PIONEERING WIFI 6E IN CHILE:

ENHANCING CONNECTIVITY AT VEGA LOS ANGELES

Pioneering WiFi 6E in Chile: Enhancing Connectivity at Vega Los Angeles

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November 2024

Executive Summary

This pioneering project implements Indoor WiFi 6E transmission tests on 160 MHz channels in Mercado Vega Los Angeles, becoming the first commercial complex in Chile to conduct tests using the 6GHz band. The initiative, developed by the Fundación País Digital, made possible by Qualcomm Incorporated through its Qualcomm Wireless Reach™ initiative, in collaboration with various entities such as Undersecretary of Telecommunications (Subtel), NIC Chile, Cisco, CMPC, Mundo Telecomunicaciones, and INACAP, aims to demonstrate the benefits of new wireless technology in terms of greater bandwidth, reduced interference, and improved stability in densely populated environments.

The main objective of the project was to evaluate the effectiveness of WiFi 6E, with additional goals to enhance connectivity using a traditional wireless network for merchants and visitors, overcoming the challenges posed by metal structures that hinder wireless signal transmission.

To achieve this, a network that included both a traditional WiFi configuration and WiFi 6E access points was installed, supported by 25 dual WiFi points (2.4 GHz and 5 GHz) and five WiFi 6E access points. Installation was carried out during nighttime hours to minimize interruptions to commercial activities. With the support of NIC Chile and Wimux (responsible for the network installation), coverage exceeding 90% was achieved, supporting more than 1,000 simultaneous users and speeds of up to 900 Mbps, with the internet link donated by Mundo Telecomunicaciones.

The results showed a 150% increase in average speed compared to WiFi 5, thanks to the use of the 6GHz band, which reduced congestion and improved connection stability. These improvements allow merchants to adopt digital solutions to enhance customer interaction and sales.

The network installation was accompanied by a mentoring program in partnership with the Companies, Business and Entrepreneurship Center (CENE) at INACAP Los Angeles campus, focusing on training the Vega Los Angeles merchants in using digital tools such as WhatsApp Business and Canva. This improved service quality and facilitated digital payment methods. Thanks to this support, 30 entrepreneurs adopted digital solutions, resulting in an estimated sales increase of 30% to 50%. Additionally, a consultative manual was created to support merchants in their digitalization process.

The project exceeded initial expectations, demonstrating the potential of the 6GHz band through the WiFi 6E network to improve connectivity in commercial environments and contribute to modernizing business practices. Next steps include implementing a quarterly network maintenance program and expanding the initiative to other markets in the Biobio region with similar connectivity issues. Lessons learned include the importance of detailed environmental evaluations before installation to minimize interference caused by metal structures.

1. General Aspects of the Project

The implementation of a WiFi network using the 6GHz band, through WiFi 6E, in the Vega Los Angeles Market is a pioneering initiative in Chile, making this market the first commercial complex in the country to conduct such tests. This milestone reflects not only technological advancement but also The Undersecretary of Telecommunicationes (Subtel)'s commitment to the continuous improvement of critical infrastructures for the country's economic and social development. In particular, Subtel's Division of Regulation and Studies played a key role in defining work milestones and result measurement protocols.

Evolution of WiFi Technologies

The evolution of WiFi technologies has been fundamental for improving wireless connectivity, increasing speeds, efficiency, and capacity. Additionally, the use of WiFi has surpassed Ethernet cable due to the growing use of devices like laptops, tablets, and mobile phones, which demand greater flexibility and mobility. Below is a summary of the main WiFi generations[1]:

	WiFi 4	**WiFi 5**	**WiFi 6**	**WiFi 6E**	**WiFi 7**
Launch	2007	2013	2019	2021	2024
IEEE Standard	802.11n	802.11ac	802.11ax	802.11ax	802.11be
Maximum Velocity	1,2 Gbps	3,5 Gbps	9,6 Gbps	9,6 Gbps	46 Gbps
Bands	2,4 GHz 5 GHz	5 GHz	2,4 GHz 5 GHz	6 GHz	2,4 GHz 5 GHz 6 GHz

Figure 1: Comparison of different wireless technologies

The 2.4 GHz, 5 GHz, and now 6 GHz bands have begun to be used, helping to avoid saturation and improving connection quality. This means that by adding the 6 GHz band, users can enjoy a faster and more stable connection, ideal for high-speed applications such as virtual reality, video games, and high-definition video streaming. It is worth noting that the use of the 6 GHz band varies by country, which may affect the performance of these technologies in different regions.

