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PTToI: Extended Streamlined Communication System for Communication and Electronics Service

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ABSTRACT

This study developed the Push-to-Talk over Internet (PTToI): Extended Streamlined Communication System for the Regional Communications and Electronics Unit 12 (RCEU12) of the Philippine National Police. The system addresses chronic communication delays caused by traditional radio equipment by integrating modern web technologies to provide fast, secure, and scalable real-time communication. Using React.js, Node.js, WebRTC, SignalR, Firebase Authentication, and OAuth 2.0, the PTToI platform enables low-latency voice transmission and efficient channel management across mobile and web environments. The system was deployed on Microsoft Azure and designed to support simultaneous users with stable performance. A descriptive-quantitative evaluation with 20 RCEU12 personnel assessed usability, functionality, accessibility, satisfaction, and acceptance. The PTToI system achieved an overall mean score of 4.73 (Excellent), reflecting strong user confidence, ease of use, and operational relevance. Despite challenges related to internet variability and limited testing time, the system demonstrated its capacity to enhance coordination, operational efficiency, and real-time communication among law enforcement personnel. The study highlights the potential of Internet-based PTT systems to modernize public safety communication and proposes future enhancements that may extend applicability to broader emergency response environments.

INTRODUCTION

Efficient communication is a core requirement of operational excellence in law enforcement and emergency response environments. Delays in continues sentence, channel congestion, and limited radio coverage hinder the swift deployment of teams and may compromise public safety. Technologies such as Push-to-Talk (PTT) have long served the communication needs of police units, emergency responders, and public safety organizations due to their immediacy and simplicity. However, traditional radio-based systems remain constrained by hardware limitations, high operational costs, and limited range.

Push-to-Talk over Internet (PTToI) systems emerged to address these challenges by integrating voice communication with modern internet infrastructure. PTToI extends traditional PTT capabilities by offering broader coverage, lower operational costs, and enhanced scalability. With the widespread availability of mobile data networks, smartphones, and cloud-based services, PTToI solutions now provide flexible and mission-critical communication channels capable of supporting highly mobile police operations.

RCEU12 of Police Regional Office 12 relies heavily on timely information exchange to coordinate responses, dispatch units, and manage emergencies. However, communication delays were frequently observed in their existing setup, resulting in compromised situational awareness and slower decision-making. Therefore, this study developed a PTToI system designed specifically for RCEU12, offering low-latency voice messaging, secure login mechanisms, multi-channel communication, and mobile accessibility.

This paper presents the system's technical foundations, design process, performance, and evaluation results based on a descriptive-quantitative approach. It also frames the PTToI system within the broader landscape of communication technologies and discusses its potential implications for future public safety communication modernization.

LITERATURE REVIEW

Related Literature

Modern emergency response and policing depend on robust communication systems capable of transmitting clear, accurate, and timely information (Rachmad, 2022). Conventional Land Mobile Radio (LMR) technologies such as VHF, UHF, TETRA, and P25 offer reliability and encrypted communication but require costly infrastructures and have limited scalability (Miller & Jensen, 2020). These limitations have encouraged the transition toward Internet-based PTT solutions (García *et al.*, 2020).

Push-to-Talk over Internet (PTToI) uses IP networks to transmit voice data using VoIP protocols, enabling real-time, wide-area communication without reliance on radio towers. PTToI offers enhanced interoperability (Antonio, 2021), ease of deployment, and reduced costs compared with LMR while supporting multimedia messaging, GPS tracking, and cloud-based management. However, PTToI systems also introduce challenges such as latency, packet loss, and dependence on network quality (Lee, 2023).

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These technological developments laid the foundation for PTToI systems that can leverage mobile data networks and cloud infrastructures.

Existing Push-to-Talk Technologies

Bearing these technical considerations, the comparison between traditional voice communication solutions and emergent ones is useful. The legacy technologies of LMR systems have influenced PTToI, which has resulted in platforms like TETRA and P25 (Ulema, 2019; Lee *et al.*, 2021). Although they are supposed to be interoperable, such systems are severely limited and expensive to operate on a daily basis (Ulema, 2019; Lee *et al.*, 2021). Based on VoIP, PTToI allows real-time interaction in the organizations and provides such functions as encrypted communication and compatibility with multiple networks (Fischer & Schmidt, 2019; Al-Fuqaha *et al.*, 2022). Such systems are inexpensive, scalable, and safe, though they need high-quality-of-service to deal with latency and bandwidth (Garcia *et al.*, 2020).

