■	< -14 and ≥ -16
■	< -16 and ≥ -28

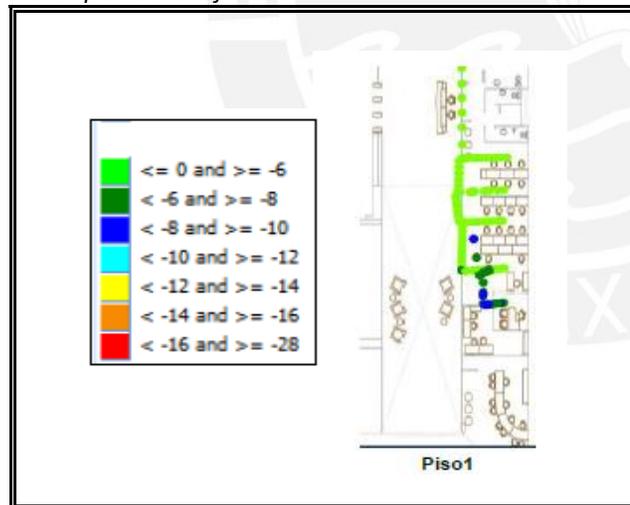
Niveles EcNo(dB)	#Muestras	Porcentaje	KPI
[-6, 0]	506	96.56%	96.56%
[-8, -6]	16	3.05%	3.44%
[-10, -8]	2	0.38%	
[-12, -10]	0	0.00%	
[-14, -12]	0	0.00%	
[-16, -14]	0	0.00%	
[-28, -16]	0	0.00%	

Portadora 1062 PISO 2 CEM2

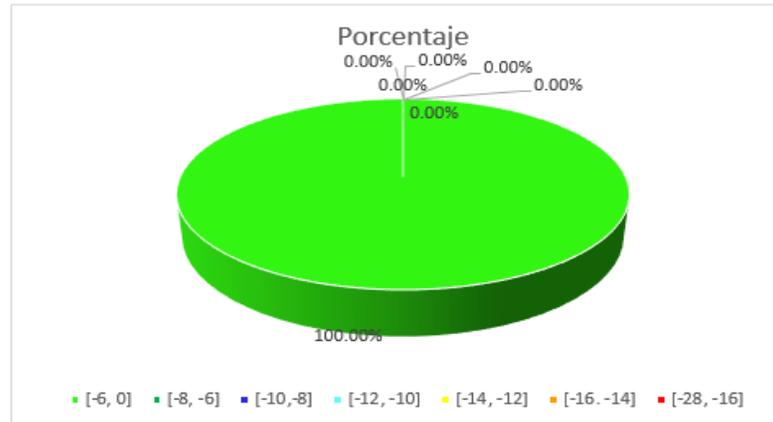
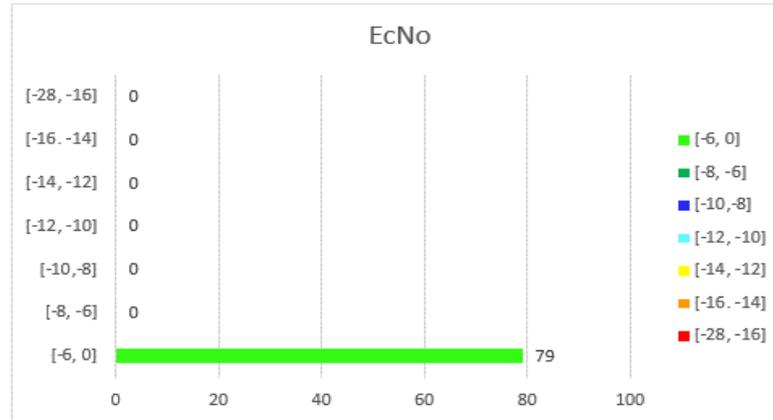


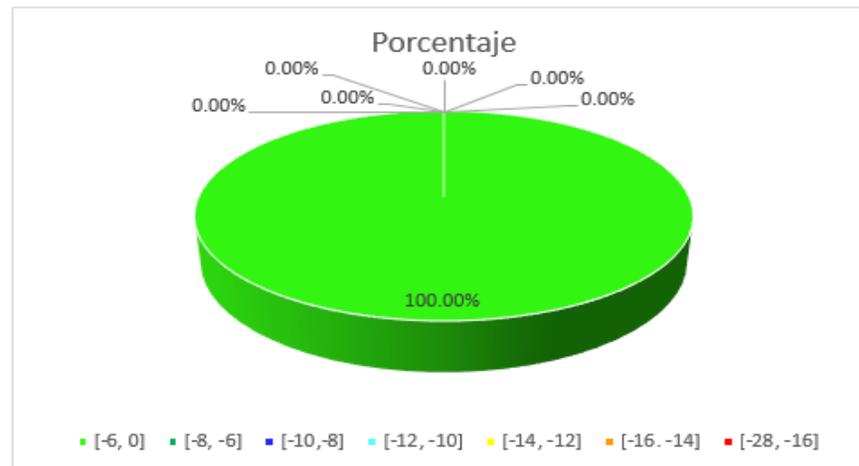
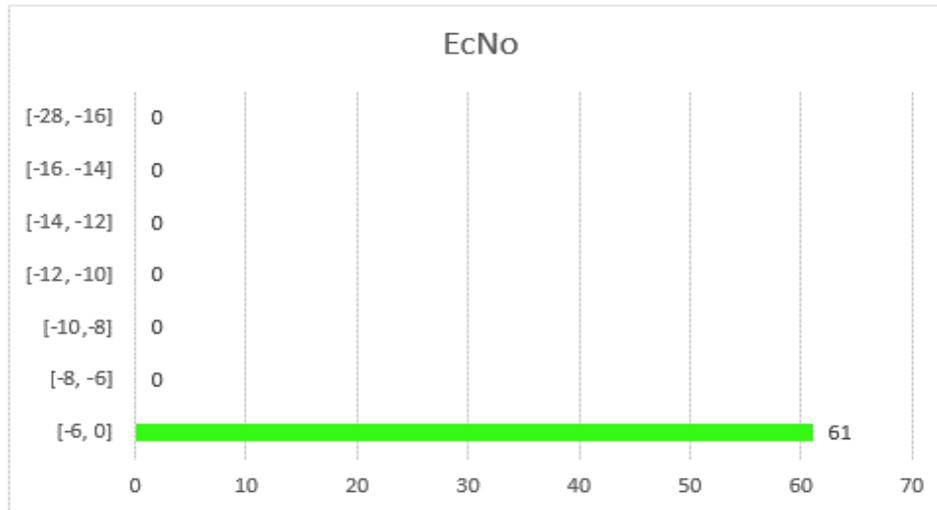
Niveles EcNo(dB)	#Muestras	Porcentaje	KPI
[-6, 0]	196	90.32%	90.32%
[-8, -6]	13	7.60%	14.62%
[-10, -8]	6	4.68%	
[-12, -10]	2	2.34%	
[-14, -12]	0	0.00%	
[-16, -14]	0	0.00%	
[-28, -16]	0	0.00%	

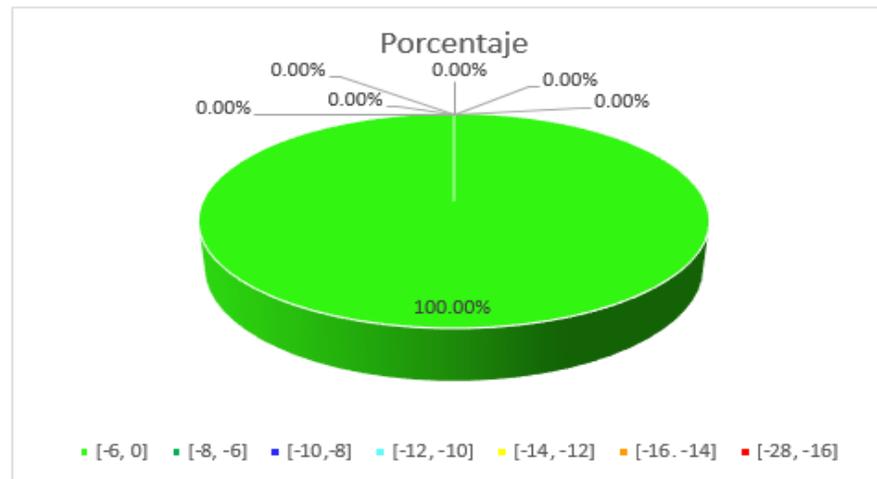
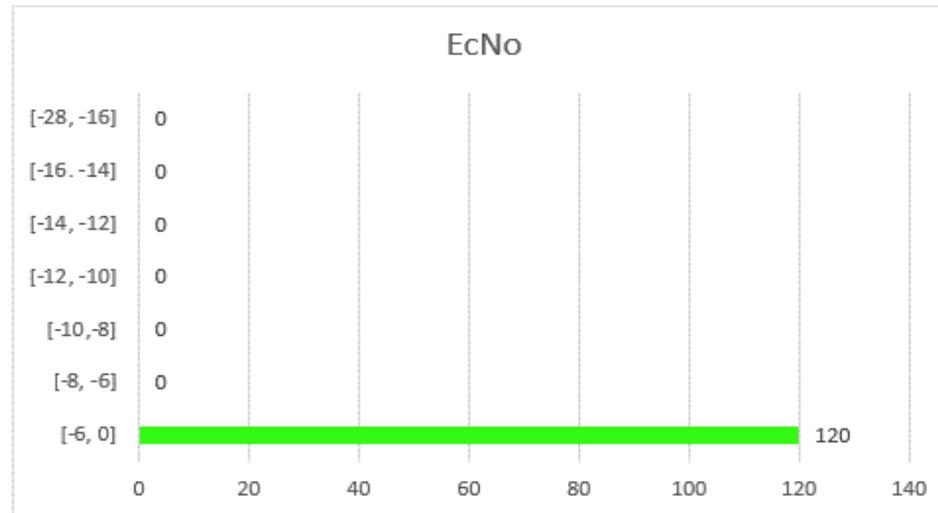
Zona que cubre la femtocelda del Piso 2 en el Piso 1

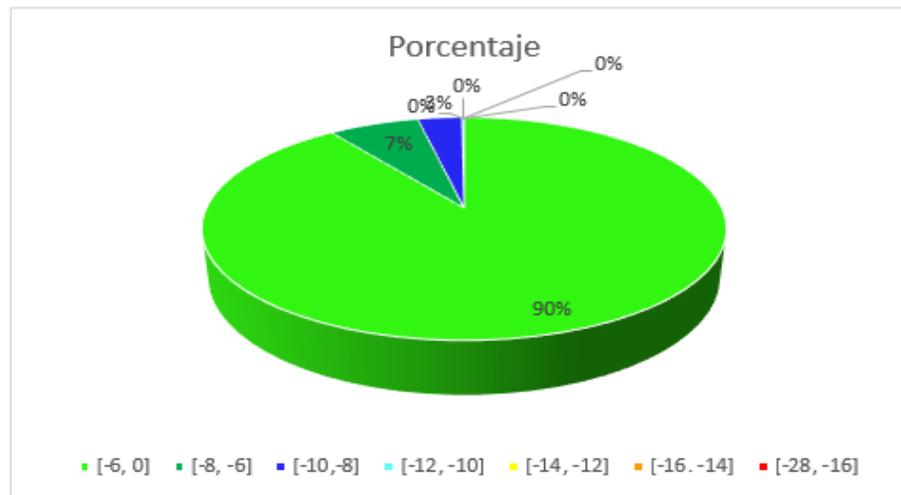
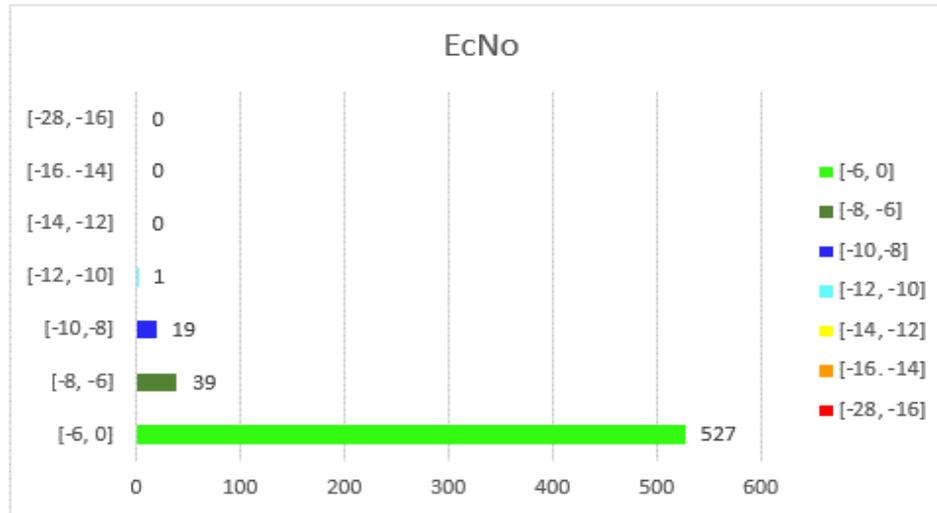


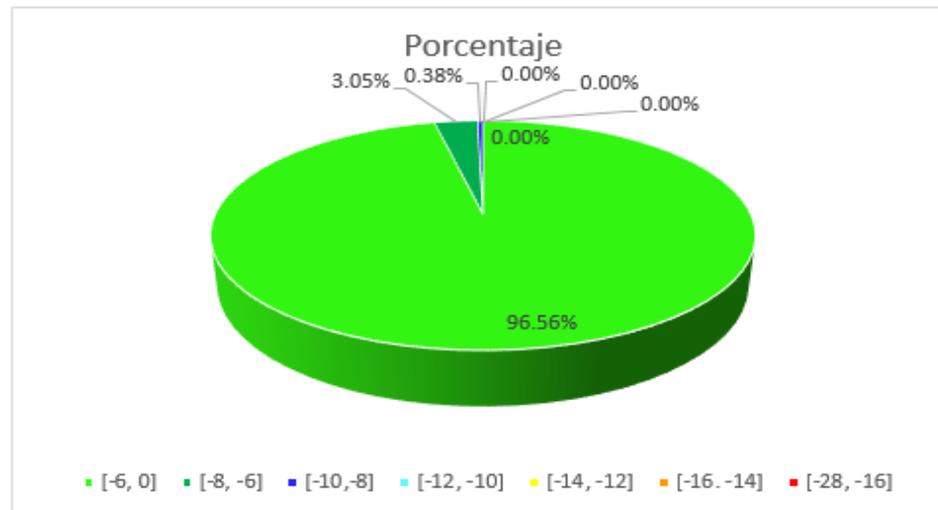
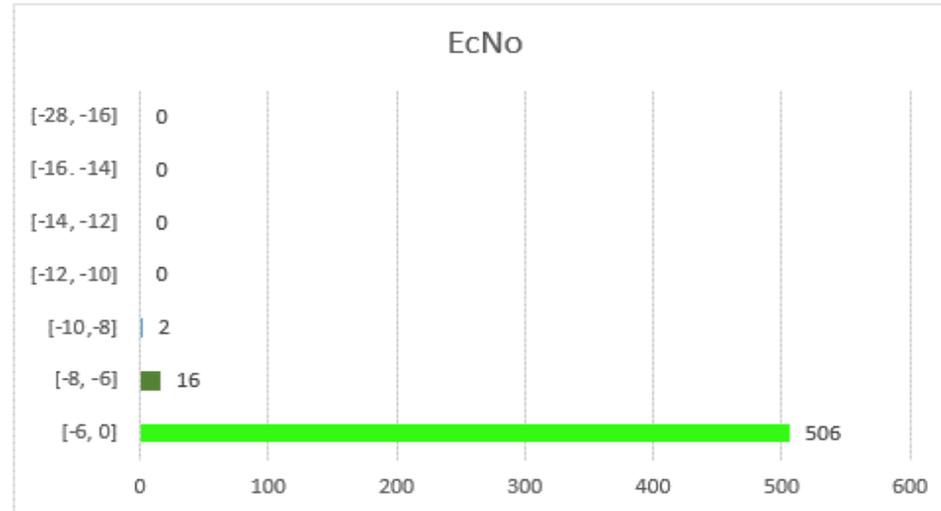
Niveles EcNo(dB)	#Muestras	Porcentaje	KPI
[-6, 0]	135	90.60%	90.60%
[-8, -6]	10	6.71%	9.40%
[-10, -8]	4	2.68%	
[-12, -10]	0	0.00%	
[-14, -12]	0	0.00%	
[-16, -14]	0	0.00%	
[-28, -16]	0	0.00%	

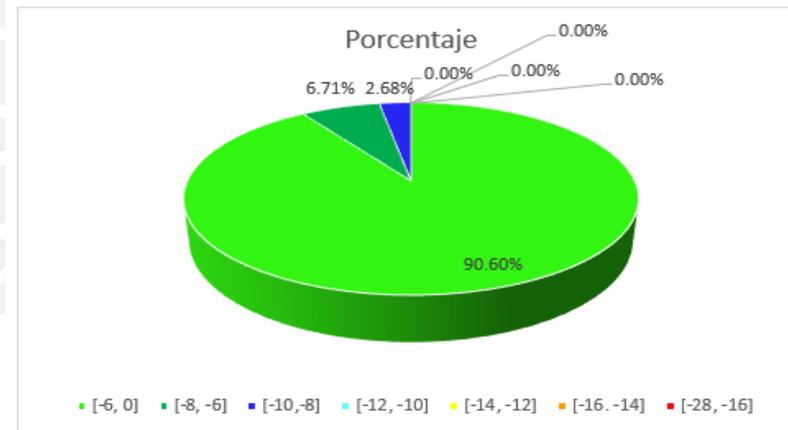
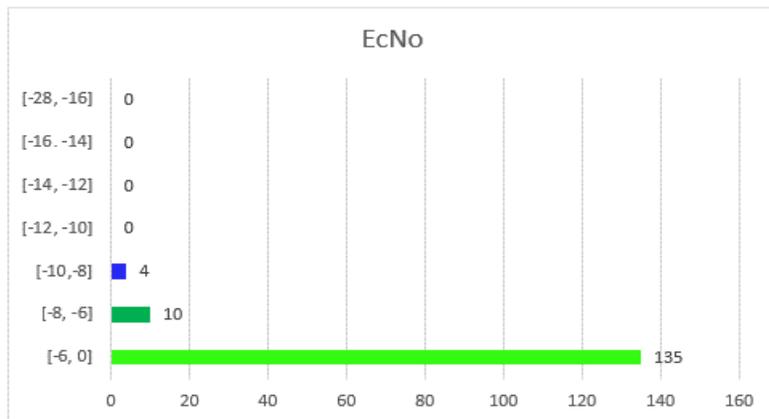
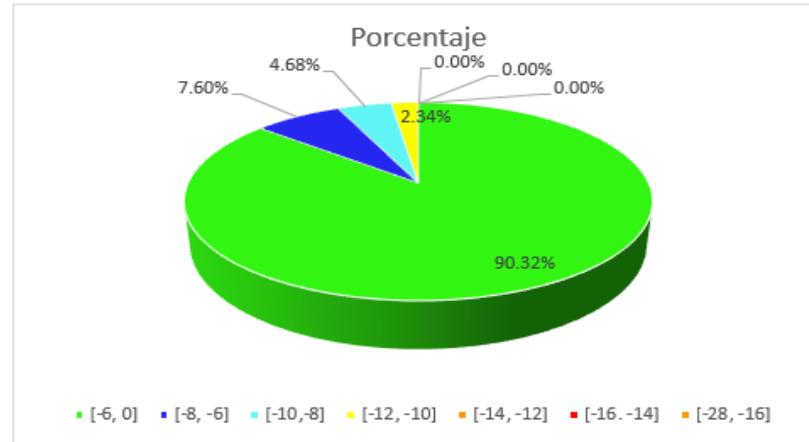
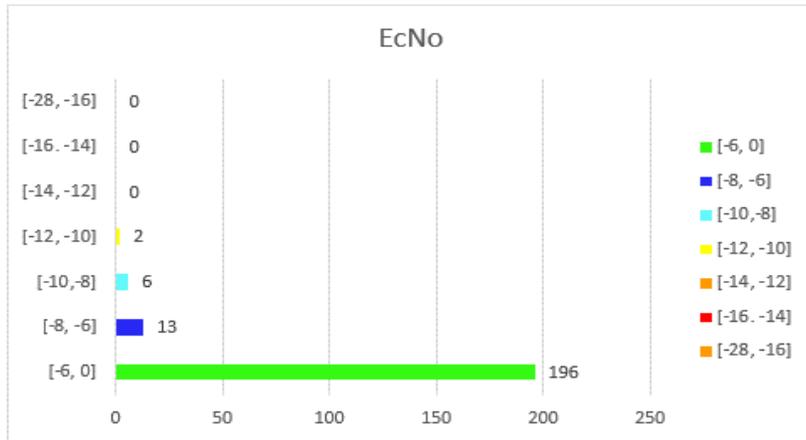