The evolution of WiFi technologies reflects a continuous commitment to improving wireless connectivity, while adapting to changing user needs and emerging applications.

Project Objective

To demonstrate the tangible benefits of WiFi 6E technology and the use of the 6GHz band, particularly in terms of improved connectivity, greater bandwidth, and reduced interference, which are crucial in environments with metal structures and densely populated spaces that traditionally hinder wireless signal transmission.

Project Context

This initiative is part of the activities executed by Fundación País Digital to collaborate with the Government's Digital Agenda, such as the Undersecretary of Telecommunications' Plan Brecha Digital Cero and the Undersecretary of Economy & EMT's Programa Digitaliza tu

[1] This project was initiated in 2023 and did not include the evaluation of WiFi 7, which was launched in 2024 and is recognized for its better performance compared to WiFi 6E in the 6GHz band.

Pyme. Over the years, País Digital has developed several related projects, such as Programa Conectando Territorios (2022-2023), Programa Pyme Activa Antofagasta (2020-2021), Chequeo Digital (2019), Simposio Pymes (2019), and Digital Solutions Workshops for businesses in regions (2018-2019).

Through a strategic collaboration between Qualcomm Technologies and Fundación País Digital, it was decided to implement a pilot project to evaluate WiFi 6E technology in Chile through Wireless Reach. The project was decided to be conducted in a market with active commercial participation, leading to discussions with CMPC to define strategic locations. Finally, Mercado Vega Los Angeles was selected, and contact was made with the Mayor, who expressed support for the project and facilitated the necessary installations, followed by discussions with market leaders to organize project logistics.

The Mercado Vega Los Angeles was chosen for its high attendance and the diversity of merchants and visitors that transit its facilities daily. Additionally, Los Angeles city is considered the “Gateway to Southern Chile” because it converges the nature and culture of central and southern Chile around the natural border of the Biobio River. It is one of the fastest-growing cities in the country over recent decades, despite not being a regional capital.

This market is a commercial facility of 13,000 square meters where more than 300 entrepreneurs operate, selling food such as fruits, vegetables, meats, and seafood, along with restaurants and grocery stores. Additionally, it includes the rural bus terminal adjacent to the market, a meeting point between urban and rural worlds. It is estimated that more than 2,000 people pass through daily.

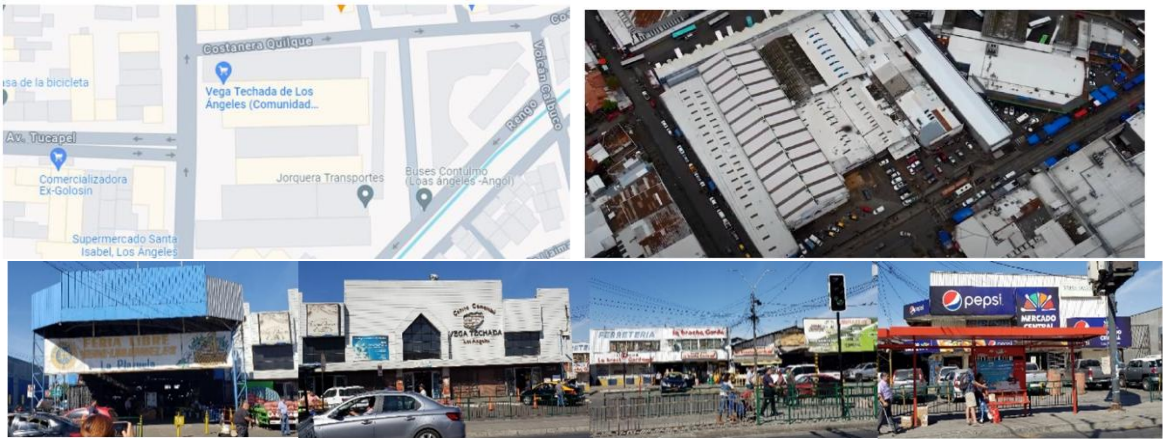

Figure 2: Several views of the Mercado Vega Los Angeles

With the technical support from NIC Chile, that is part of the University of Chile, which advised and acted as Technical Inspector of Works (ITO) in connectivity aspects, a WiFi network was designed to include both a traditional configuration and one based on WiFi 6E, for comparative analysis of wireless technology performance, especially improvements with 6GHz band access. Once the design was finalized, the provider responsible for installing the necessary infrastructure was identified. Additionally, a 1GB internet link was donated by Mundo Telecomunicaciones to ensure optimal connectivity for the deployment. WiFi 6E equipment was provided on a loan basis by Cisco Chile.