Table 1: Comparative Analysis of PTT Technologies

Technology	Network Type	Advantages	Challenges
LMR (VHF/UHF, TETRA, P25)	Dedicated Radio Frequencies	High reliability, encrypted communication, wide- area coverage	High infrastructure cost, limited interoperability, frequency licensing issues
PTToC (MCPTT, Carrier-Based PTT, OTT Apps)	Cellular Networks (3G/4G/5G)	Broad coverage, multimedia integration, cost- effective	Dependent on network availability, potential congestion
PTToI (Cloud- based & Software PTT)	Internet (Wi-Fi, Broadband)	Scalable, cost- efficient, cross- platform	Latency, QoS issues, requires stable internet

These developments are indicative of, a positive move toward IP-based PTT (Push-to-Talk) solutions like PTToI ("Voice Over Internet Protocol", 2007; "Enabling Next-Generation Public Safety Operations with Mission-Critical Networks and Wearable Applications", 2021). PTT allows users to send instant voice messages at a press of a button ("PoC radio", 2023), while PTToI, as shown in Table 1, provides the same options over the Internet. This approach is a combination of flexible internet communication and reliability required in critical use (Martinez, 2022). Among the major concerns of law enforcement PTToI are the minimization of latency, network redundancy, and the security level (Lee, 2023).

Push-to-Talk (PTT) technology evolved out of Land Mobile Radio (LMR) to Push-to-Talk over Cellular (PTToC) and Push-to-Talk over Internet (PTToI). Although LMR is consistently dependable, it can be quite expensive and interoperability can be a problem with LMR ("Voice Over Internet Protocol", 2007). In comparison, PTToI (which uses VoIP and encryption) provides affordable, secure, and real-time communication (Brown *et al.*, 2021; Martinez, 2022). Improving PTToI using IP-based protocols and QoS resolved communication gaps that facilitates the seamless integration with law enforcement networks (Lee, 2023).

Altogether, the analysis of PTT technologies forms the basis of the proposed PTToI system (García *et al.*, 2020; Lee *et al.*, 2021; Rani & Kumar, 2021). It aims to create a working PTToI application to RCEU12 through critical evaluation of the strengths and weaknesses of LMR, PTToC, and PTToI. Based on this understanding, the following part will look at the reality of applying PTToI to law enforcement and emergency services (Lee *et al.*, 2021).

PTToI in Public Safety and Law Enforcement

Several studies document the transition from traditional LMR to PTToI systems in law enforcement, firefighting, EMS, and disaster response. For example, Thompson (2022) found that PTToI systems enhanced situational awareness by enabling multi-group communication and rapid information dissemination. Similarly, Fitzgerald and Bruce (2023) observed that PTToI platforms support better interoperability between agencies, improving coordination during emergencies.

International research also shows that PTToI reduces the cost of communication infrastructure while expanding communication coverage, especially in countries with well-developed mobile networks (Nakamura & Sato, 2021). However, challenges such as cybersecurity vulnerabilities, server management, and dependency on network stability are frequently cited (Parker, 2023).

In the Philippine context, research discussing PTToI remains limited. Most available studies focus on radio communication or mobile data services, demonstrating a gap in literature regarding locally developed PTToI applications tailored to police operations. This study therefore contributes new empirical insights by building and evaluating a PTToI system suited to the needs and constraints of RCEU12.

MATERIALS AND METHODS

Methodology

The study employed a developmental research design supported by descriptive-quantitative evaluation. System development followed the Agile Software Development Life Cycle, allowing iterative construction, testing, and refinement based on user feedback.

The Agile Model of SDLC approach was applied in

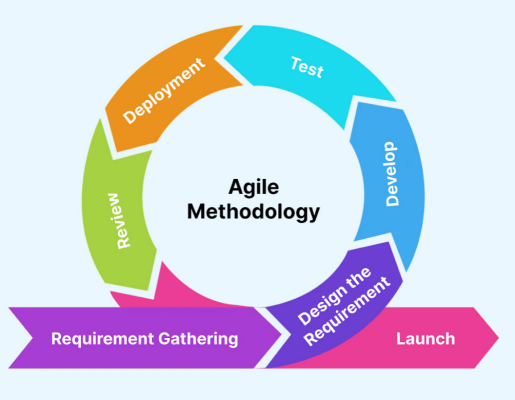

Figure 1: Agile Model of SDLC

the development of the PTToI application as shown in Figure 1. Agile was selected because it has several iterations, feedbacks, and constant improvement. The Agile methodology follows a structured sequence, starting with requirement gathering and progressing through requirement analysis, system design, develop, testing, deployment, review and launch. This fulfilled real-time communication requirements and resulted in a final platform that was stable.