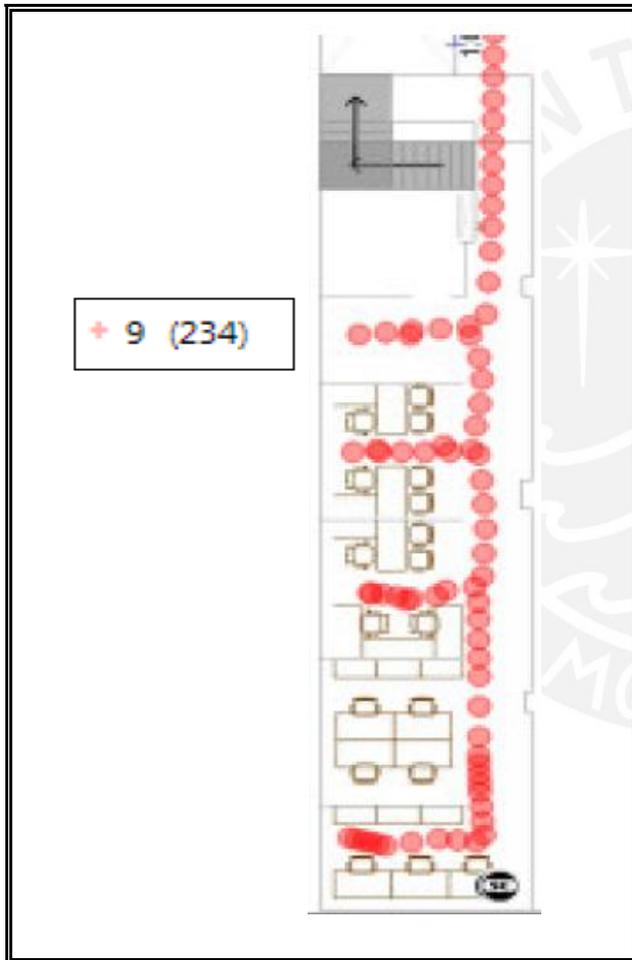




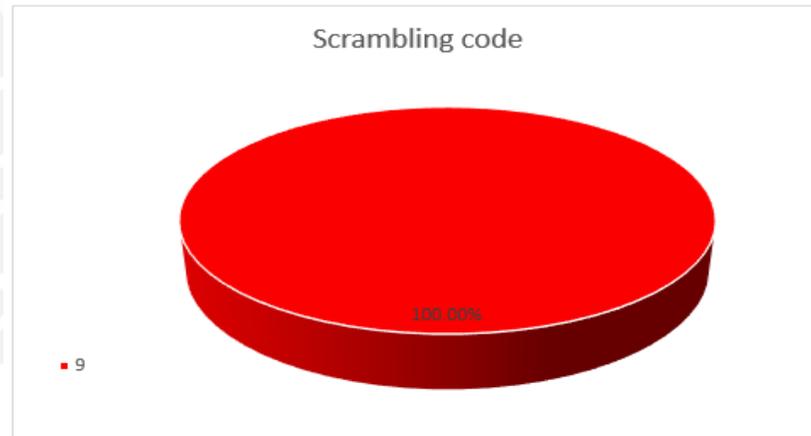


Muestras de Best Server (Scrambling Code)

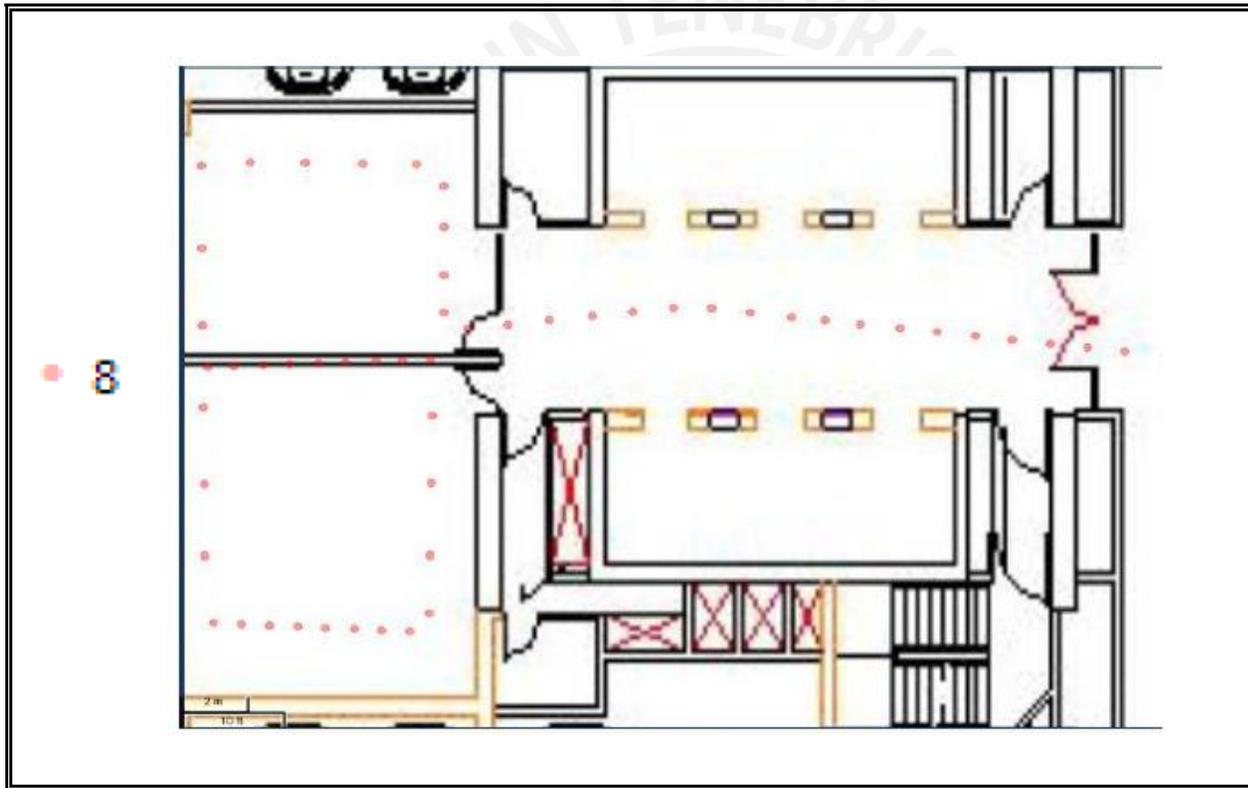
Portadora 1062 sótano 1 CEM1



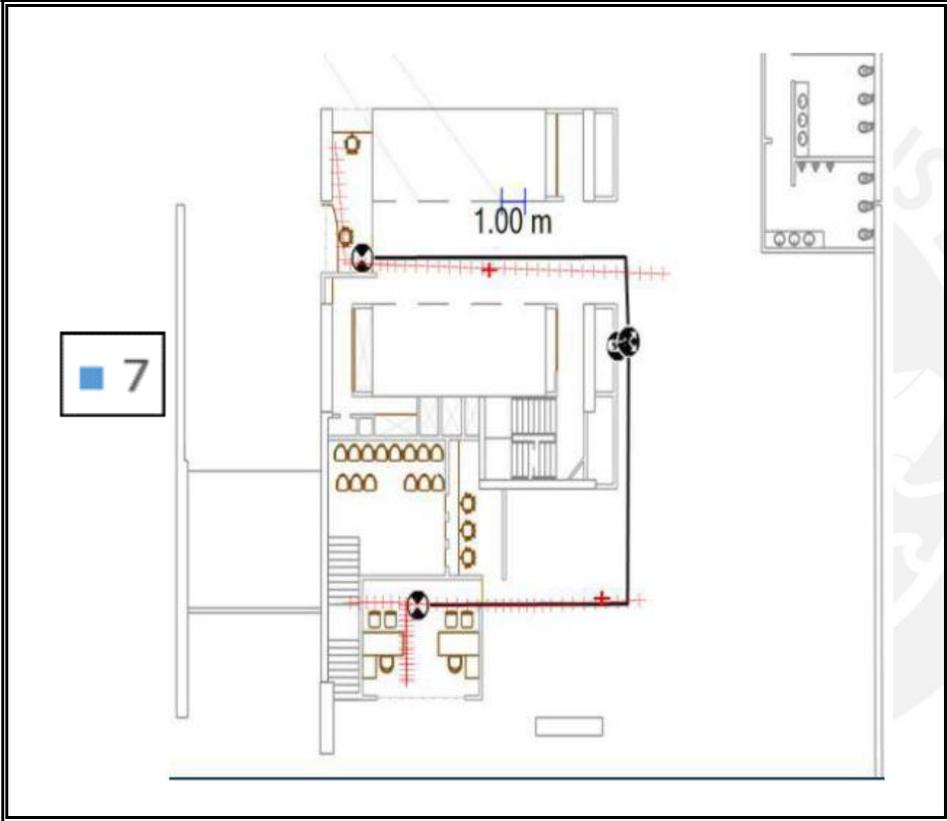
PSC	Porcentaje	#Muestras	KPI
9	100.00%	234	100%



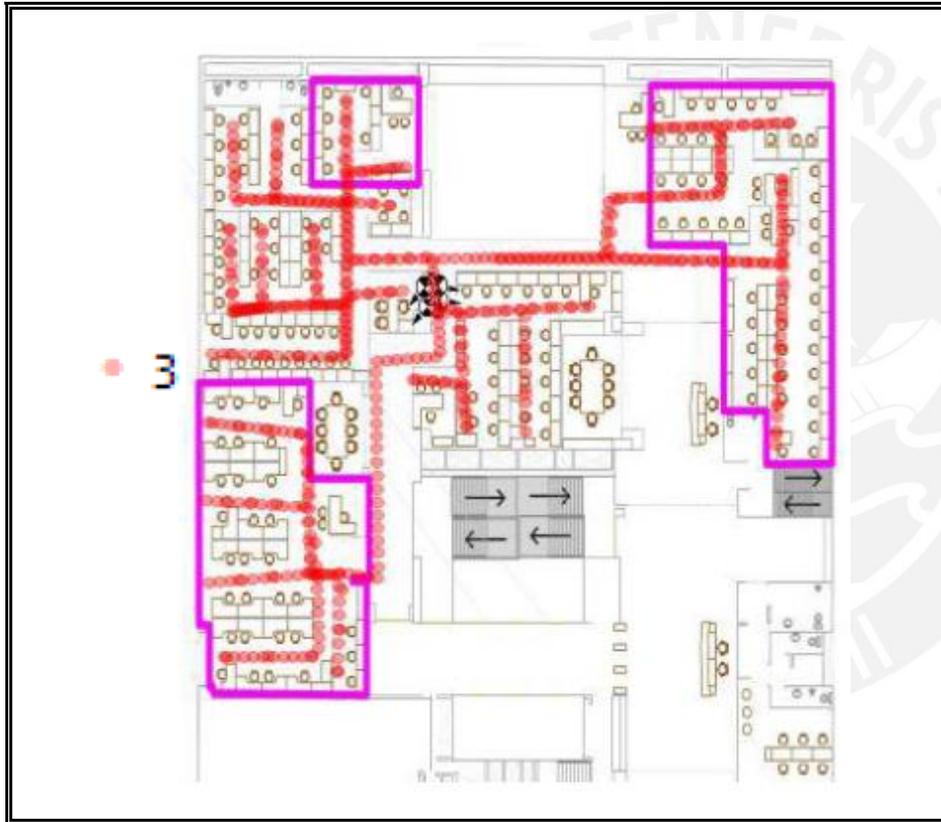
Portadora 1062 sótano 3 CEM2



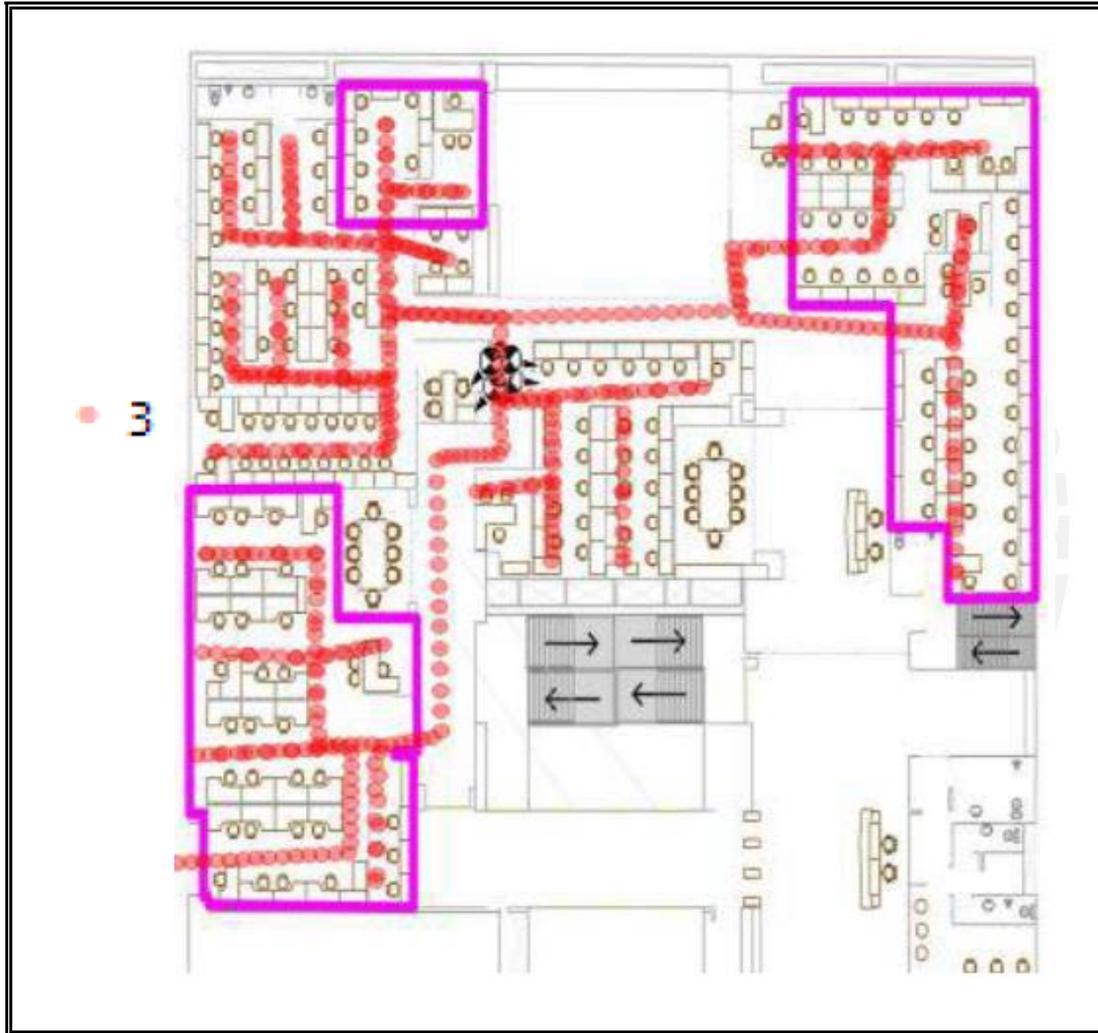
Portadora 1062 sótano 1 CEM2



Portadora 1062 PISO 1 CEM2

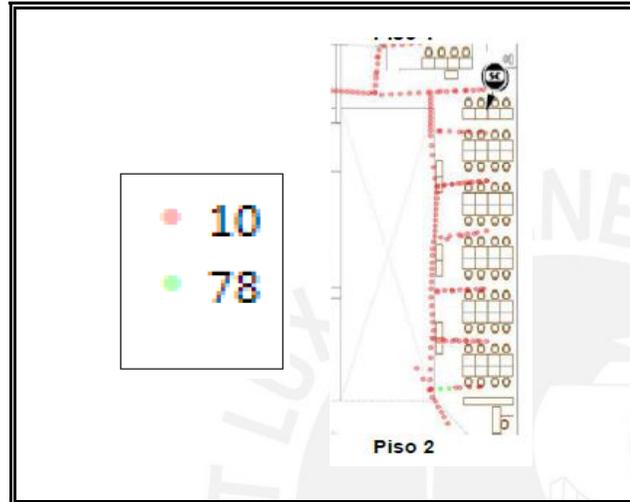


Portadora 1087 PISO 1 CEM2



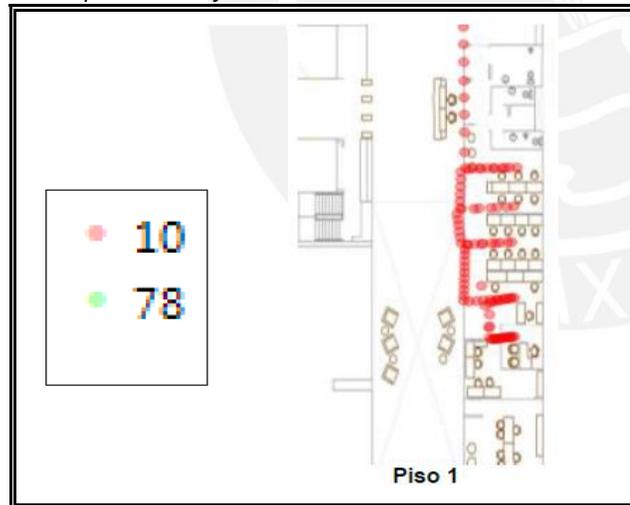
● 3

Portadora 1062 PISO 2 CEM2



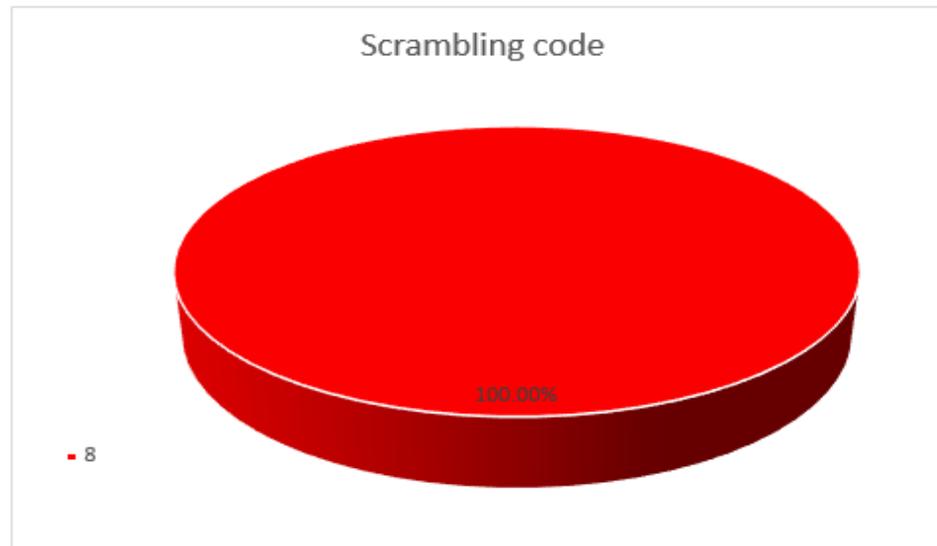
PSC	Porcentaje	#Muestras	KPI
10	98.82%	168	98.82%
78	1.18%	2	1.18%