It is worth mentioning that these kinds of markets lack adequate internet signals due to the metal structure of the premises, so these connectivity projects also benefit the community, providing training for business digitalization in these markets.

The process was carried out under the supervision of the Undersecretary of Telecommunications (Subtel), which authorized experimental WiFi 6E tests in indoor environments. This pilot's main objective is to demonstrate the benefits of new technology in terms of greater bandwidth, reduced interference, and improved stability in densely populated environments such as markets, where traditional infrastructure has faced limitations. Thus, it is expected to set a precedent for future connectivity projects in similar commercial spaces.

Project Stakeholders

The project was a collaboration between multiple private, public, and civil society entities that played various roles in the successful implementation of the project.

- Qualcomm: Project funding through Wireless Reach in addition to project management and technical support.
- Undersecretary of Telecommunications: Authorized the temporary use of the 6GHz spectrum band, defined work protocols, and conducted on-site measurements.
- Mundo Telecomunicaciones: Donated a 1GB internet link for 12 months.
- Cisco: Provided WiFi 6E equipment on loan, which had to be imported as there are currently no authorized distributors for such products.
- NIC Chile: Technical counterpart for the implementation and verification of connectivity.
- INACAP Los Angeles: The Electricity and Electronics Telecommunications Department served as the technical counterpart for monitoring connectivity measurements, and the Companies, Business and Entrepreneurship Center (CENE) at INACAP supported merchants in digitizing their businesses.
- Wimux: Regional company responsible for network installations.
- Municipalidad de Los Angeles: Local government providing institutional and logistical support.
- Gobierno Regional de Biobio: Regional government supporting local economic development.
- CMPC: National forestry company involved in strengthening local productive development as part of its corporate social responsibility role, funding manual design activities and the event launch.
- Market leaders: Representing the various markets involved in the project.

Figure 3: Project Collaborators

Launch Event

On Tuesday, November 14, 2023, a launch event was held at the entrance of the Vega Los Angeles fruit and vegetable market. Company executives and national and local authorities delivered speeches highlighting the importance of this activity. In the morning, the launch event took place, followed by afternoon training sessions on tools for digitizing merchants' businesses.

Figure 4: Project Launch and Training Sessions Conducted the Same Day

Mentorship Program in Partnership with INACAP

Following the launch, a support program for businesses in Vega Los Angeles was developed. This activity was carried out in collaboration with the Companies, Business and Entrepreneurship Center (CENE) at INACAP, focusing on providing connectivity to merchants and training them in the use of digital tools to improve service quality and facilitate various payment methods. Through a series of on-site interventions, student mentors conducted initial diagnostics, offered advanced workshops, and executed final diagnostics to measure the program's impact.

Figure 5: Mentorship Program Including Graduation Ceremony

From this experience, 30 entrepreneurs graduated, incorporating digital tools into their businesses. The installation of WiFi networks and training on digital tools such as WhatsApp Business and Canva set a precedent for how access to appropriate technologies can significantly boost sales, estimated at 30% to 50%, with the adoption of just two or three digital solutions.

Additionally, a consultative manual was designed as a practical and advisory tool, summarizing the most relevant knowledge from the digital tools training sessions.

Figure 6: Merchant Support Manual

This intervention not only highlights the importance of connectivity and technological training but also underscores the critical role of technology in driving progress and strengthening local commerce. Technology thus becomes an indispensable ally for business development, offering new growth opportunities and more equitable access to the global market.

2. Installation Details and Technical Configuration

Authorization for Temporary Use of the 6GHz Spectrum Band

A request was submitted to the Undersecretary of Telecommunicationes (Subtel) for experimental use of WiFi 6E technology in Chile. To this end, a technical project was prepared and approved by the subsecretary, as evidenced in the resolution.