Requirement Gathering

A case study of RCEU12 of PRO12 policies and workflow was conducted using interviews. This assisted in establishing the precise problems, particularly in communication between units and the stations. The defined features of the phase included customizable interface, instant and group communication, voice-to-text transcription, and broad compatibility of the network. These requirements formed the basis of alignment to the context of the operation of the system, which caused the process of setting the requirements to be rationale as discussed in the following section. Application requirements were established through studying the processes in RCEU12 so that system objectives were equal to operations. These relationships have a visual basis in the resulting context diagram.

The information flow and process logic of the PTToI

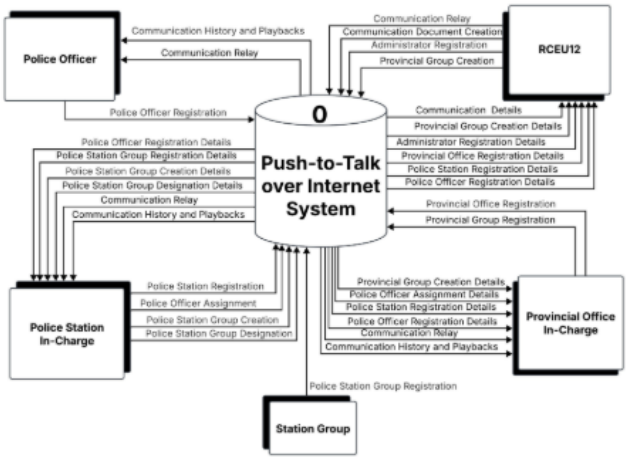

Figure 2: Context Diagram

application are described in a context diagram (see Figure 2) to facilitate the effective exchange of information.

Design the Requirement

Design the Requirement phase ensures that all specifications are met and prepares the system for development. The in-scope of this capstone study focused on developing a Push-to-Talk over Internet System for an Extended Streamlined Communication:

In-scope

- User authentication and session management
- Cross-platform Registration handling on PC; Voice Communication for Mobile
- Implementation of half-duplex voice messaging (only one user speaks at a time)
- Real-time voice transmission using Internet Protocol (IP)
- Communication over Wi-Fi or mobile data networks
- Encryption of voice data during transmission
- Communication History for Recent/Offline Voice Messages

Out-scope

- Simultaneous two-way voice communication (like phone calls) is not supported.
- No implementation of enterprise-grade security, like end-to-end encryption or biometric authentication
- The system will not support communication without internet connectivity.
- No integration with platforms like WhatsApp and Messenger
- The project is a prototype and will not be deployed for public or commercial use, but for the Police Regional Office 12.
- No voice recognition or translation features included

Figure 3 shows the RPOI12 Dispatch Console

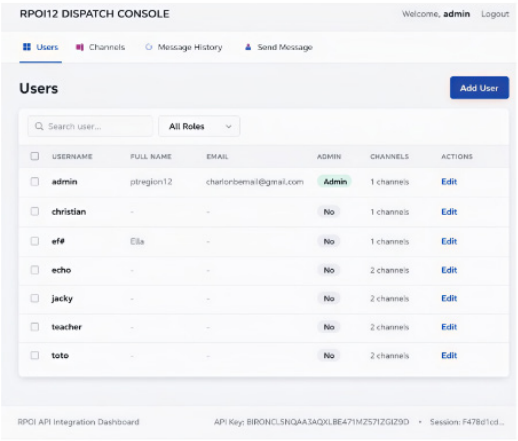

Figure 3: RPOI12 Dispatch Console Home Page

Home Page, the online control panel for the PTToI system. The console enables administrators to monitor communication channels, track user activity, and view message history in real-time.