Zona que cubre la femtocelda del Piso 2 en el Piso 1

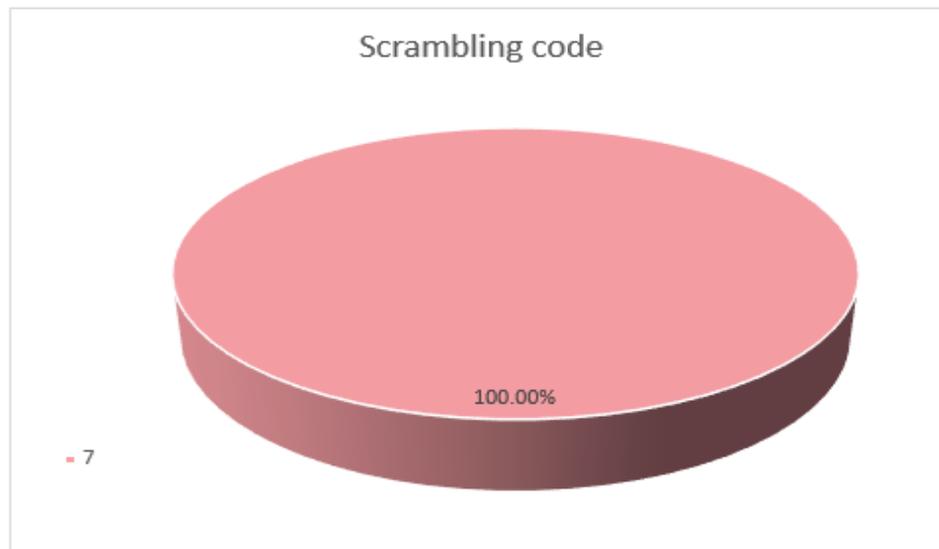


PSC	Porcentaje	#Muestras	KPI
10	100.00%	106	100.00%

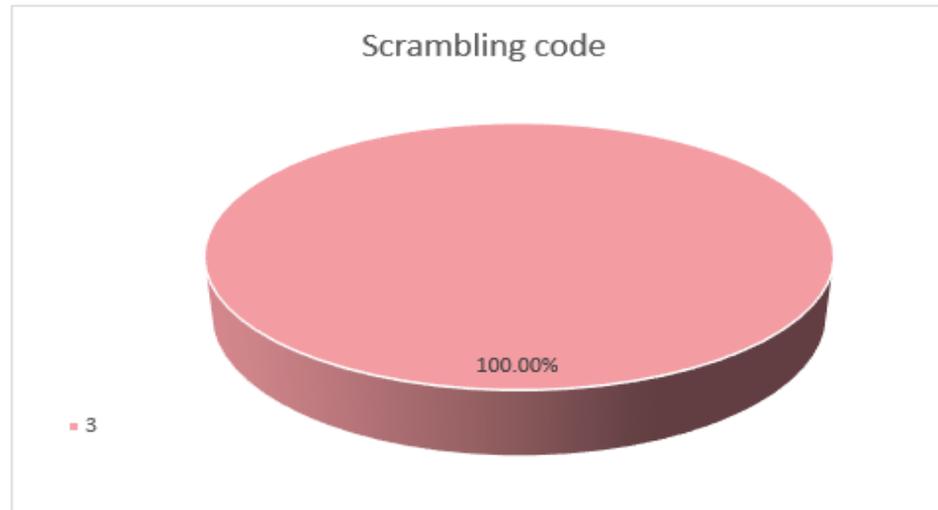
PSC	Porcentaje	#Muestras	KPI
8	100.00%	60	100.00%



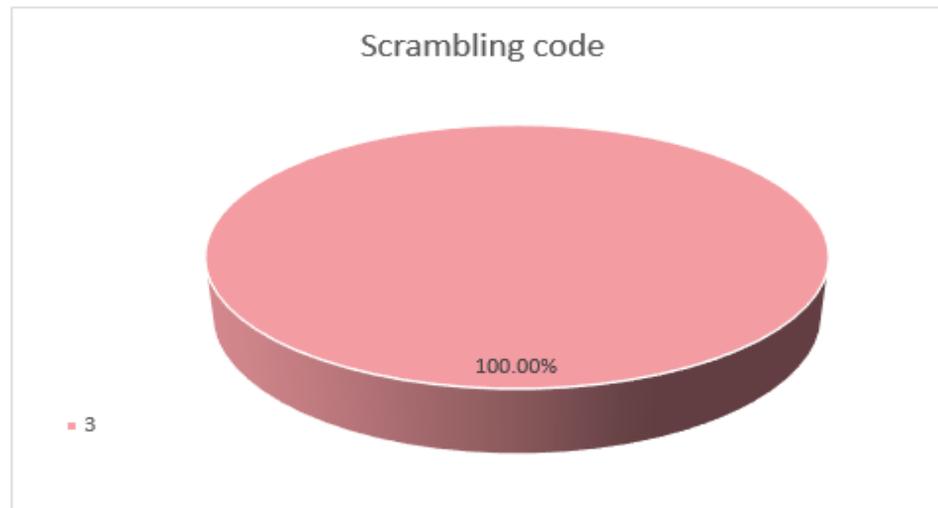
PSC	Porcentaje	#Muestras	KPI
7	100.00%	119	100.00%

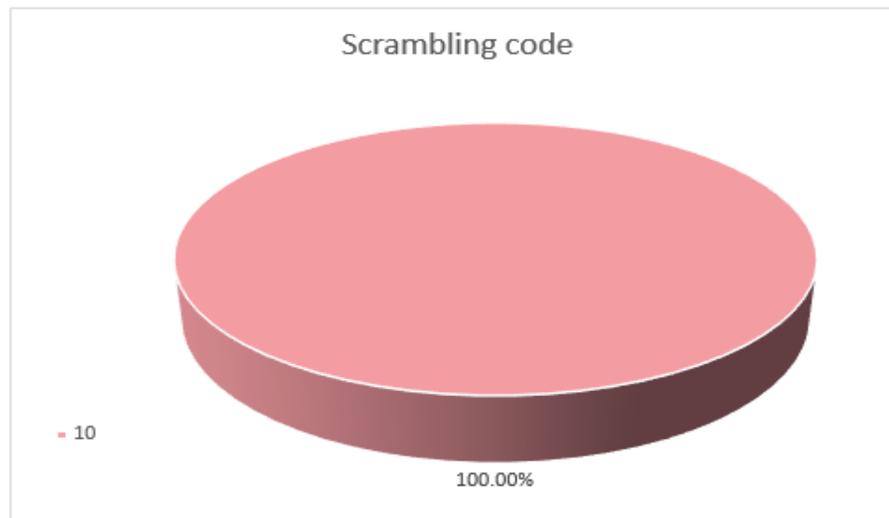
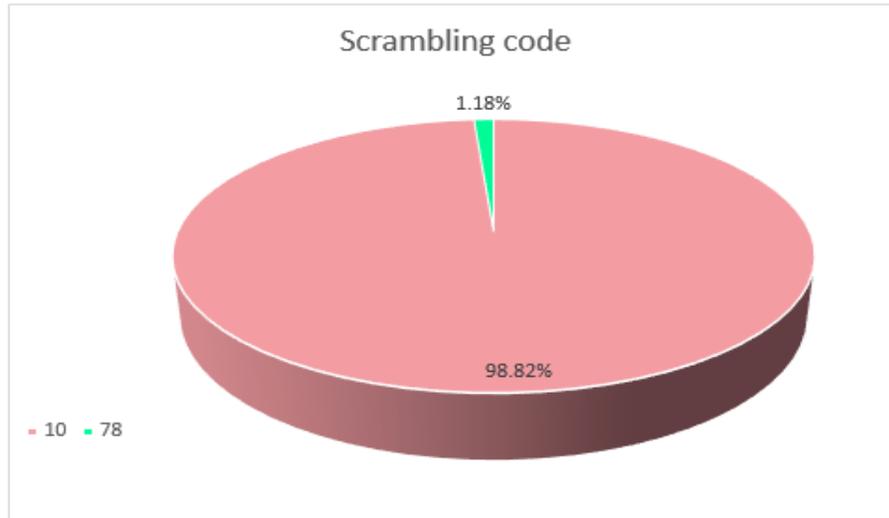


PSC	Porcentaje	#Muestras	KPI
3	100.00%	583	100.00%



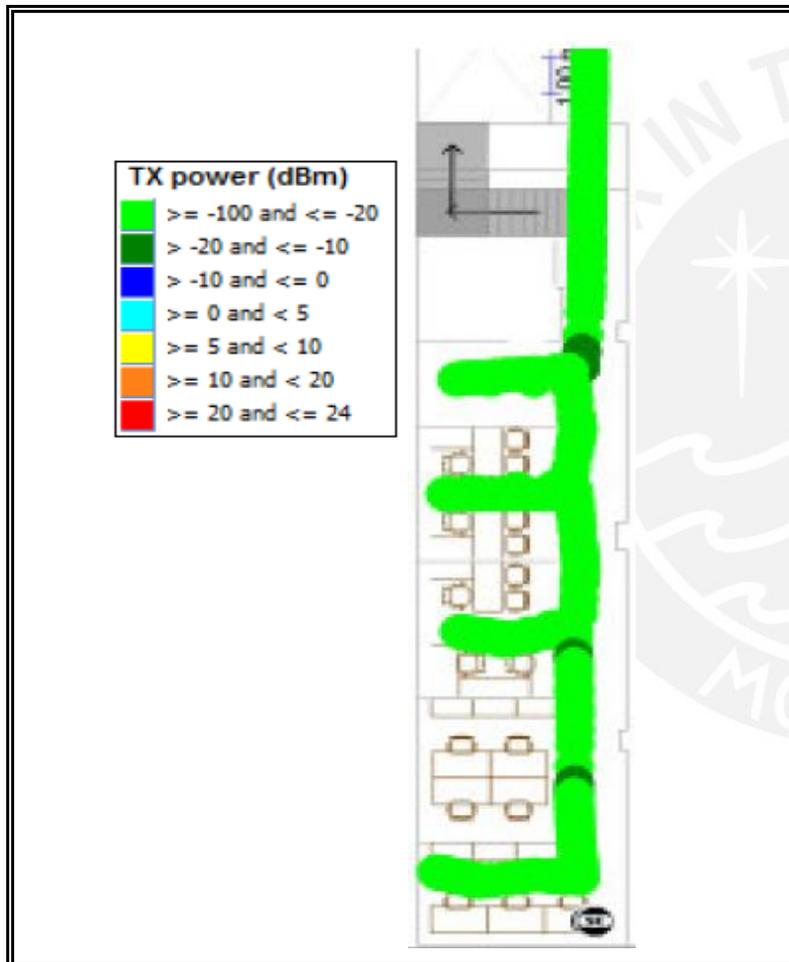
PSC	Porcentaje	#Muestras	KPI
3	100.00%	523	100.00%





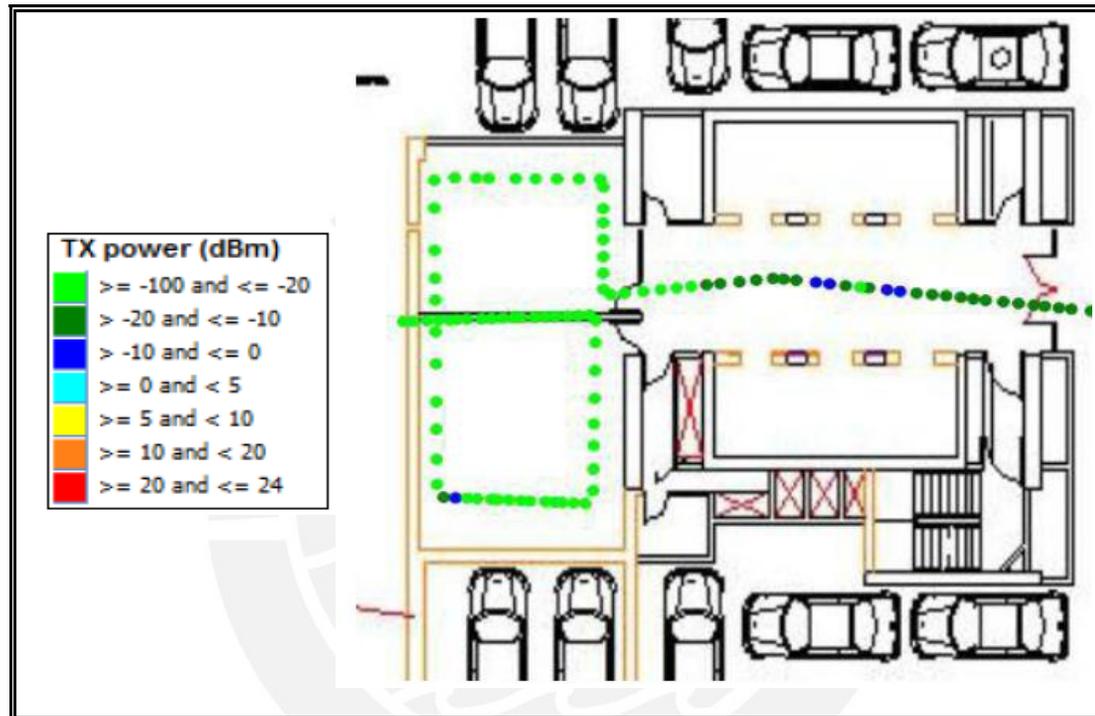
Muestras de Tx Power

Portadora 1062 sótano 1 CEM1



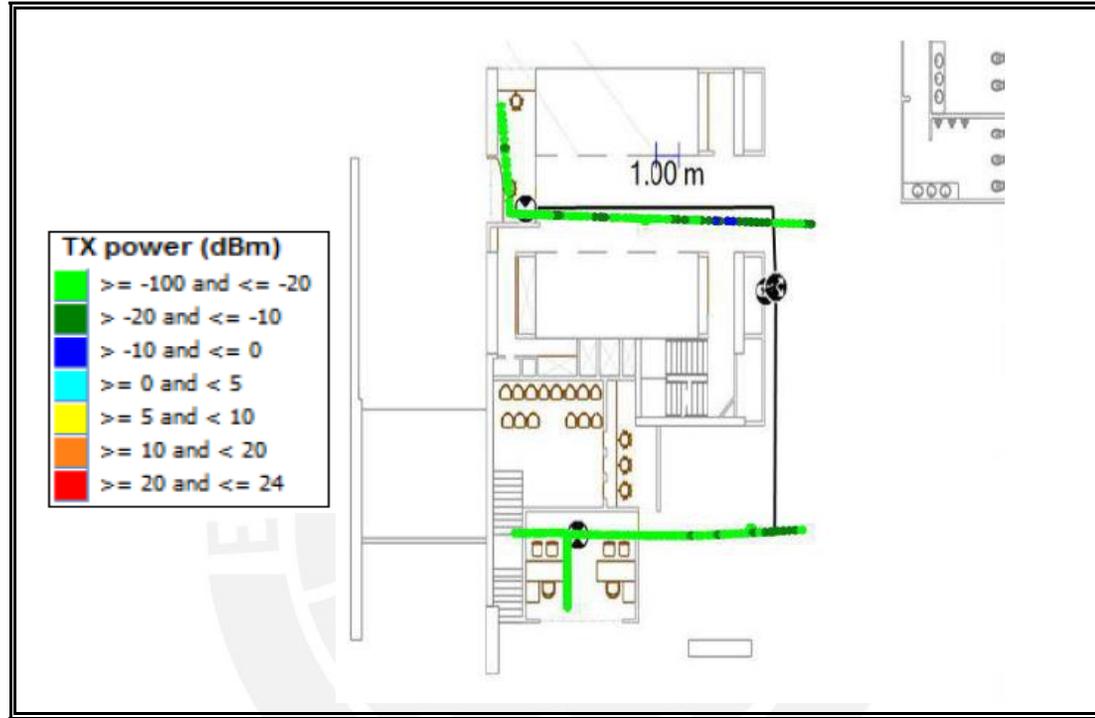
Tx Power (dBm)	#Muestras	Porcentaje	KPI
[-100,-20]	133	93.66%	100.00%
[-20, -10]	9	6.34%	
[-10,0]	0	0.00%	0.00%
[0, 5]	0	0.00%	
[5,10]	0	0.00%	
[10,20]	0	0.00%	
[20,24]	0	0.00%	

Portadora 1062 sótano 3 CEM2



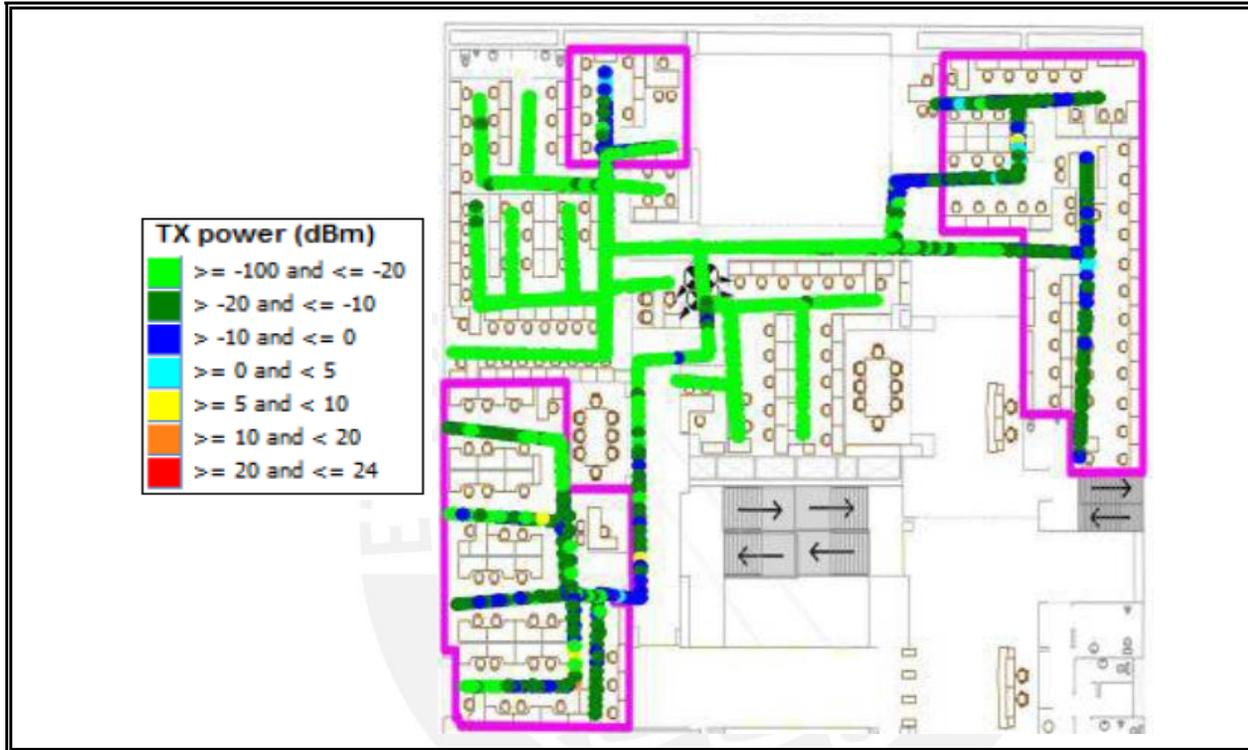
Tx Power (dBm)	#Muestras	Porcentaje	KPI
[-100,-20]	71	63.39%	93.75%
[-20, -10]	34	30.36%	
[-10,0]	7	6.25%	6.25%
[0, 5]	0	0.00%	
[5,10]	0	0.00%	
[10,20]	0	0.00%	
[20,24]	0	0.00%	