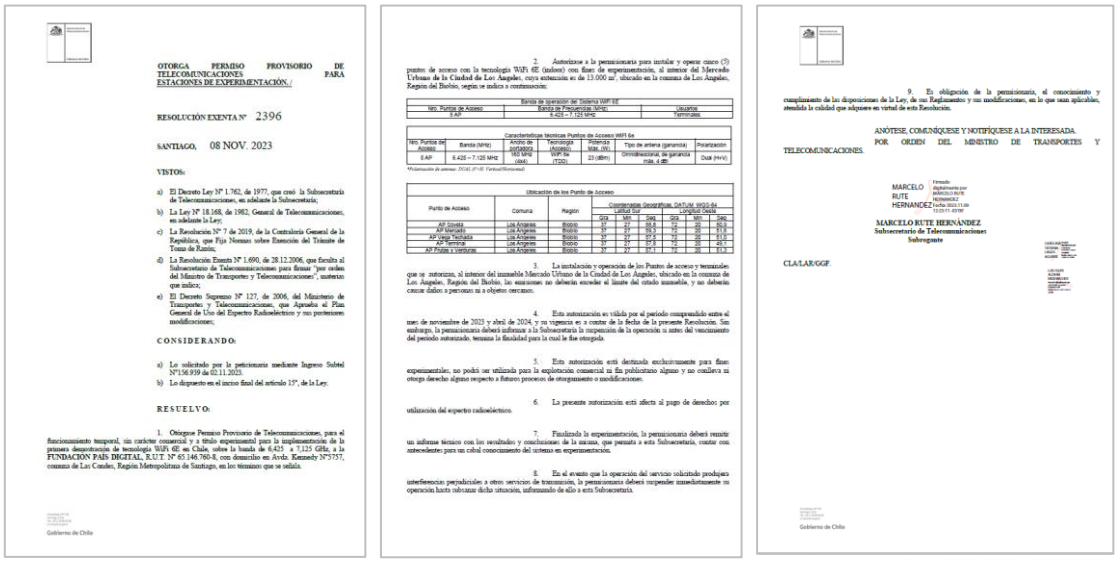

Figure 7: Resolution Authorizing Fundación País Digital to Conduct 6GHz Band Testing

Additionally, permits were obtained from the Municipalidad de Los Angeles and each of the facility leaders to carry out the installations of both the WiFi network and WiFi 6E equipment.

Installation Strategy

The total facility comprises five administrative units: Vega, Sovela, Market, Rural Bus Terminal, Fruits, and Vegetables. Structurally, these are multiple metallic warehouses connected within a constructed area of 13,000 square meters, housing over 300 businesses.

The installation was planned and executed with technical support from the telecommunications provider Wimux and NIC Chile (University of Chile). Nighttime work was chosen to avoid interruptions to normal commercial activities.

Figure 8: Market Installations

During the initial site visit, the complexity of current communications was noted due to the isolation caused by the galvanized material of the warehouses. In subsequent visits, equipment installation points were determined to achieve WiFi coverage exceeding 90%.

Finally, a high-capacity network was built, capable of supporting more than 1,000 simultaneous users with bandwidths of 700Mbps per user (conditioned by the internet connection). The work was carried out between October 15 and October 25, 2023.

Characterization of the Installation, Plans, and Equipment Used

The installation involved setting up 25 WiFi points with dual WiFi technology (2.4GHz and 5GHz) and building a wired Cat6e network for its operation. Five communication racks (one for each administrative area) were included, each equipped with its power source, router, and manageable switches. Additionally, five WiFi 6E points (one for each administrative area) of the Cisco Catalyst CW91661 model were installed, provided directly by Cisco as a collaboration for the project. The installation also included enabling controllers and switches.

The project involved installing high-end equipment, including Mikrotik and Cisco routers, Tplink manageable switches, and Ubiquiti U6Pro access points. Moreover, a structured cabling infrastructure with CAT6A and CAT6 was implemented, essential to support the high transmission speeds offered by WiFi 6E.

Figure 9: Equipment Used

The network is segmented into several VLANs to better organize traffic and ensure security. The access points are strategically distributed throughout the market to maximize efficiency and coverage, as can be seen in the connection diagram and equipment location plan:

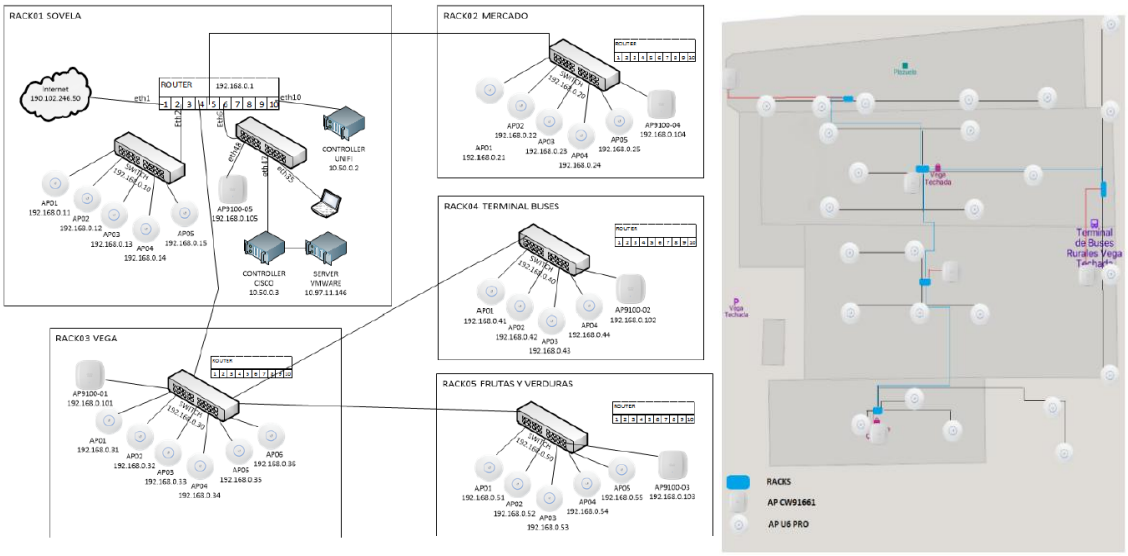

Figure 10: Connection Diagram and Equipment Location Plan

Capabilities of Dual WiFi Technology (2.4GHz and 5GHz)

The network demonstrates the capability to support more than 500 simultaneous connections, offering each user speeds of up to 700Mbps, a significant improvement compared to the infrastructure prior to the project.

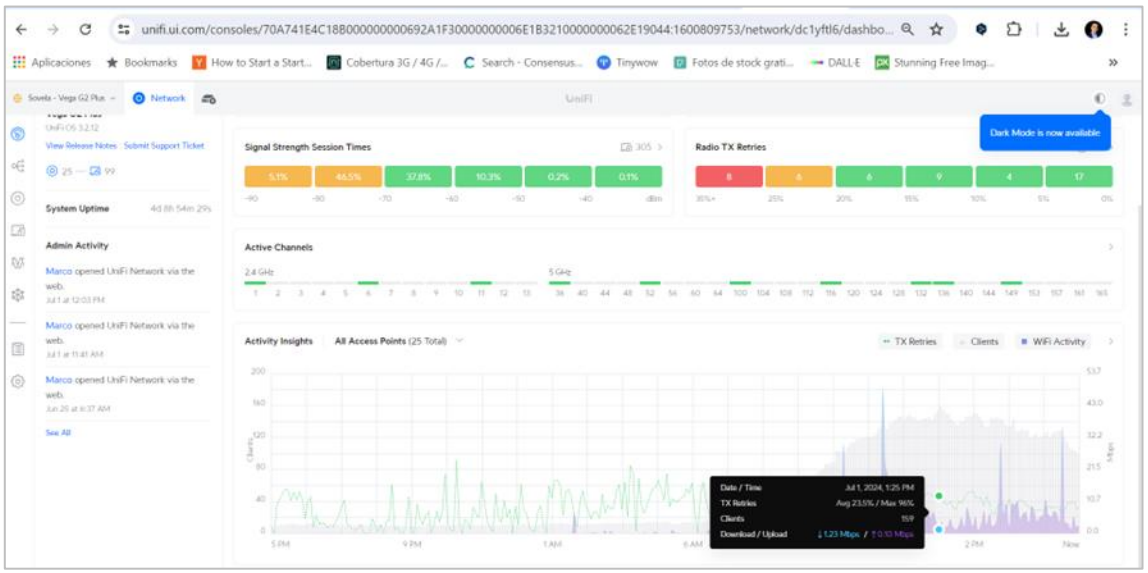

Figure 11: Dashboard Monitoring the Installed Network

3. WiFi 6E Network Performance and Results

WiFi 6E technology[2] represents the latest evolution in wireless communication technologies, extending the capabilities of the WiFi 6 standard by including the 6GHz band. This expansion not only increases the available spectrum but also significantly improves performance by reducing congestion in saturated networks typical of densely populated environments such as shopping centers and transportation hubs.

The introduction of WiFi 6E enables wider channels of up to 160 MHz, increases spectrum efficiency, and improves latency, providing ultra-fast transmission speeds and a more stable connection. These characteristics make WiFi 6E a solution for applications requiring high bandwidth and low latency, such as high-definition video streaming, online gaming, and virtual reality applications, thus promoting a significant advancement in end-user experience and the efficiency of enterprise and commercial networks.