Figure 4 illustrates a mobile prototype that indicates

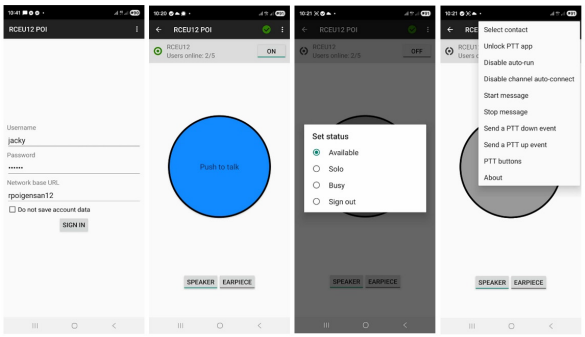

Figure 4: PTToI Mobile Application Interface

a simple PTToI application that will facilitate instant reliable voice communication. It shows the prudent design and key characteristics of a PTToI application intended to serve as a real-time communication tool to organizations (law enforcement and administrative units). It is also an effective instrument of instant and secure voice communication across the Internet due to its simplicity and efficiency.

The system is designed using the MVC (Model-View-Controller) design pattern on the right side. The Controller is in charge of communication with the user and communication logic, the View is an ASP. NET core backend, which has a SignalR real-time communication system and Firebase cloud message and user authentication. The View is an ASP.NET core backend with a SignalR real-time communication system and Firebase cloud message and user authentication. The infrastructure is installed on the cloud-based systems like Microsoft Azure, and it can support load balancing and scalability. The Model manages the in-persistent storage and processing with the help of Microsoft SQL Server, and other technologies like WebRTC, VoIP SDKs, and audio processing modules provide the dependable and effective transmission of voice. This full architecture is capable of providing a secure, real-time and scalable PTT communication system to fit law enforcement and field operations.

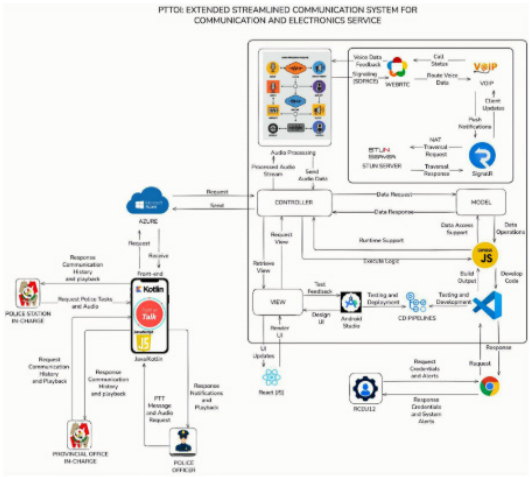

Figure 5: System Architecture

Development and Testing

During the stage of development and testing, we worked on creating, coding, and testing PTToI system. We developed the core modules including the user management, channel communication, message handling, and implemented an aspect of real-time connection through WebRTC and SignalR. React.js was used to create the frontend that provides the dispatchers and officers with a responsive and easy-to-use interface. Back end was developed using node.js and express which made it efficient in processing data, routing is secure and has the ability to scale.

Twenty (20) personnel from RCEU12 served as evaluators, including police officers, radio operators, and technical staff. These participants represented actual system users with direct involvement in communication operations.

Deployment

After the completion of the development and testing phase, the project went to the deployment phase during which the emphasis had moved to the validation phase to the rollout phase of the project. The PTToI system deployment phase transformed the project to a fully operational communication platform instead of a tested prototype. At this phase, we configured the environment to be deployed, integrated important technologies, and maintained stable user access. The back-end infrastructure was deployed in Microsoft Azure which was chosen due to its reliability, scalability and secure cloud platform. Azure App Services used were used to install the Node. js and Express.js server which handled the user accounts, authentication and routing voice data. Real-time push-to-talk functions were powered by WebRTC and SignalR,

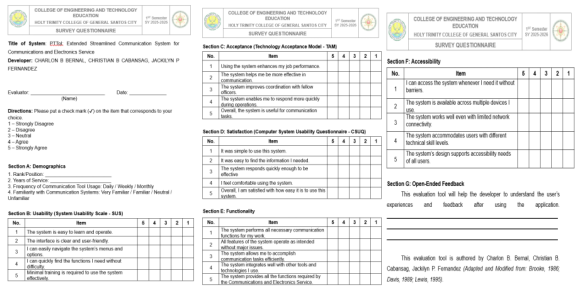

Figure 6: Evaluation Tools

and the STUN/TURN servers provided the smooth voice transmissions even with the different network conditions.