Portadora 1062 sótano 1 CEM2



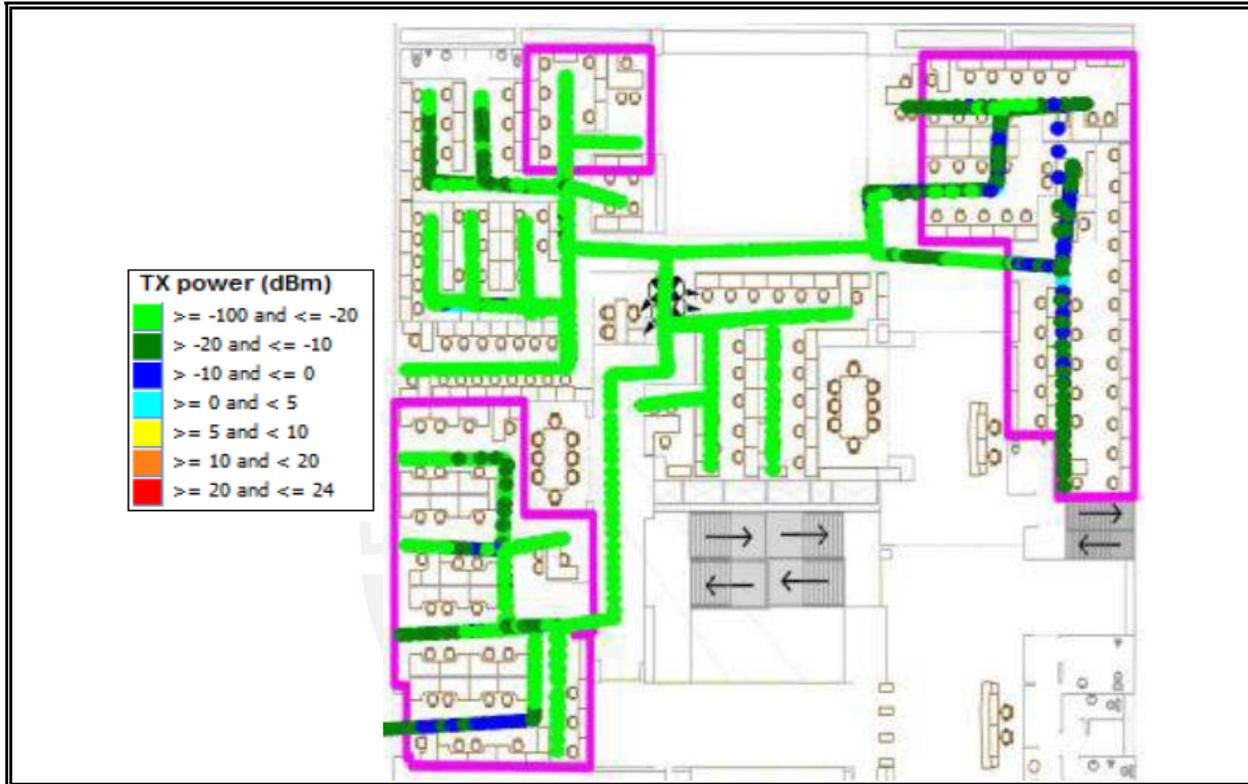
Tx Power (dBm)	#Muestras	Porcentaje	KPI
[-100,-20]	175	83.73%	98.56%
[-20, -10]	31	14.83%	
[-10,0]	3	1.44%	1.44%
[0, 5]	0	0.00%	
[5,10]	0	0.00%	
[10,20]	0	0.00%	
[20,24]	0	0.00%	

Portadora 1062 PISO 1 CEM2



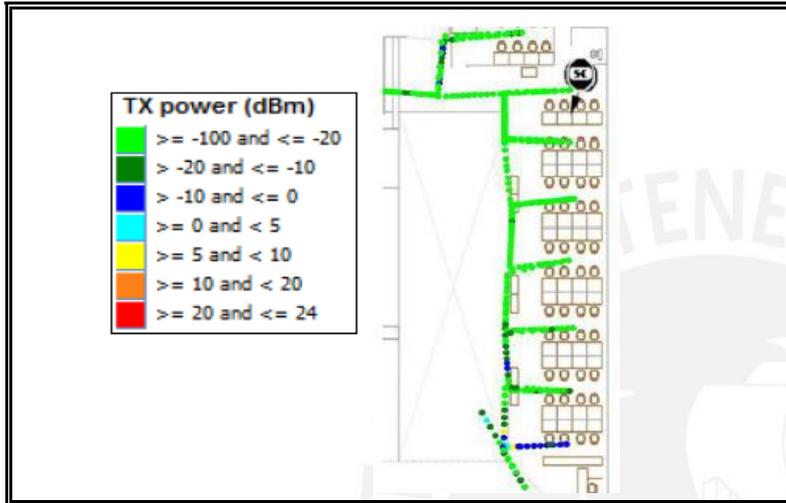
Tx Power (dBm)	#Muestras	Porcentaje	KPI
[-100,-20]	603	59.47%	85.80%
[-20, -10]	267	26.33%	
[-10,0]	122	12.03%	14.20%
[0, 5]	16	1.58%	
[5,10]	5	0.49%	
[10,20]	1	0.10%	
[20,24]	0	0.00%	

Portadora 1087 PISO 1 CEM2



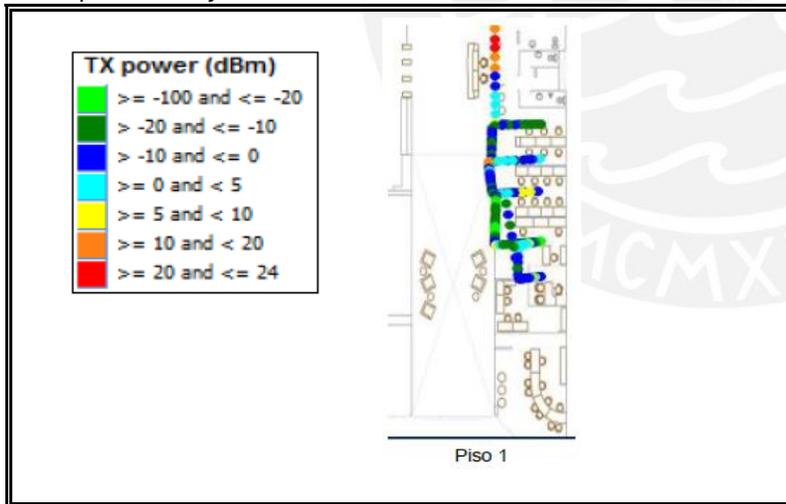
Tx Power (dBm)	#Muestras	Porcentaje	KPI
[-100,-20]	638	68.97%	91.35%
[-20, -10]	207	22.38%	
[-10,0]	72	7.78%	
[0, 5]	8	0.86%	8.65%
[5,10]	0	0.00%	
[10,20]	0	0.00%	
[20,24]	0	0.00%	

Portadora 1062 PISO 2 CEM2

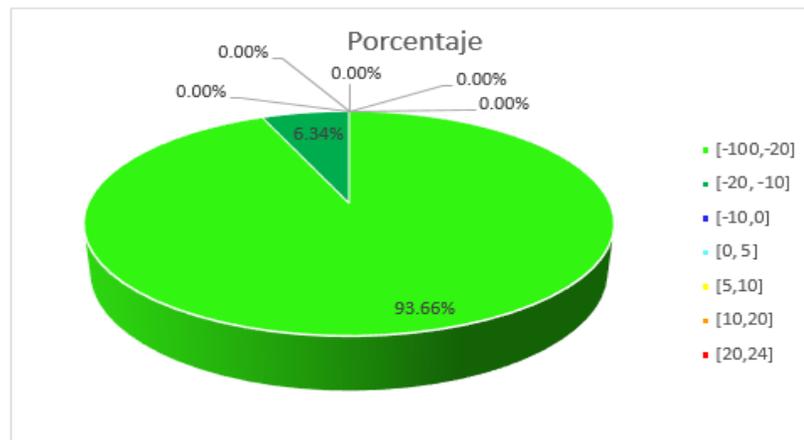
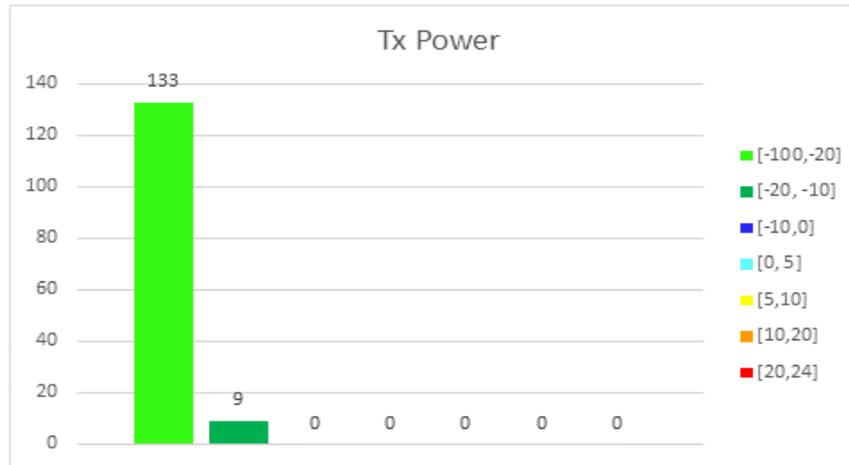


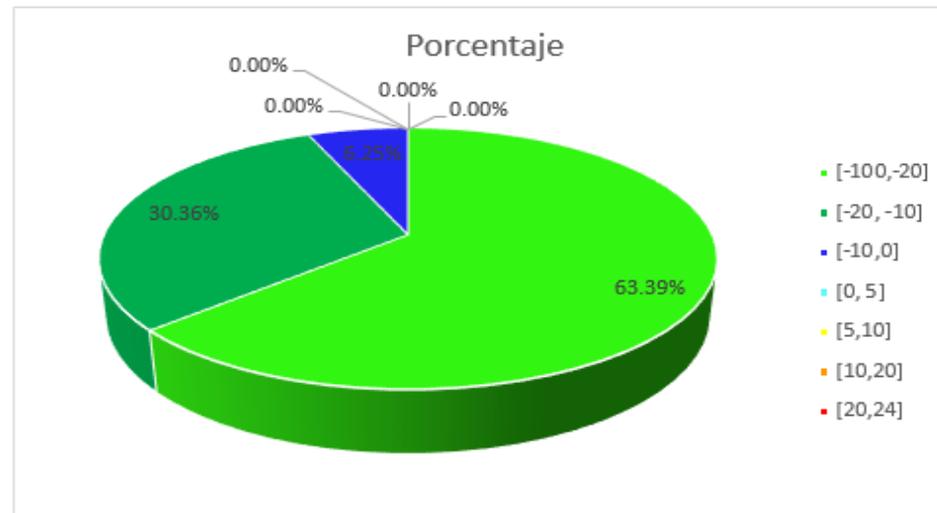
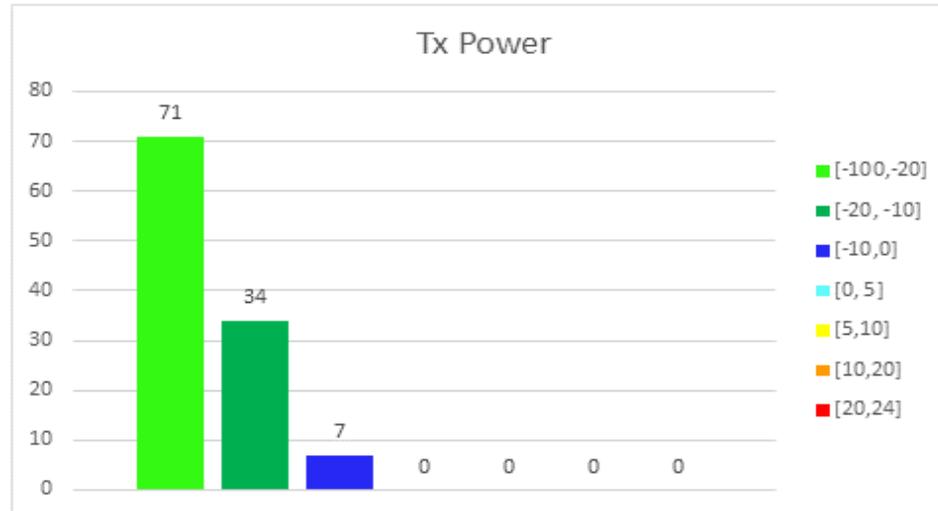
Tx Power (dBm)	#Muestras	Porcentaje	KPI
[-100,-20]	239	78.88%	91.75%
[-20, -10]	39	12.87%	
[-10,0]	20	6.60%	8.25%
[0, 5]	3	0.99%	
[5,10]	2	0.66%	
[10,20]	0	0.00%	
[20,24]	0	0.00%	

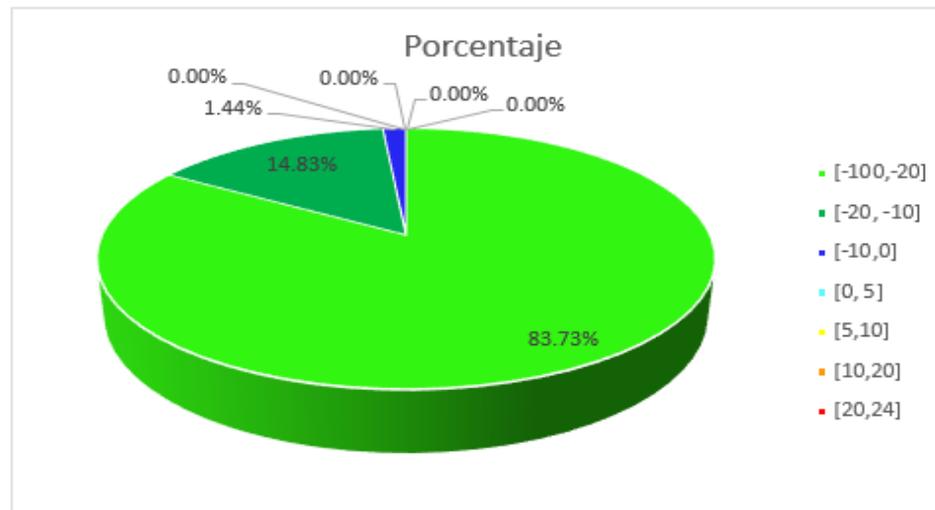
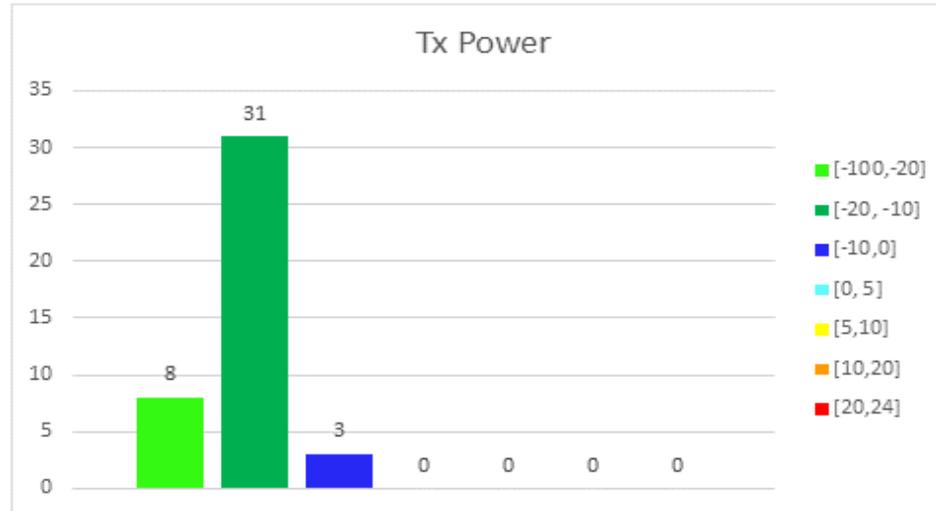
Zona que cubre la femtocelda del Piso 2 en el Piso 1

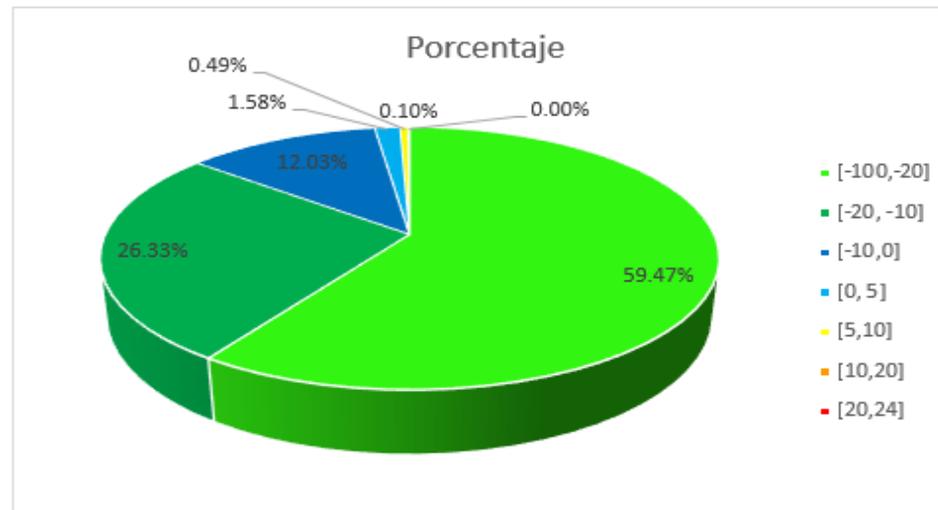
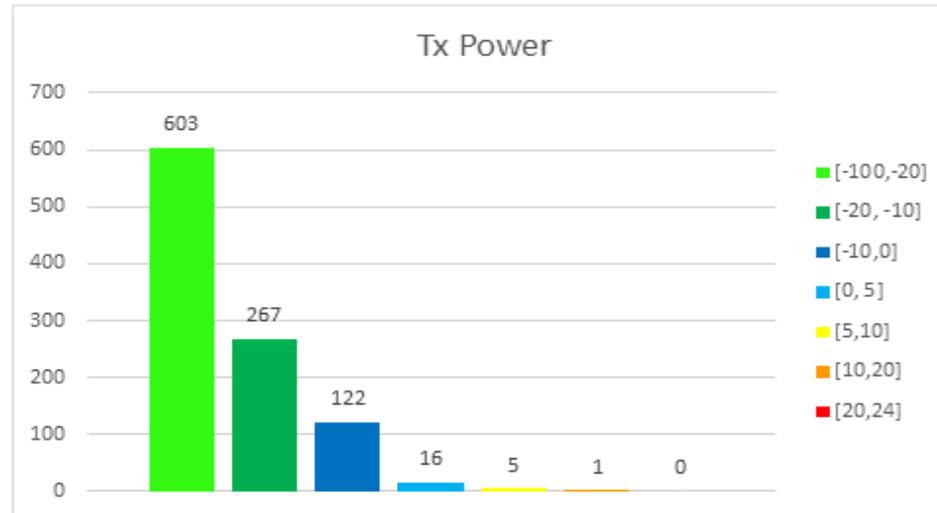