Characteristics of the Provisional WiFi 6E Permit

According to Article 15 of the General Telecommunications Law, a provisional permit was requested for experimental purposes to test indoor WiFi transmission using the WiFi 6E protocol on 160MHz channels, utilizing microwave frequency bands from 6425 to 7125 MHz in the commune of Los Angeles, Biobio Region. The provisional permit is non-commercial and was used exclusively for demonstrative purposes for a period of six (6) months starting in November 2023. The following outlines the technical characteristics of the experimental project:

Location of Transmission Systems (and/or Reception)

Access Points:

EB	City	Region	Geographic Coordinate System WGS84	
			South Latitude	West Longitude
AP Sovela	Los Angeles	Biobío	37.46632	72.34747
AP Mercado	Los Angeles	Biobío	37.46648	72.34768
AP Vega Techada	Los Angeles	Biobío	37.46597	72.34751
AP Terminal	Los Angeles	Biobío	37.46606	72.34697
AP Frutas y Verduras	Los Angeles	Biobío	37.46587	72.34757

Clients: Clients will be at a maximum radius of 50 meters from each Acess Point.

Operational Characteristics by Bands: FDD or TDD
• Microwave (6425 - 7125 MHz) TDD

Theoretical Speeds Achieved by Bands
• Microwave (6425 - 7125 MHz): 4.8Gbps per 160MHz channel (4x4)

[2] It should be noted that this project began in 2023 and therefore did not include the evaluation of WiFi 7, which was launched in 2024 and is recognized for its better performance compared to WiFi 6E in the 6GHz band.

Bandwidths to Be Used
• Microwave (6425 - 7125 MHz): 160 MHz channels

Users Per Radio Station
• Microwave (6425 - 7125 MHz): 20 concurrent users per AP

Coverage Radius by Bands
• Microwave (6425 - 7125 MHz): Approx. 50 meters

The antenna gain at the base station is 4 dBi.

Testing Protocols

To ensure the effectiveness and efficiency of the WiFi 6E network, a protocol was implemented that included conducting speed and stability tests to capture performance variations due to user density.

The following equipment was considered:
1.- 5 laptops with HP ProBook 440 G9 compatibility with WiFi 6E. External WiFi 6E USB adapters were also used to measure performance on older devices without this wireless technology.
2.- High-performance server with Debian, PCIe 10Gb Ethernet LAN card, connected via Cat6 cable to a Cisco Catalyst 9300 Switch.

The testing protocol was as follows:
1.- Tests were conducted using 160 MHz channels on a single computer.
2.- Multi-client tests were conducted with 5 notebooks and 5 WiFi6E wireless network cards in a central area of the market.
3.- Measurements were taken around the market's infrastructure to check for communications within the 6GHz spectrum, in addition to the requested experimental permit.

The results were analyzed to detect potential interferences or network drops, ensuring that the infrastructure meets the highest standards of quality and reliability in a highly active commercial environment.

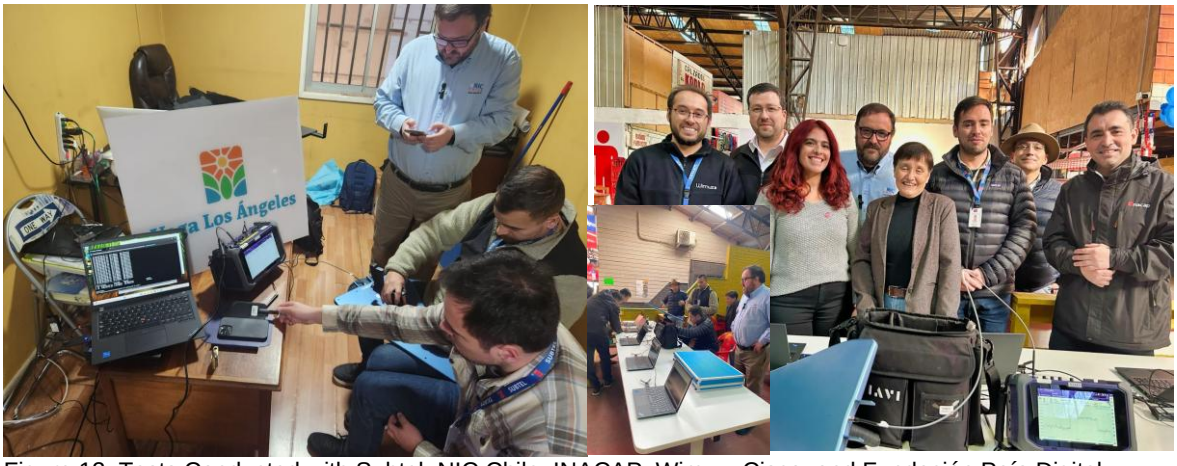

Figure 12: Tests Conducted with Subtel, NIC Chile, INACAP, Wimux, Cisco, and Fundación País Digital