In order to test the functionality of the system, its performance, and reliability, we performed unit integration, and system testing. The researchers had to adapt the evaluation tool based on Brooke (1986), Davis (1989), and Lewis (1995).

Firebase Firestore manage real-time synchronized communication logs and user profiles and Firebase Authentication and OAuth 2.0 offered the users encrypted access and a log in. React.js web interface on the frontend was installed on Azure Web Apps to enable dispatchers to track channels, manage users, and control communication sessions.

CI/CD pipelines automated testing, integration, and updates, reducing downtime and ensuring stability. Pilot deployment at RCEU12 allowed officers to test the system in real-world conditions. This phase integrated cloud hosting, real-time voice streaming, and secure user control into a single system, achieving the PTToI objective of a safe, scalable, and responsive communication platform for law enforcement operations.

Review

Since the deployment stage was successfully ended and the PTToI system was fully functional, the project moved to the review stage, which acted as an intermediary between rollout and final launch. The PTToI review stage is a significant phase during which the system is considered attentively and feedback is evaluated. Major tasks verified whether the system was functioning as desired. The system tested to ensure it addressed the project objectives, examined its capabilities and functionality, and collected user responses. The system was tested by end users, with feedback provided by RCEU12 staff, police officers, and administrators. Their feedback assisted in identifying usability problems and enhancing the user interface. The team also monitored performance to ensure necessary standards. Several updates were made according to the learnt, and through teamwork and continuous upgrades, the team designed a more reliable and effective PTToI System.

Launch

At the end of the review cycle, the project entered the launch stage, introducing the PTToI system to end users.

As the last phase of the agile methodology, launching was the culmination of the cycle, supported by a well-planned implementation process that ensured successful rollout without hitches.

An implementation plan was created to organize the transition from development and testing to real-world use. It served as a roadmap, telling the story of how the project developed from an idea into a working system, and enumerating the activities, schedules, duties, and materials required to bring the PTToI system to completion.

RESULTS AND DISCUSSION

This chapter provide the findings of the analysis of Push-to-Talk over Internet (PTToI) system- a technology that provides the users to send and receive voice messages through the internet in a manner of a walkie talkie but using digital networks. The test was conducted to RCEU12 and PRO12. They were given a structured questionnaire, three of them were the System Usability Scale (SUS, evaluated user-friendliness), Technology Acceptance Model (TAM, user acceptance of new technology), and Computer System Usability Questionnaire (CSUQ, user satisfaction survey). The system aspects were rated on a five-point Likert scale by the respondents (Boone *et al.*, 2012).

The following are the raw survey responses collected from 20 personnel of RCEU12 and PRO12 dated October 2-3, 2025. Each item was rated on a 5-point scale:

5 – Strongly Agree
4 – Agree
3 – Neutral
2 – Disagree
1 – Strongly Disagree

These responses are compiled in Table 2, and form the basis for the subsequent evaluation.