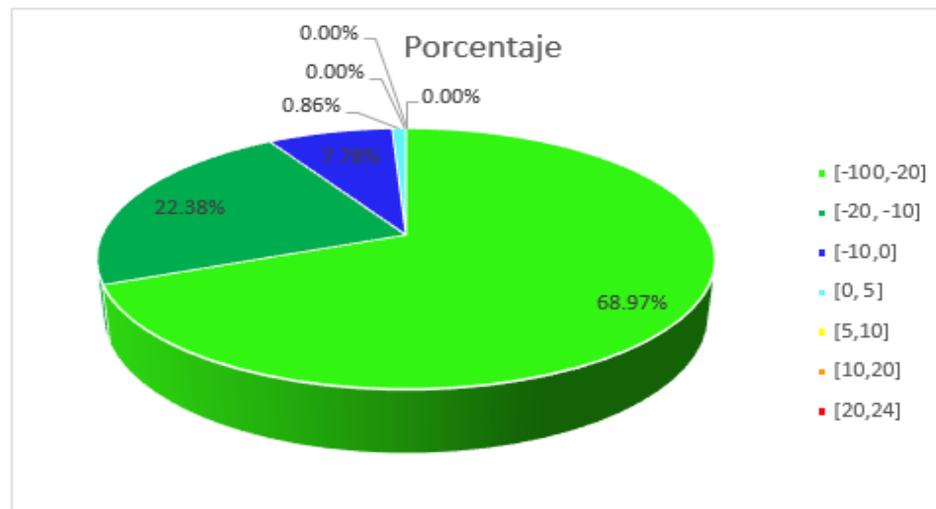
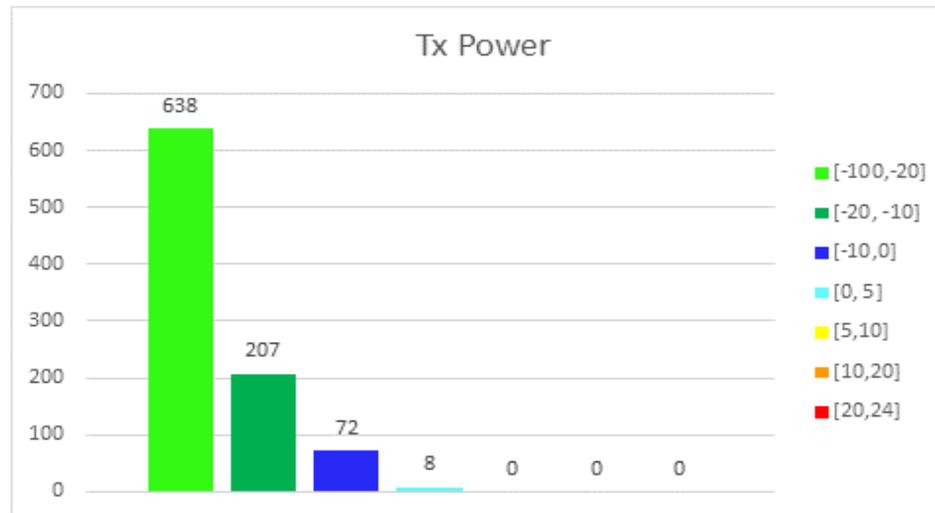
Tx Power (dBm)	#Muestras	Porcentaje	KPI
[-100,-20]	8	4.23%	29.10%
[-20, -10]	47	24.87%	
[-10,0]	71	37.57%	70.90%
[0, 5]	26	13.76%	
[5,10]	17	8.99%	
[10,20]	18	9.52%	
[20,24]	2	1.06%	

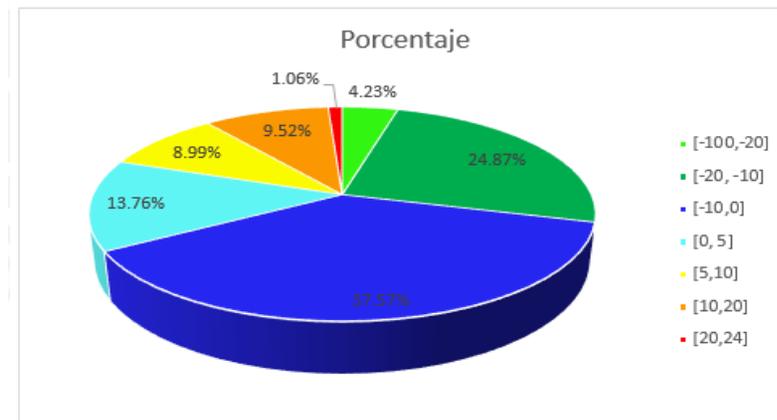
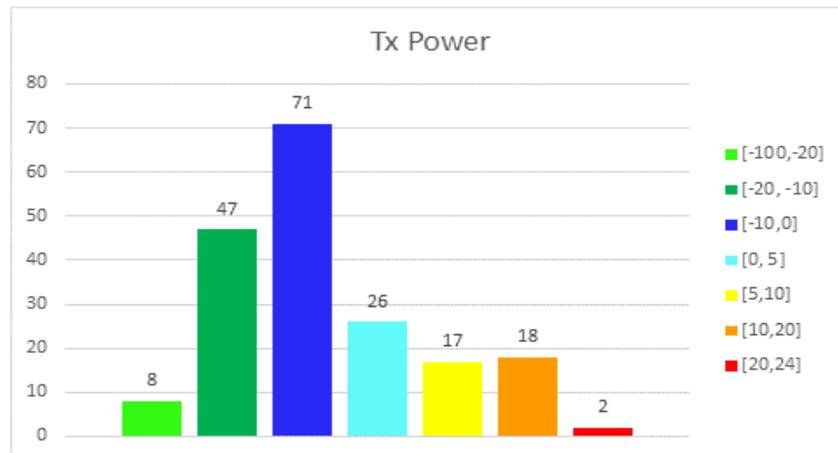
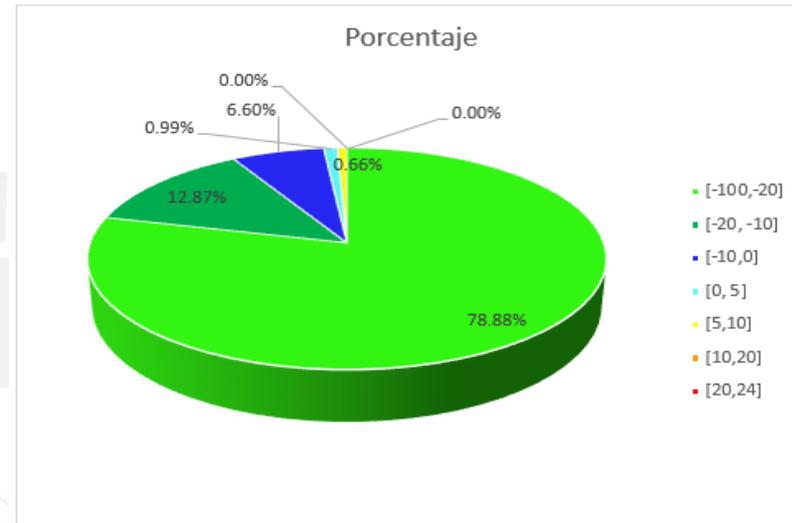
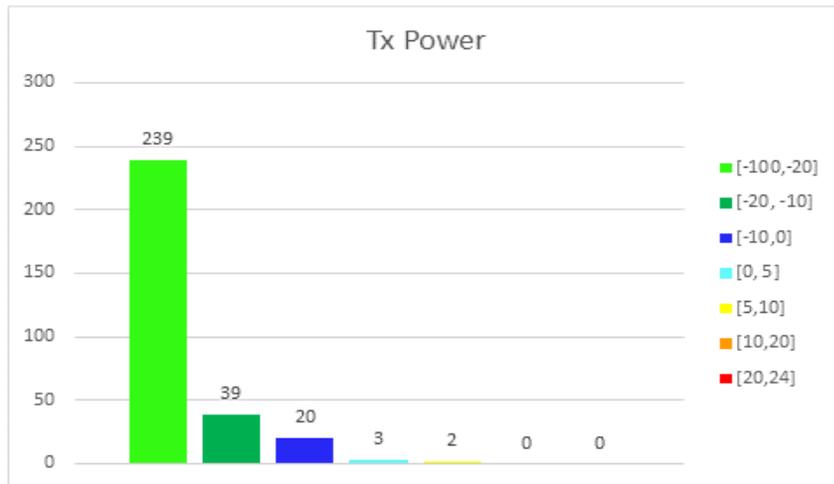






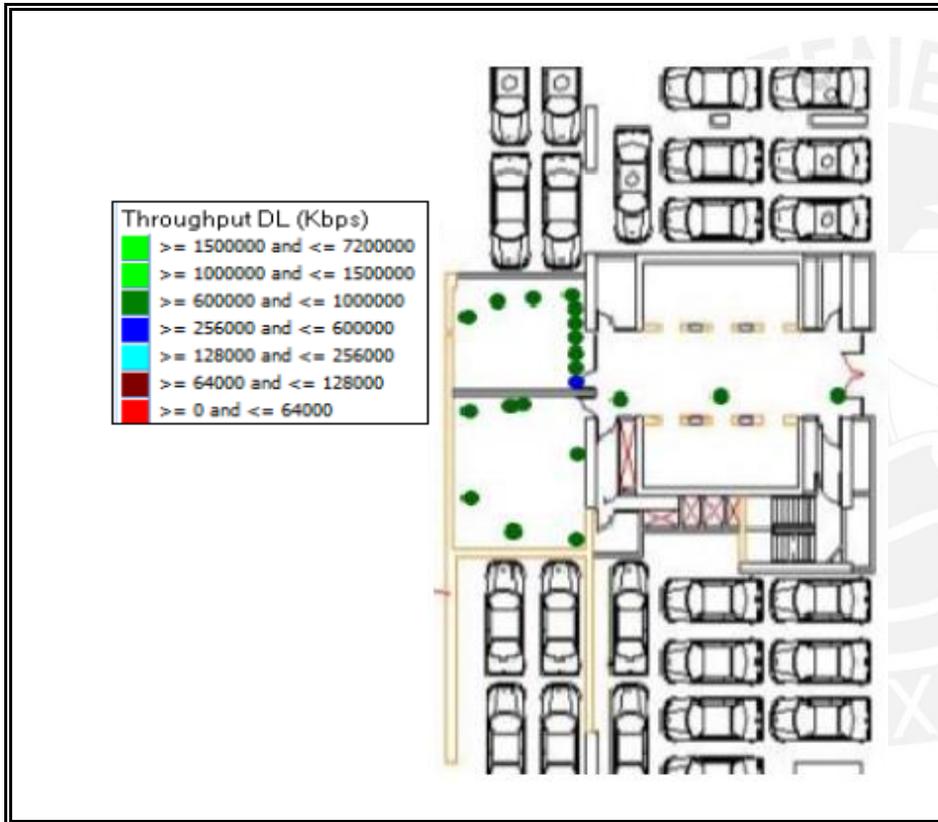






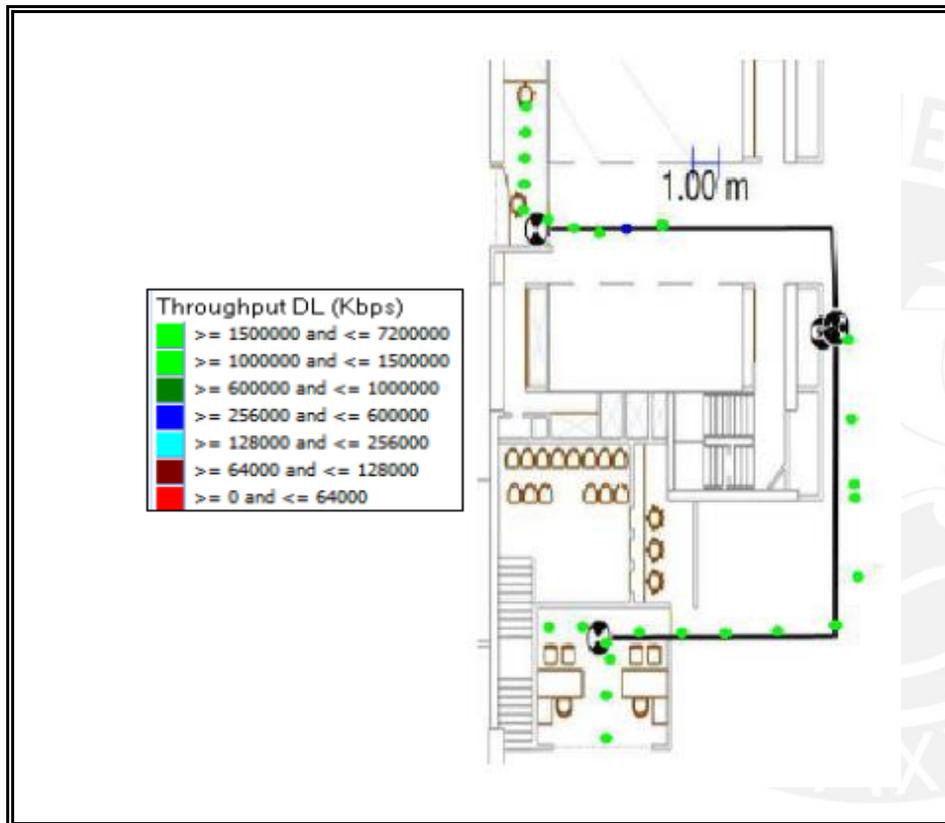
Throughput DL

Portadora 1062 sótano 3 CEM2



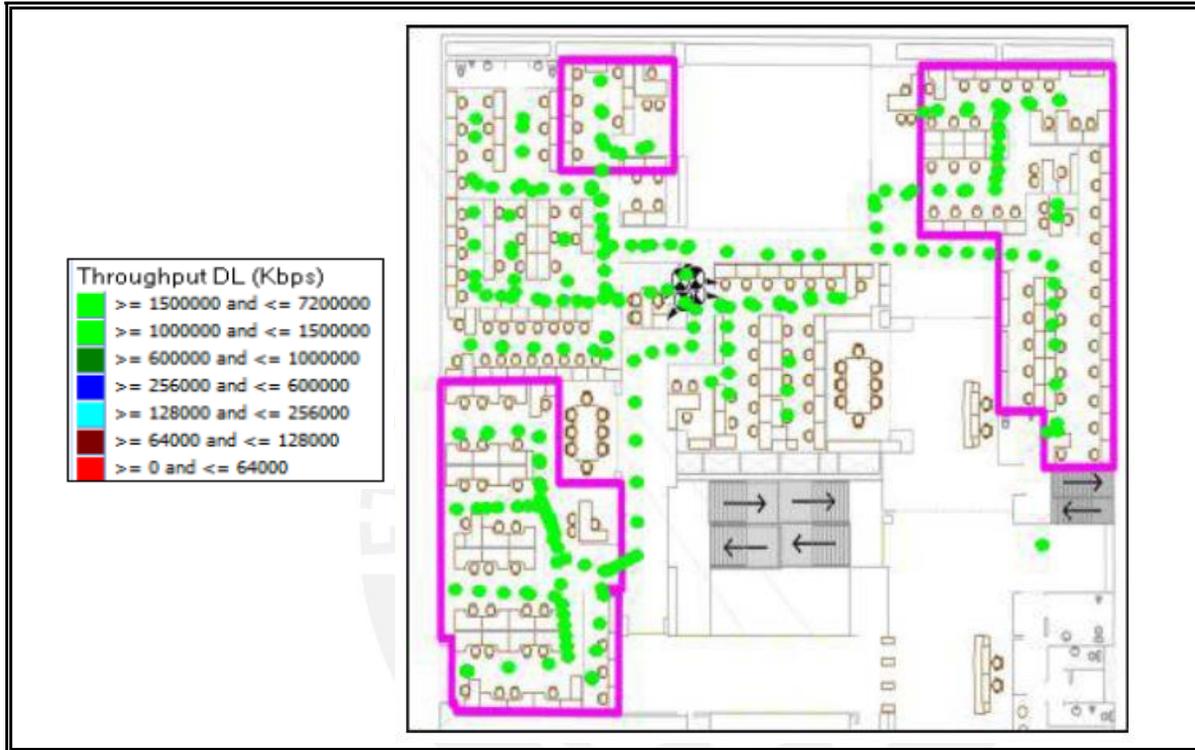
Throughput DL (kbps)	#Muestras	Porcentaje	KPI
[0,64]	0	0.00%	100.00%
[64, 128]	0	0.00%	
[128,256]	0	0.00%	
[256, 600]	1	5.00%	
[600,1000]	19	95.00%	
[1000,1500]	0	0.00%	
[1500,16000]	0	0.00%	0.00%

Portadora 1062 sótano 1 CEM2



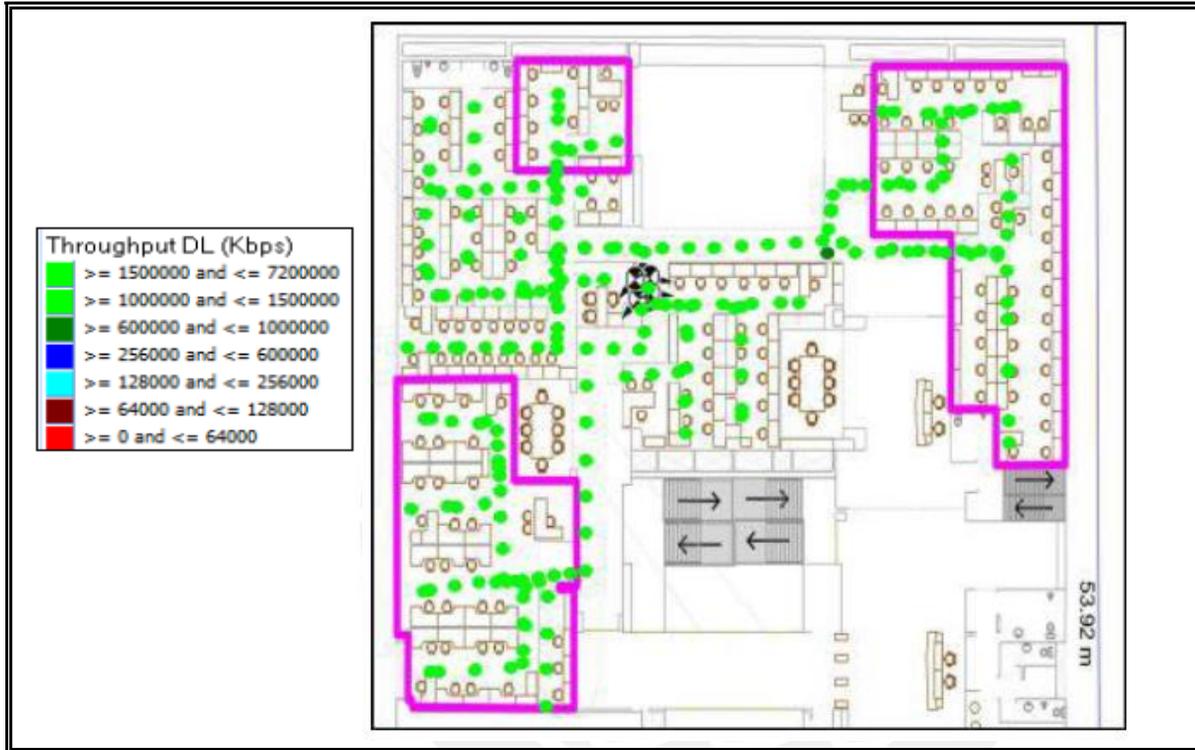
Throughput DL (kbps)	#Muestras	Porcentaje	KPI
[0,64]	2	4.55%	13.64%
[64, 128]	0	0.00%	
[128,256]	2	4.55%	
[256, 600]	1	2.27%	
[600,1000]	0	0.00%	
[1000,1500]	1	2.27%	
[1500,16000]	38	86.36%	86.36%

Portadora 1062 PISO 1 CEM2



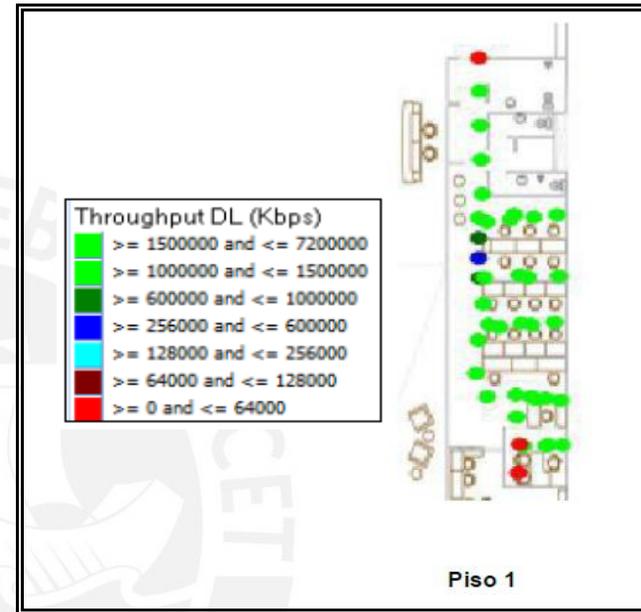
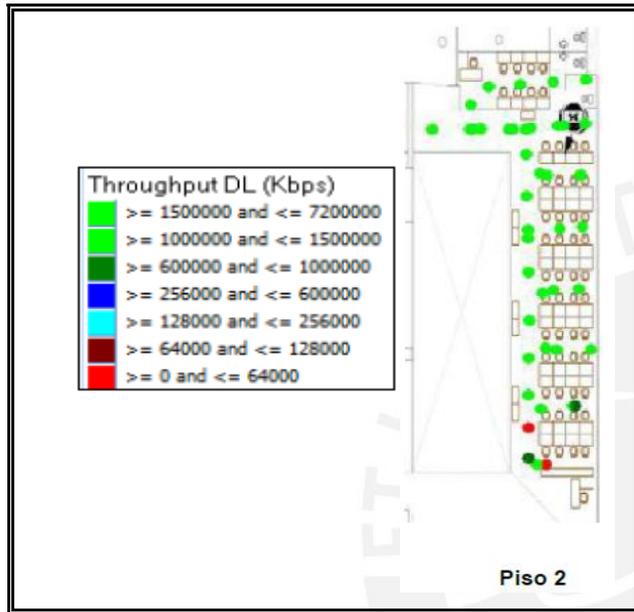
Throughput DL (kbps)	#Muestras	Porcentaje	KPI
[0,64]	1	0.45%	1.34%
[64, 128]	0	0.00%	
[128,256]	0	0.00%	
[256, 600]	0	0.00%	
[600,1000]	2	0.89%	
[1000,1500]	0	0.00%	
[1500,16000]	221	98.66%	98.66%