Measurement Results

On May 16, 2024, a Subtel team conducted measurements using a WiFi spectrum analyzer software to assess the performance of the WiFi 6E network installed in the Mercado Vega Los Angeles. The purpose of these measurements was to evaluate network performance in terms of speed, coverage, stability, and concurrent user capacity, as well as to identify potential interferences in the market environment.

The aim of these measurements was to verify the effectiveness of the WiFi 6E network deployment by analyzing coverage achieved in various areas of the market, signal stability, and performance under high user density conditions. Areas for improvement, such as interference points or zones, were identified.

Measurements were conducted in a central area of the market, yielding the following results:

Figure 13: Measurements Taken with 5 Devices

Subsequently, 9 measurements were conducted in different areas of the Vega Los Angeles Market to evaluate coverage and achieved speeds.

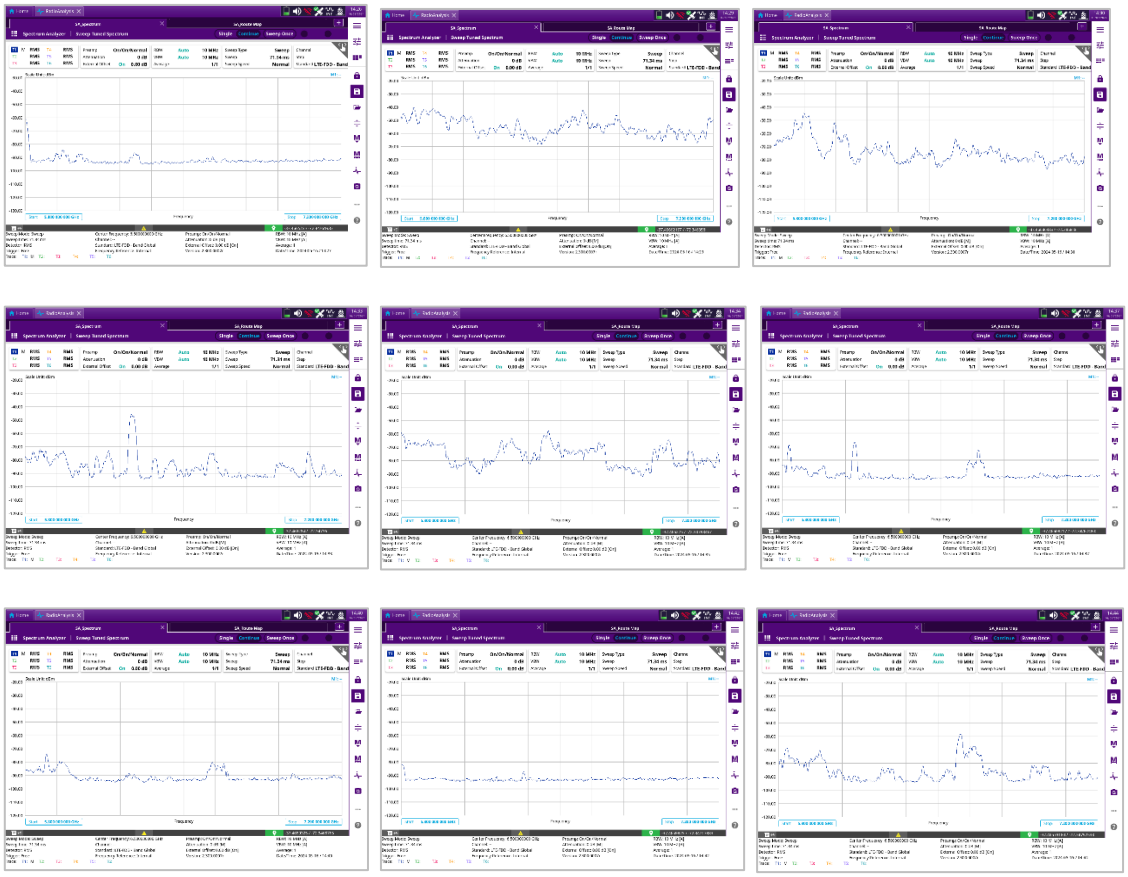

Figure 14: Measurements Conducted in Various Areas of the Market

Results Summary:

• Connection Speed: Speeds measured in various areas averaged 700 Mbps, with peaks of up to 900 Mbps in areas with less interference.