Portadora 1087 PISO 1 CEM2



Throughput DL (kbps)	#Muestras	Porcentaje	KPI
[0,64]	0	0.00%	0.46%
[64,128]	0	0.00%	
[128,256]	0	0.00%	
[256,600]	0	0.00%	
[600,1000]	1	0.46%	
[1000,1500]	0	0.00%	
[1500,16000]	218	99.54%	99.54%

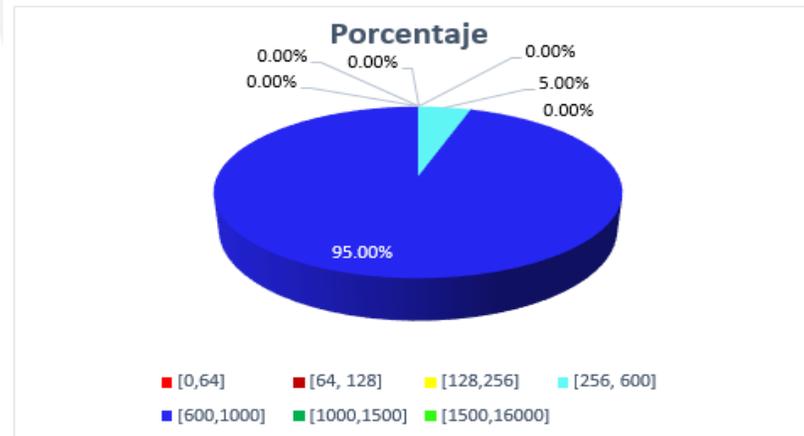
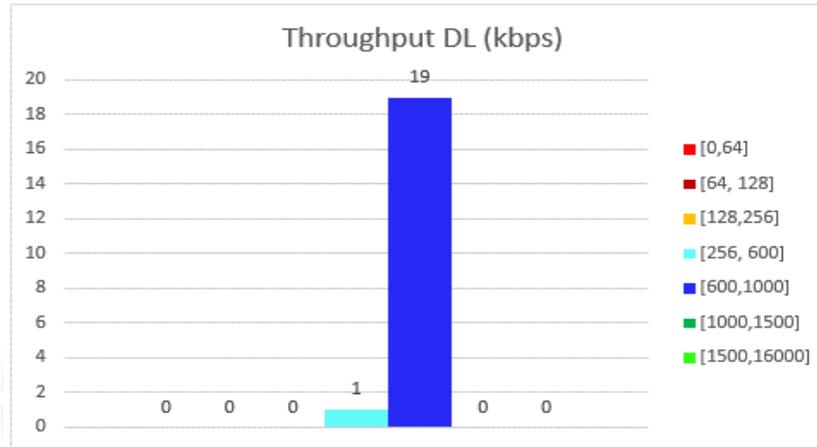
Portadora 1062 PISO 2 CEM2

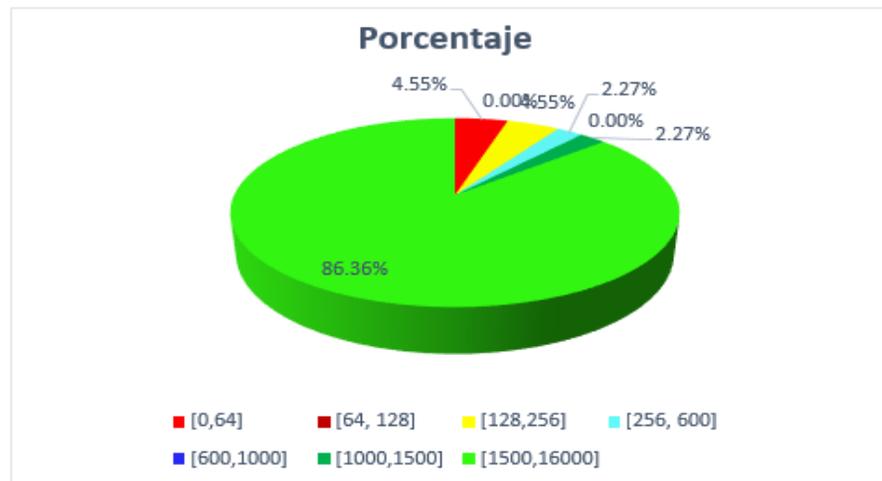
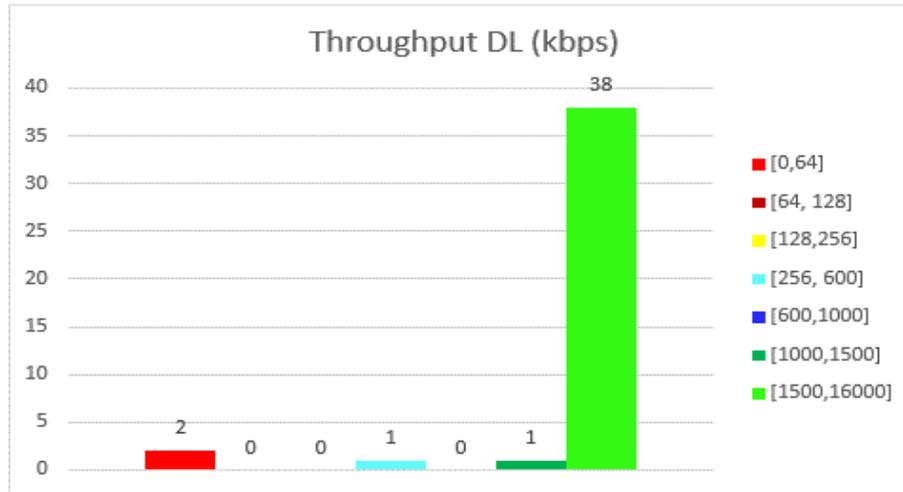


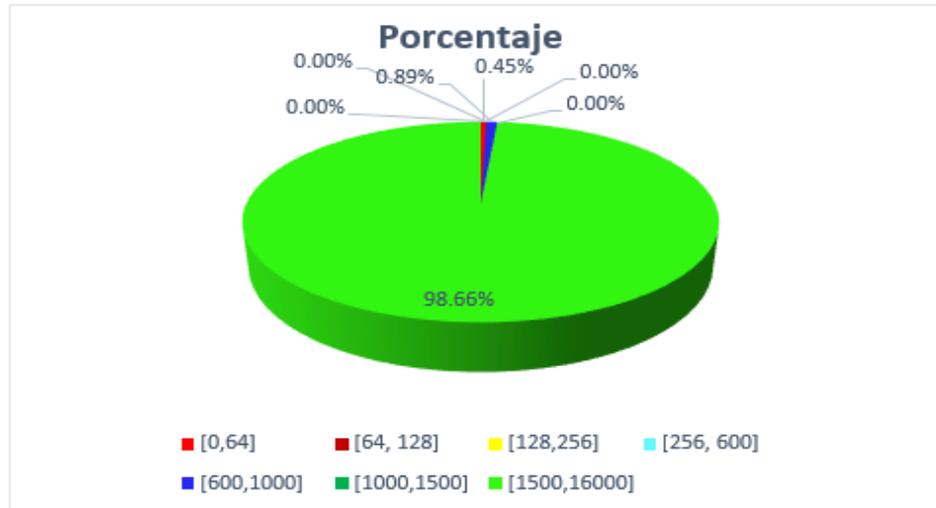
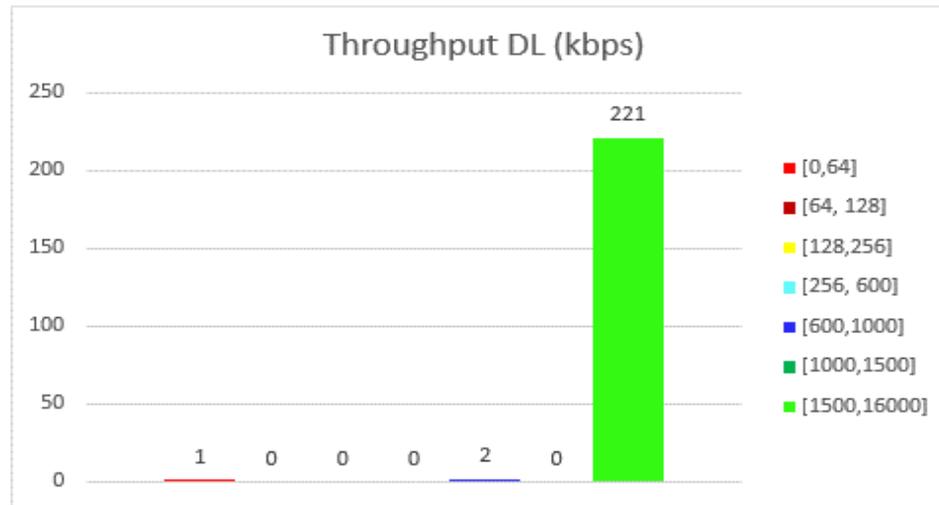
Zona que cubre la femtocelda del Piso 2 en el Piso 1

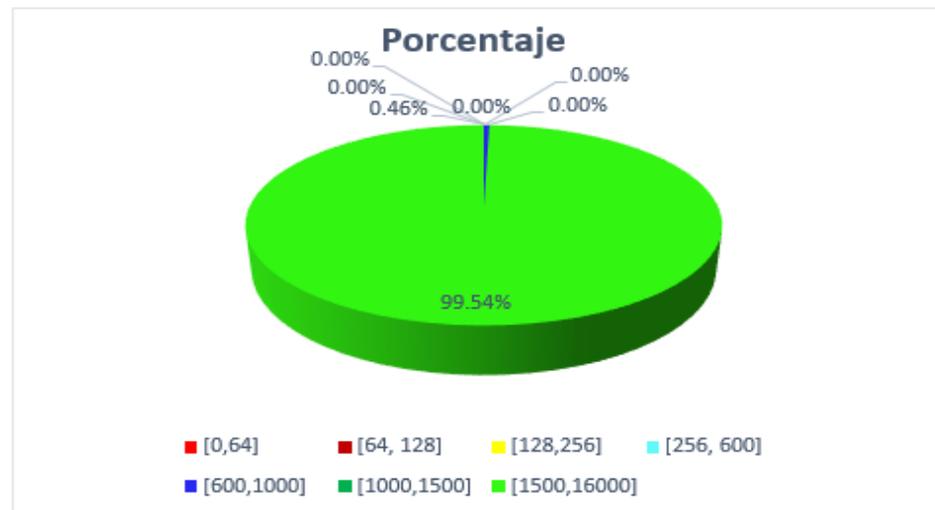
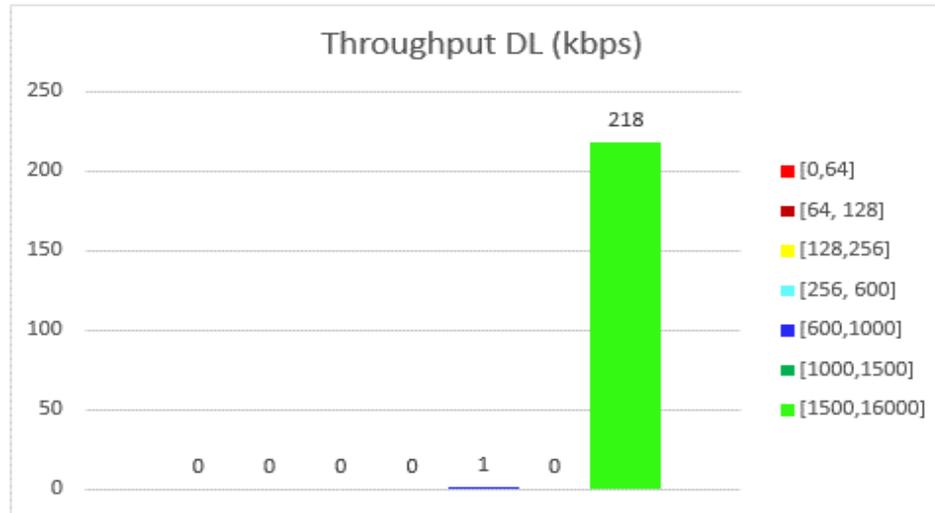
Throughput DL (kbps)	#Muestras	Porcentaje	KPI
[0,64]	2	4.76%	14.29%
[64, 128]	0	0.00%	
[128,256]	0	0.00%	
[256, 600]	0	0.00%	
[600,1000]	2	4.76%	
[1000,1500]	2	4.76%	
[1500,16000]	36	85.71%	

Throughput DL (kbps)	#Muestras	Porcentaje	KPI
[0,64]	3	7.14%	33.33%
[64, 128]	0	0.00%	
[128,256]	0	0.00%	
[256, 600]	1	2.38%	
[600,1000]	2	4.76%	
[1000,1500]	8	19.05%	
[1500,16000]	25	59.52%	

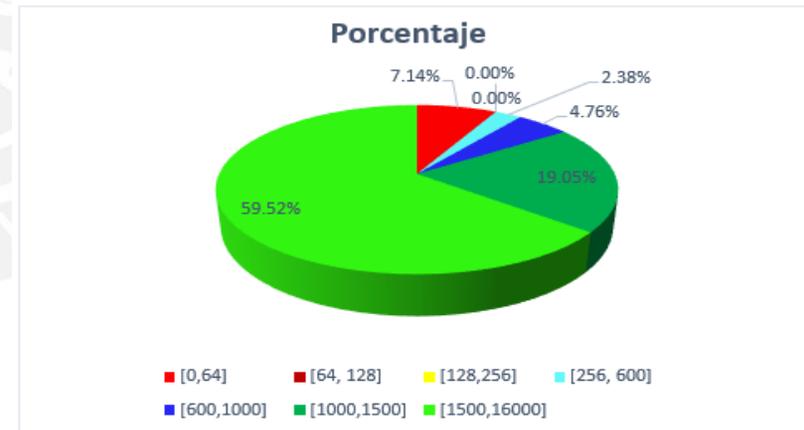
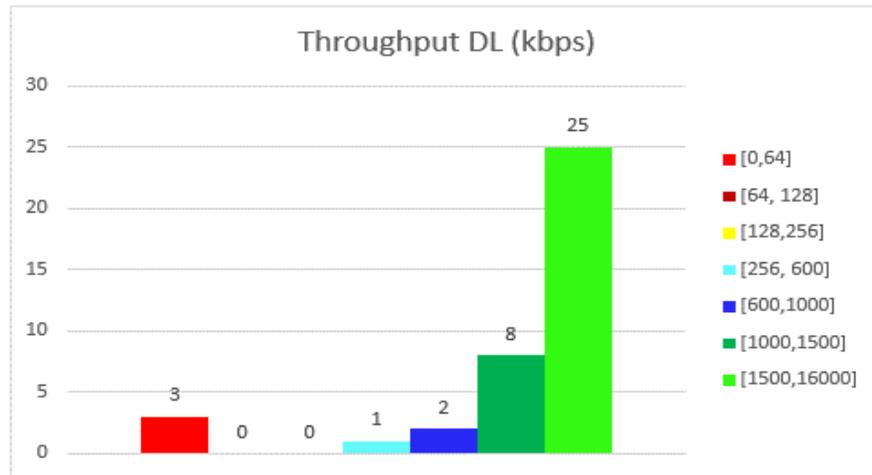
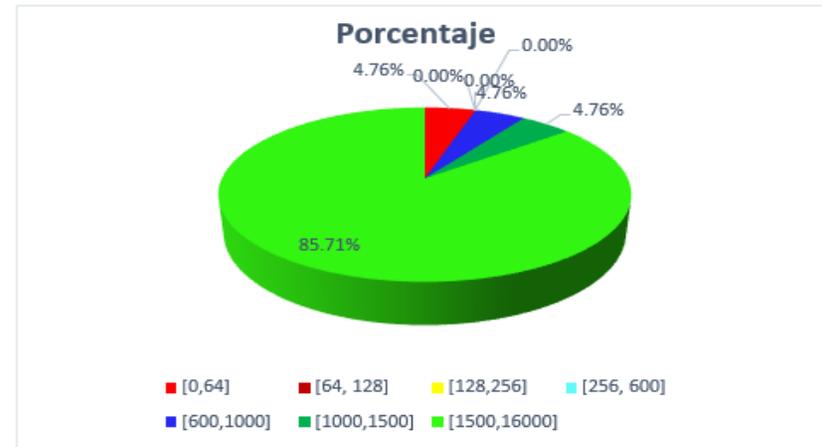
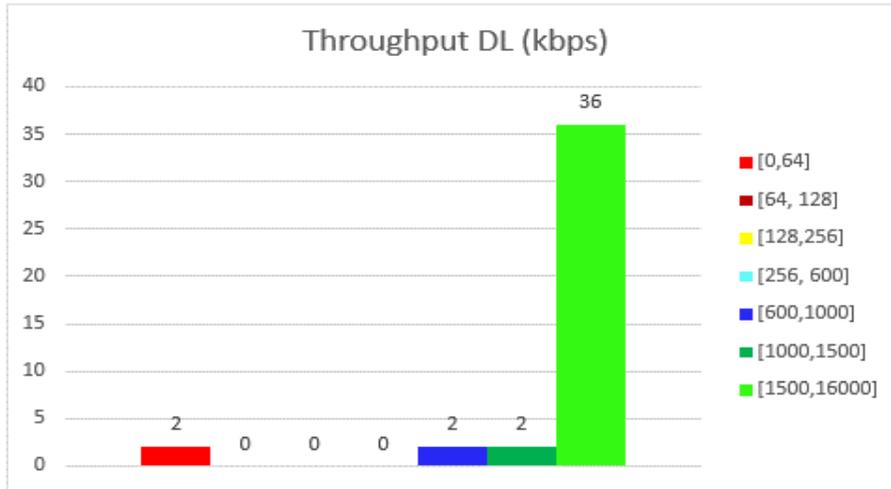






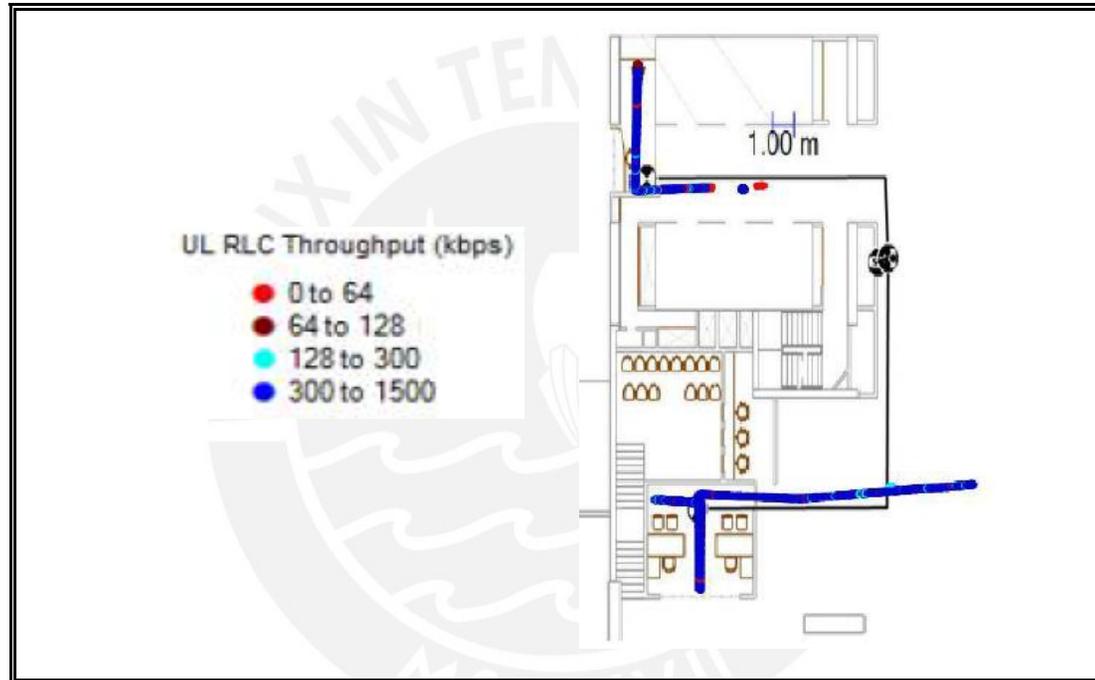


Piso 2



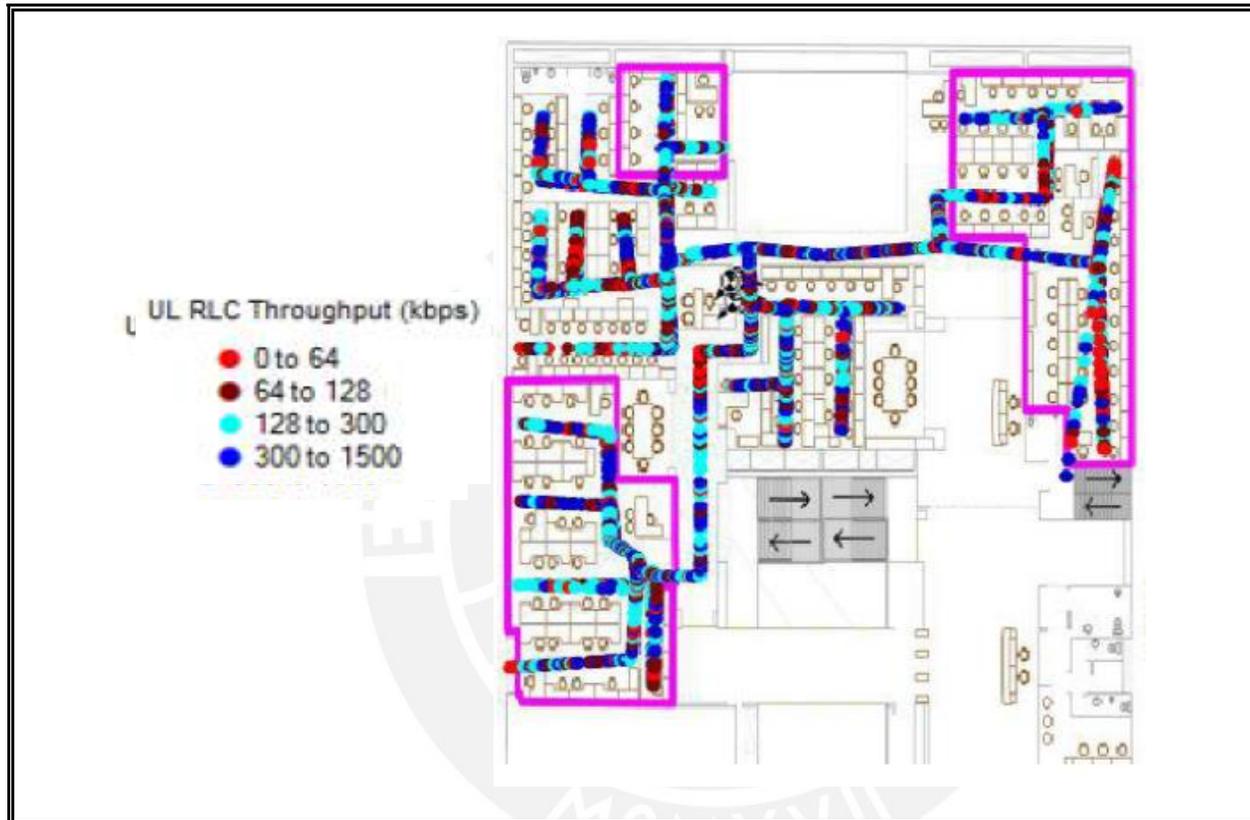
Throughput DL

Portadora 1062 sótano 1 CEM2



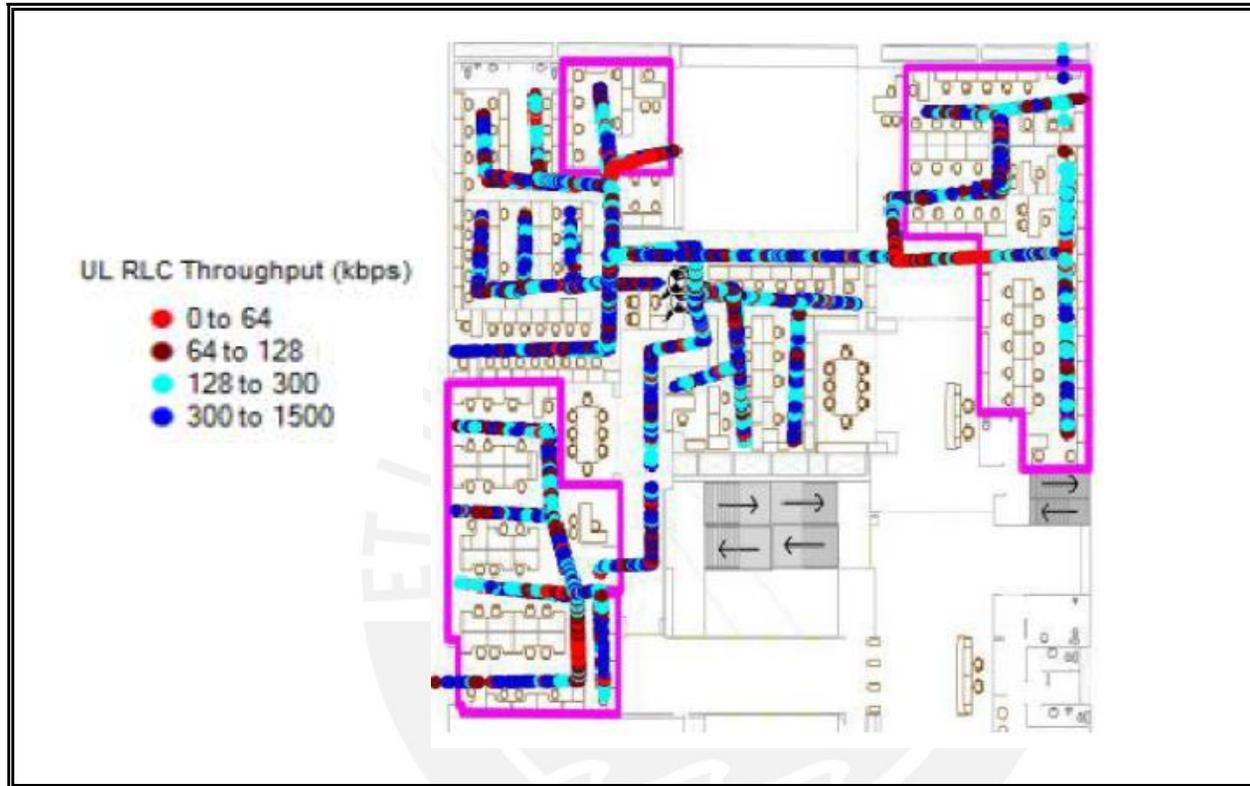
Throughput UL (kbps)	#Muestras	Porcentaje	KPI
[0,64]	38	4.68%	4.93%
[64, 128]	2	0.25%	
[128,300]	36	4.43%	95.07%
[300, 1500]	736	90.64%	

Portadora 1062 PISO 1 CEM2



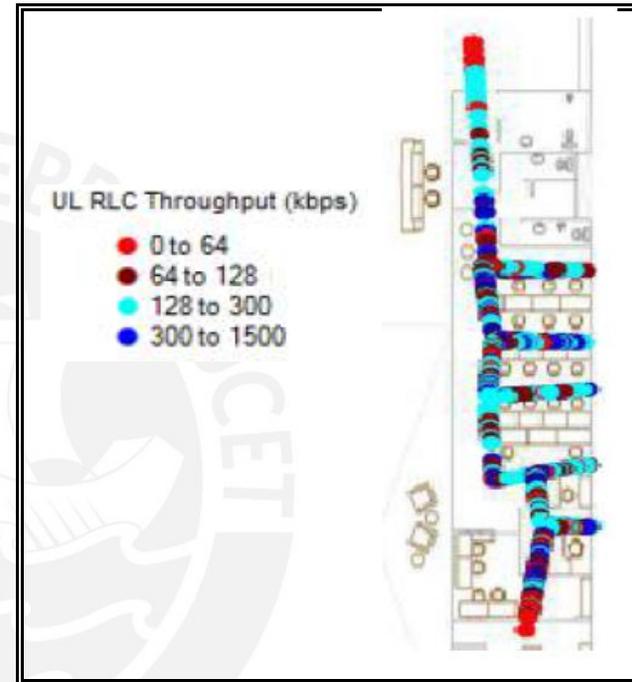
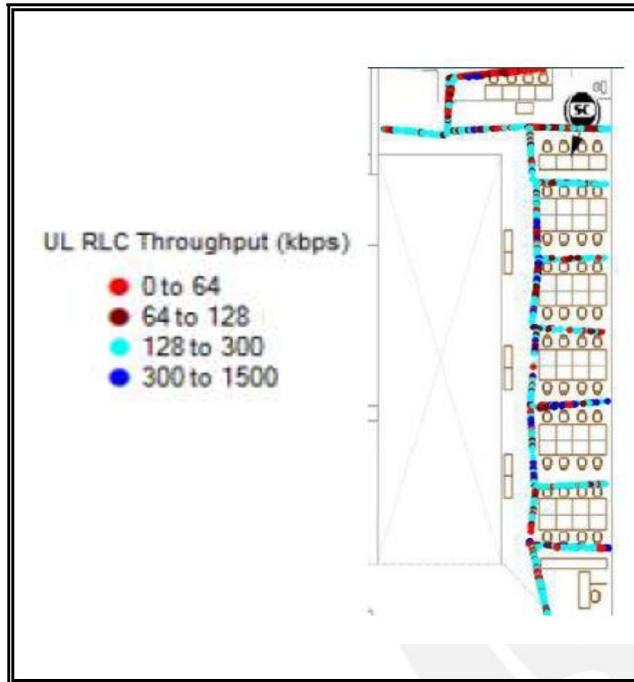
Throughput UL (kbps)	#Muestras	Porcentaje	KPI
[0,64]	184	11.31%	75.35%
[64, 128]	217	13.34%	
[128,300]	595	36.57%	
[300, 1500]	631	38.78%	

Portadora 1087 PISO 1 CEM2



Throughput UL (kbps)	#Muestras	Porcentaje	KPI
[0,64]	192	11.35%	24.66%
[64, 128]	225	13.31%	
[128,300]	617	36.49%	
[300, 1500]	657	38.85%	

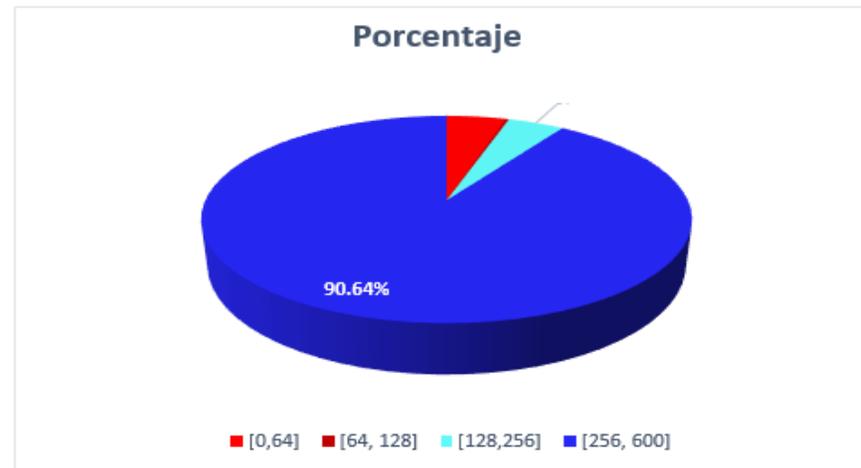
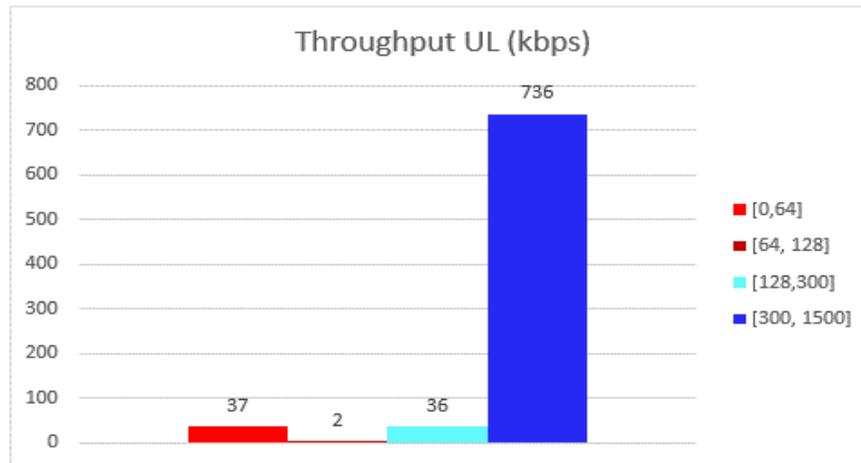
Portadora 1062 PISO 2 CEM2

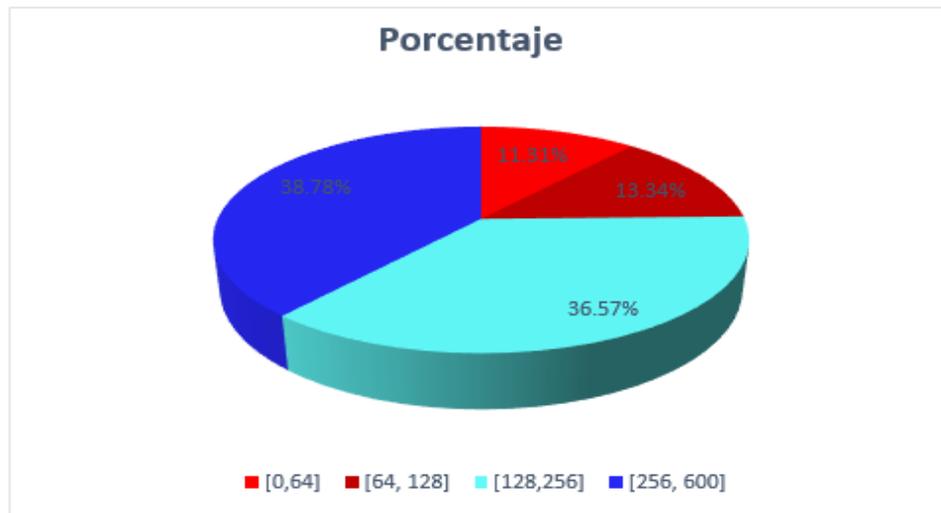
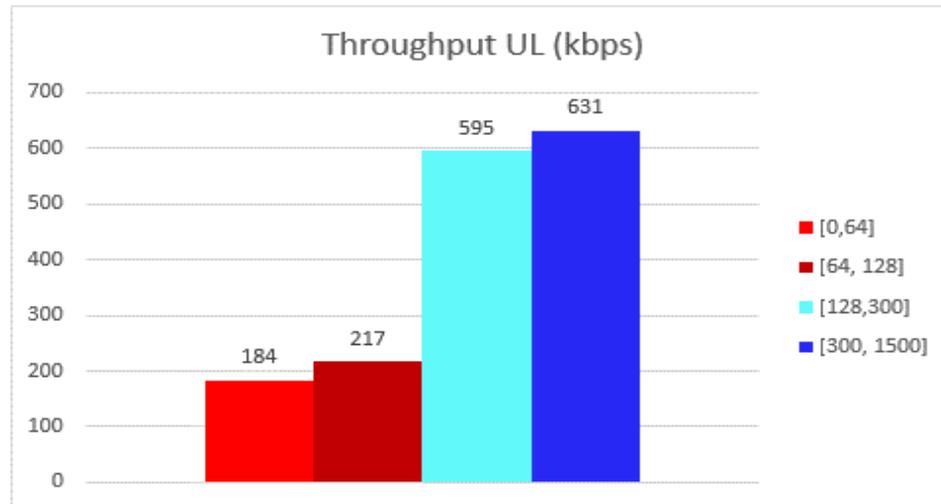


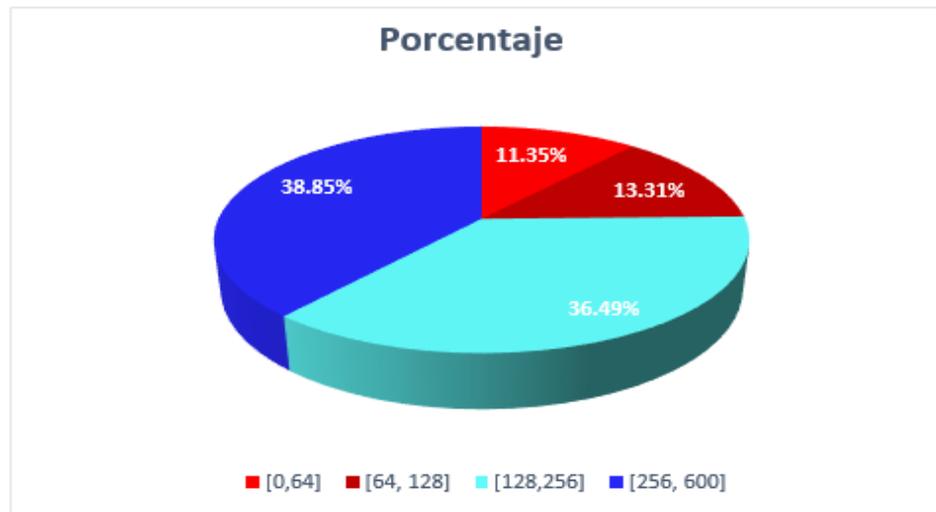
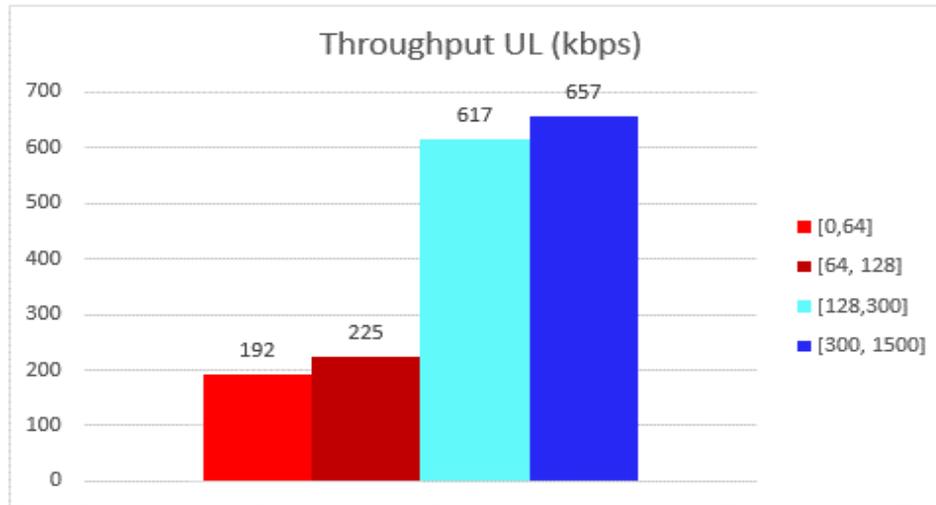
Zona que cubre la femtocelda del Piso 2 en el Piso 1