• Coverage: The market map shows coverage exceeding 90%, with good signal strength in most areas.

• Interferences: Light interferences in the 6 GHz spectrum were identified during the measurements. These interferences did not affect signal quality.

Results obtained with WiFi 6E show a 150% increase in average speed compared to the WiFi 5 network, particularly in densely populated areas. This improvement is due to the use of the 6 GHz band, which provides wider channels and reduces congestion.

4. Conclusions and Recommendations

The project has met and exceeded initial expectations in terms of technological improvements and socio-economic benefits, setting a significant precedent for future digital infrastructure initiatives in commercial environments. In addition to testing this new WiFi 6E wireless technology, it demonstrated the advantages of the 6GHz band. Specifically, the indoor WiFi 6E pilot proved that achieving Chile's fastest internet is possible, meeting universal connectivity goals of 1 Gigabit access, aligning with European Union recommendations[3].

The trial analyzed Wi-Fi 6E in terms of network performance, connectivity improvements, and interference management, and it does not include recommendations for spectrum allocation or using a particular band for a specific technology.

Technological Improvements Achieved

The project demonstrated that the WiFi 6E network offers high-speed and low-latency connections, essential in densely populated commercial environments. Coverage exceeding 90% was achieved at the Mercado Vega Los Angeles, with speeds of up to 900 Mbps, enabling a seamless digital experience for merchants and visitors.

Impact on the Commercial Community

This project has served as a catalyst for the modernization of commercial practices within the market. Merchants can now manage and interact with customers online and process digital transactions without delays. For example, merchants have started offering electronic payments, which has increased their sales and improved customer satisfaction.

The following testimonials reflect the positive impact of the new infrastructure on the market's economic activity and the support process for digitizing businesses in Vega Los Angeles.

The Vice President of the Fruits and Vegetables Community, Bernardo Mellado, stated, "Everything that has happened has been a great advancement. Technology goes hand in hand with progress. Training people is extraordinarily positive, especially because the world is becoming increasingly digitalized. This is key for businesses to grow and for all of us to move forward with technology. The future vision is clear: we are all very happy because we knew we were falling behind, but with this system, we will begin to advance and continue growing in terms of sales. The sector will gain recognition, take on a tourist character, and attract more visitors. We need to stay connected to technological advancement to reach all that potential."

Ana María Burgos, a merchant of Vega Techada de Los Ángeles, located at lot six, mentioned, "I am very grateful that they came to help us with the digital aspect, as it is a new world for us that often scares us. Now I have a manual from which I am studying and putting into practice everything that was explained to us about digital sales."

[3] The complete details of the European Commission's recommendations can be found in the downloadable documents at the following link: https://digital-strategy.ec.europa.eu/en/library/recommendation-regulatory-promotion-gigabit-connectivity

Verónica Toro, a student of Engineering in Administration at INACAP Los Angeles Campus, stated, “It has been a great two-way learning process where we have all been able to learn. I am grateful for the opportunity and trust placed in us as students. The warmth of the merchants was truly wonderful, and helping to improve their productive line really benefited us as future professionals.”

The Director of the Companies, Business and Entrepreneurship Center at INACAP Los Angeles Campus, Marieta Valdebenito, stated, “For us, it has been a completely enriching instance, especially because of the learning gained by our students. We hope to continue being a contribution to the community in the Biobio Province and we invite everyone to approach our campus and work with us.”

Next Steps

As a next step, it is suggested to implement a WiFi network maintenance program every three months, conducting stability and speed tests to ensure the continuous proper functioning of the infrastructure. Additionally, the possibility of expanding this initiative to other markets in the Biobio region will be evaluated, prioritizing those facing similar connectivity problems.

Additionally, future steps could include the evaluation of Wi-Fi 7 technology, given its superior performance and improvements over Wi-Fi 6E, particularly in environments with high user density and interference. As Wi-Fi 7 becomes more accessible, it could provide even higher data rates, better spectrum efficiency, and lower latency, making it an essential consideration for future deployments.

Lessons Learned

A significant challenge was the interference caused by the metal structures of the facility. To mitigate this issue, the access points were adjusted to less congested frequencies. Nighttime work was conducted to avoid interruptions to commercial activities. In future deployments, it is suggested to include a detailed evaluation of the environment's materials before installation, aiming to determine the optimal location for access points and minimize potential interferences.

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