Throughput UL (kbps)	#Muestras	Porcentaje	KPI
[0,64]	132	19.79%	33.58%
[64, 128]	92	13.79%	
[128,300]	346	51.87%	66.42%
[300, 1500]	97	14.54%	

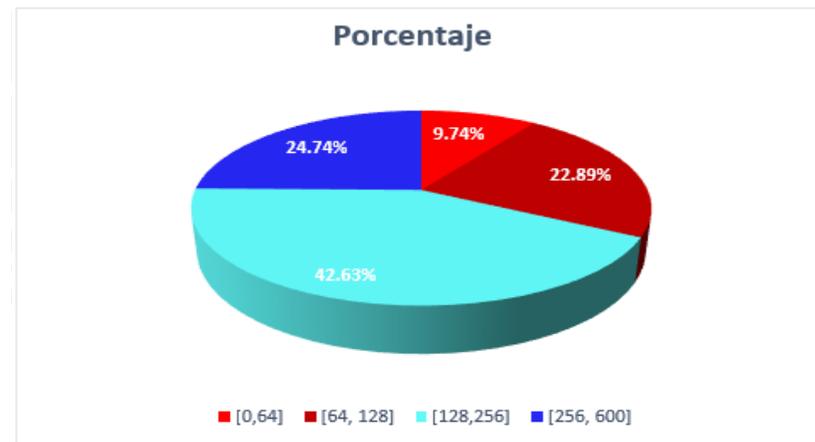
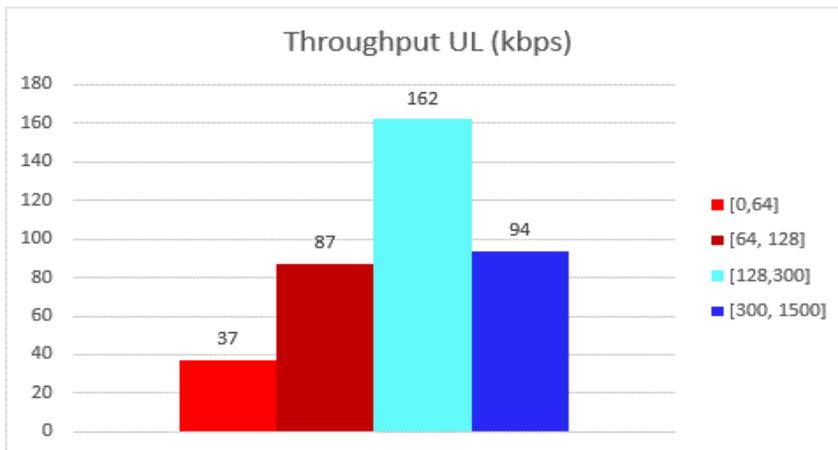
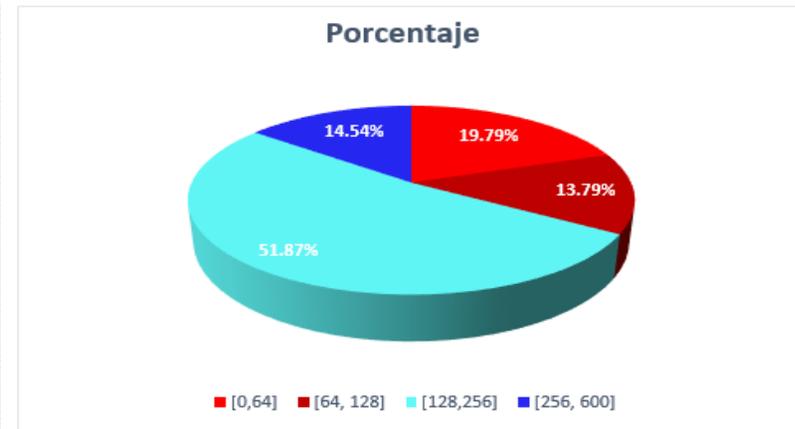
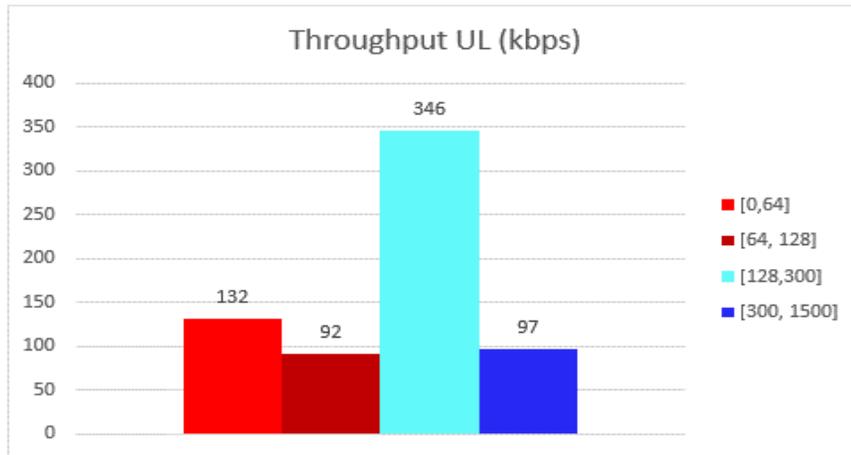
Throughput UL (kbps)	#Muestras	Porcentaje	KPI
[0,64]	37	9.74%	32.63%
[64, 128]	87	22.89%	
[128,300]	162	42.63%	67.37%
[300, 1500]	94	24.74%	







Piso 2



Eventos

CEM II - Piso 1 Zona donde se encuentra dos portadoras con PSC-3

- 1062.

Total Count(Calls + Drop)	Calls Count	Dropped Count	Drop Rate %
30	30	0	0.000%

- 1087.

Total Count(Calls + Drop)	Calls Count	Dropped Count	Drop Rate %
30	30	0	0.000%

CEM II - Piso 1-2 Zona con PSC-10

- 1062.

Total Count(Calls + Drop)	Calls Count	Dropped Count	Drop Rate %
45	45	0	0.000%

CEM II - Sotano 1 PSC 9

- 1062.

Tptal Count(Calls + Drop)	Calls Count	Dropped Count	Drop Rate %
60	60	0	0.000%

CEM II - Sotano 3 PSC 8

- 1062.

Total Count(Calls + Drop)	Calls Count	Dropped Count	Drop Rate %
30	30	0	0.000%

Prueba de Hard Handover Metro to Macro:

Intra Frequency 1062 PSC 10

Timestamp	Protocol	Directi	Message Name	Additional Info
12/08/2016 04:47:57.095 p.m.		Event	Intra Frequency HHO Cmd	Source Frequency: 882.5 ; Target Frequency : 882.5 ; Source PSC: 10 ; Target PSC : 78
12/08/2016 04:47:57.301 p.m.		Event	Intra Frequency HHO Success	

Direction	Event
UE	Device: Galaxy S5 #2; File: 3g_hosalien_nm_p1_srta_1175.AHD;1
EventId	WCDMA: Intra Frequency HHO Cmd
AdditionalInfo	Source Frequency: 882.5 ; Target Frequency : 882.5 ; Source PSC: 10 ; Target PSC : 78

Intra Frequency 1062 PSC 9

Timestamp	Protocol	Direction	Message Name	Additional Info
10/07/2016 09:54:34.836 p.m.		Event	Intra Frequency HHO Cmd	Source Frequency: 882.5 ; Target Frequency : 882.5 ; Source PSC: 9 ; Target PSC : 222
10/07/2016 09:54:34.896 p.m.		Event	Intra Frequency HHO Success	

Direction	Event
UE	Device: Galaxy S5 #2; File: NM_CEM1_S1_OHD_4.AHD;1
EventId	WCDMA: Intra Frequency HHO Cmd
AdditionalInfo	Source Frequency: 882.5 ; Target Frequency : 882.5 ; Source PSC: 9 ; Target PSC : 222

Intra Frequency 1062 PSC 3

Timestamp	Protocol	Direction	Message Name	Additional Info
17/07/2016 08:44:06.033 p.m.		Event	Intra Frequency HHO Cmd	Source Frequency: 882.5 ; Target Frequency : 882.5 ; Source PSC: 3 ; Target PSC : 78
17/07/2016 08:44:06.037 p.m.		Event	Intra Frequency HHO Success	

Direction	Event
UE	Device: Galaxy S5 #2; File: NM_P1_OHO.AHD;1
EventId	WCDMA: Intra Frequency HHO Cmd
AdditionalInfo	Source Frequency: 882.5 ; Target Frequency : 882.5 ; Source PSC: 3 ; Target PSC : 78

Intra Frequency 1062 PSC 7

17/07/2015 04:25:20.754 p.m.	Event	Intra Frequency HHO Cmd	Source Frequency : 882.5 ; Target Frequency : 882.5 ; Source PSC : 7 ; Target PSC : 78
17/07/2015 04:25:20.764 p.m.	Event	Intra Frequency HHO Success	

Direction	Event
UE	Device: Galaxy S5 #2; File: NM_S1_cuartos_OHO_1.AHD;1
EventId	WCDMA: Intra Frequency HHO Cmd
AdditionalInfo	Source Frequency: 882.5 ; Target Frequency : 882.5 ; Source PSC: 7 ; Target PSC : 78

Intra Frequency 1087 PSC 3

Timestamp	Protocol	Direction	Message Name	Additional Info
17/07/2015 08:34:32.018 p.m.		Event	Intra Frequency HHO Cmd	Source Frequency : 887.5 ; Target Frequency : 887.5 ; Source PSC : 3 ; Target PSC : 78
17/07/2015 08:34:32.019 p.m.		Event	Intra Frequency HHO Success	

Direction	Event
UE	Device: Galaxy S5 #2; File: NM_P1_OHO_f2.AHD;1
EventId	WCDMA: Intra Frequency HHO Cmd
AdditionalInfo	Source Frequency: 887.5 ; Target Frequency : 887.5 ; Source PSC: 3 ; Target PSC : 78

Prueba de Hard Handover Macro to Metro

Intra Frequency 1062 PSC 9

Timestamp	Protocol	Direction	Message Name	Additional Info
10/07/2015 12:20:06.820 a.m.		Event	Intra Frequency HHO Cmd	Source Frequency: 882.5 ; Target Frequency : 882.5 ; Source PSC: 78 ; Target PSC : 9
10/07/2015 12:20:06.823 a.m.		Event	Intra Frequency HHO Success	

Direction	Event
UE	Device: Galaxy S5 #2; File: NM_CEM1_S1_IHD.AHD;1
EventId	WCDMA: Intra Frequency HHO Cmd
AdditionalInfo	Source Frequency: 882.5 ; Target Frequency : 882.5 ; Source PSC: 78 ; Target PSC : 9

Intra Frequency 1062 PSC 10

17/07/2015 08:44:11.300 p.m.	Event	Intra Frequency HHO Cmd	Source Frequency: 882.5 ; Target Frequency : 882.5 ; Source PSC: 78 ; Target PSC : 10
17/07/2015 08:44:11.431 p.m.	Event	Intra Frequency HHO Success	

Direction	Event
UE	Device: Galaxy S5 #2; File: NM_P1_OHO.AHD;1
EventId	WCDMA: Intra Frequency HHO Cmd
AdditionalInfo	Source Frequency: 882.5 ; Target Frequency : 882.5 ; Source PSC: 78 ; Target PSC : 10

Intra Frequency 1062 PSC 3

Timestamp	Protocol	Direction	Message Name	Additional Info
17/07/2016 10:17:51.490 p.m.		Event	Intra Frequency HHO Cmd	Source Frequency: 882.5 ; Target Frequency : 882.5 ; Source PSC: 362 ; Target PSC : 3
17/07/2016 10:17:51.625 p.m.		Event	Intra Frequency HHO Success	

Direction	Event
UE	Device: Galaxy S5 #2; File: NM_P2_IHO.AHD;1
EventId	WCDMA: Intra Frequency HHO Cmd
AdditionalInfo	Source Frequency: 882.5 ; Target Frequency : 882.5 ; Source PSC: 362 ; Target PSC : 3

Intra Frequency 1062 PSC 7

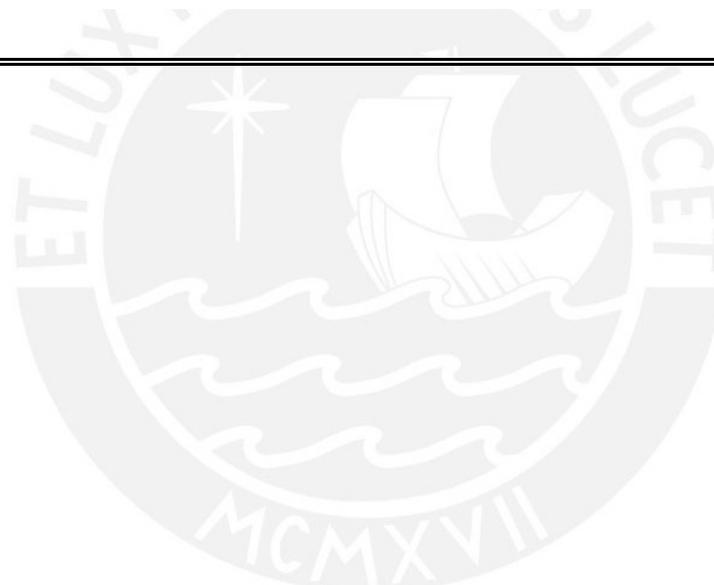
17/07/2016 04:25:28.761 p.m.		Event	Intra Frequency HHO Cmd	Source Frequency: 882.5 ; Target Frequency : 882.5 ; Source PSC: 78 ; Target PSC : 7
17/07/2016 04:25:28.929 p.m.		Event	Intra Frequency HHO Success	

Direction	Event
UE	Device: Galaxy S5 #2; File: NM_S1_cuartos_OHO_1.AHD;1
EventId	WCDMA: Intra Frequency HHO Cmd
AdditionalInfo	Source Frequency: 882.5 ; Target Frequency : 882.5 ; Source PSC: 78 ; Target PSC : 7

Intra Frequency 1087 PSC 3

Timestamp	Protocol	Direction	Message Name	Additional Info
17/07/2015 08:33:16.353 p.m.		Event	Intra Frequency HHO Cmd	Source Frequency: 887.5 ; Target Frequency : 887.5 ; Source PSC: 78 ; Target PSC : 3
17/07/2015 08:33:16.362 p.m.		Event	Intra Frequency HHO Success	

Direction	Event
UE	Device: Galaxy S5 #2; File: NM_P1_IHO_f2.AHD;1
EventId	WCDMA: Intra Frequency HHO Cmd
AdditionalInfo	Source Frequency: 887.5 ; Target Frequency : 887.5 ; Source PSC: 78 ; Target PSC : 3

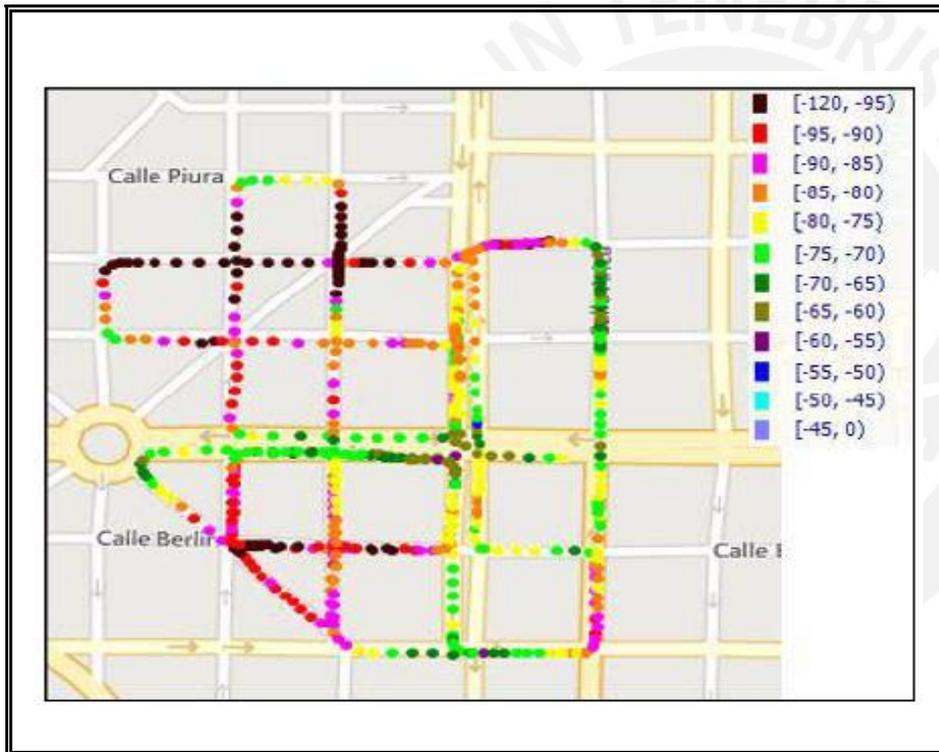


Niveles de señal Outdoor luego de la puesta de la Solución

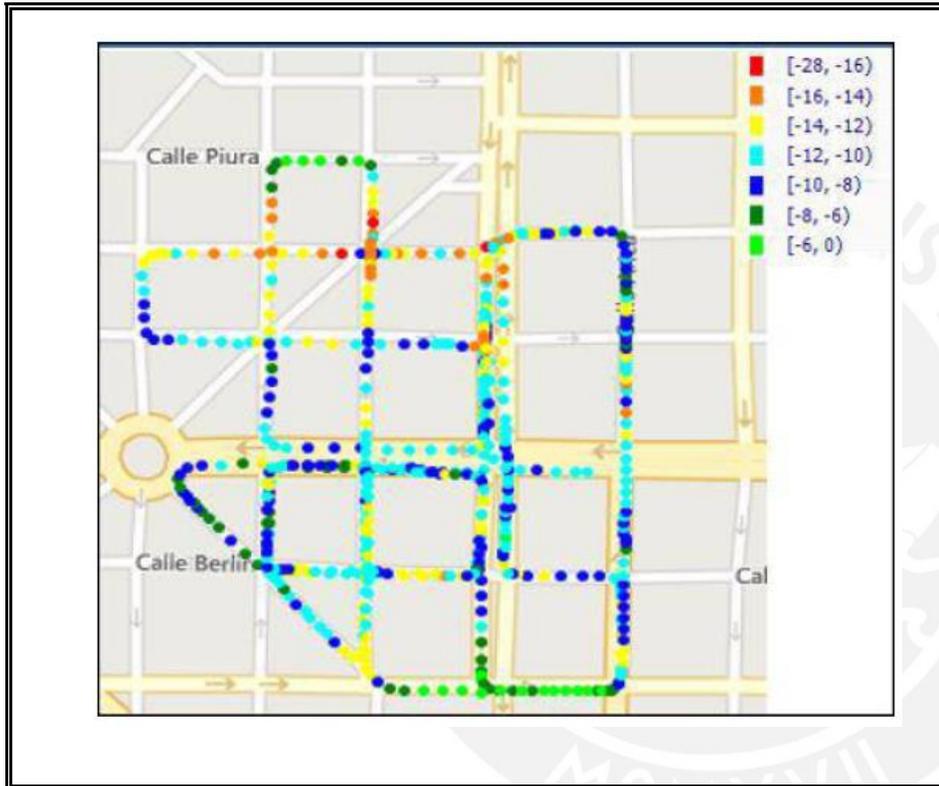
BEST SERVER



RSCP



EcNo



Comentarios del Autor:

Se pudo observar que existen casos en los que no se llegan a los valores planteados para los parámetros de Throughput y Tx Power, con ello se concluye que el nivel de Throughput depende de la carga presente en la red y las condiciones de radio y los niveles de Tx Power dentro del sistema, pueden verse afectados por interferencia de otros móviles que estén transmitiendo con la red macro y estén cerca del sistema de femtoceldas, con lo cual estos parámetros pueden presentar variaciones.