System Evaluation Results

Table 2: Survey Questionnaire Summary

Section	Item	Respondent 1	Respondent 2	Respondent 3	Respondent 4	Respondent 5	Respondent 6	Respondent 7	Respondent 8	Respondent 9	Respondent 10	Respondent 11	Respondent 12	Respondent 13	Respondent 14	Respondent 15	Respondent 16	Respondent 17	Respondent 18	Respondent 19	Respondent 20	Average
Usability	**Section Mean**																					4.72
Usability	Item 1	4	5	5	5	5	5	5	5	5	5	5	5	4	5	4	5	4	5	5		4.85
	Item 2	3	5	4	5	4	4	5	5	3	4	5	5	5	5	4	5	5	5	5		4.55
	Item 3	3	5	5	5	5	5	5	5	5	5	5	5	5	5	4	3	5	5	5		4.75
	Item 4	4	5	5	5	4	5	5	5	5	5	5	5	5	3	5	5	4	5	5		4.75
	Item 5	4	5	5	5	5	5	5	5	4	4	5	5	5	5	2	5	5	5	5		4.7
Acceptance	**Section Mean**																					4.78
Acceptance	Item 1	4	5	5	5	5	5	5	5	3	5	4	5	5	4	4	4	5	5	5	4	4.6
	Item 2	5	5	5	5	5	5	5	5	5	5	5	5	5	4	5	5	5	5	5	4	4.9
	Item 3	5	5	5	5	5	5	5	5	5	4	4	5	4	5	3	5	5	4	5	5	4.7
	Item 4	5	5	5	5	5	5	5	5	4	5	5	5	5	4	5	5	5	4	5	4	4.8
	Item 5	5	5	5	5	5	5	5	5	5	5	5	5	4	4	5	5	5	5	5	5	4.9
Satisfaction	**Section Mean**																					4.83
Satisfaction	Item 1	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
	Item 2	5	5	5	5	5	5	5	5	5	4	5	5	4	5	4	5	5	5	5	5	4.85
	Item 3	4	5	5	5	5	5	5	5	5	4	5	5	4	5	3	4	5	5	5	5	4.7
	Item 4	5	5	5	5	5	5	5	5	5	5	5	5	5	4	5	5	4	5	5	4	4.85
	Item 5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	5	5	4	5	5	4	4.85
Functionality	**Section Mean**																					4.5
Functionality	Item 1	4	5	5	4	4	4	5	5	5	5	4	5	5	4	4	5	5	4	5	4	4.55
	Item 2	4	5	4	3	4	5	5	5	3	5	4	5	5	5	3	4	4	5	5	4	4.35
	Item 3	4	5	4	4	5	5	5	5	4	4	4	5	5	5	4	5	5	5	5	4	4.6
	Item 4	4	5	4	4	4	4	5	5	5	5	4	5	5	4	3	5	5	4	5	4	4.45
	Item 5	4	5	4	4	3	4	5	5	5	5	4	5	5	4	5	5	4	5	5	5	4.55
Accessibility	**Section Mean**																					4.97
Accessibility	Item 1	5	5	5	5	5	4	5	5	5	5	4	5	5	4	4	3	5	5	5	5	4.7
	Item 2	4	5	5	5	5	5	5	5	5	5	4	4	5	5	4	3	5	5	5	5	4.7
	Item 3	4	5	5	4	5	5	5	5	5	5	5	4	5	5	4	3	5	5	5	5	4.65
	Item 4	5	5	5	5	5	5	5	5	5	4	4	5	5	4	3	4	5	4	5	4	4.6
	Item 5	5	5	5	5	5	5	5	5	5	4	4	5	5	4	3	5	5	5	5	4	4.7

In order to increase the transparency and smoothness, the main evaluation dimensions show the results of the survey. The discussion begins with usability and moves to acceptance, satisfaction, functionality, and accessibility, with each dimension building upon the previous findings. Tables 3 to 7 present the computed mean scores for each item in the survey. These results provide insights into the overall performance of the system, highlighting both strengths and areas that may benefit from future enhancements.

According to the results of the study, the usability of the PTToI system is very high, which is why interaction

Table 3: System Usability Scale (Mean = 4.72, Excellent)

Section 1: Usability (To evaluate the PTToI system provides a user-friendly and intuitive experience)		**Mean**	**Interpretation**
Item 1	The system is easy to learn and operate.	4.85	Excellent
Item 2	The interface is clear and user-friendly.	4.55	Excellent
Item 3	I can easily navigate the system's menus and options.	4.75	Excellent
Item 4	I can quickly find the functions I need without difficulty.	4.75	Excellent
Item 5	Minimal training is required to use the system effectively.	4.70	Excellent
Total Mean		4.72	Excellent

through a friendly interface is possible. The easy flow of navigation, positioning of the buttons and layout of the menu allows a quick access to the fundamental functions. These interface features align with the major principles of usability that are critical to law enforcement communication equipment. As Kaya, Ozturk, and Altin Gumussoy (2019) put it, the usability as indicated by SUS and other tools is extremely relevant in the design of a mobile application. Therefore, the level of users satisfaction can be seen by the fact that the average score of this section was 4.72.

The acceptance score can be used to trace concrete evidence of the user intent and willingness to use the PTToI system. Active voice, secure authentication, and

Table 4: Acceptance (Mean = 4.78, Excellent)

Section 2: Acceptance (To determine if the PTToI system is practical and acceptable for official use within RCEU12)		**Mean**	**Interpretation**
Item 1	Using the system enhances my job performance.	4.60	Excellent
Item 2	The system helps me be more effective in communication.	4.90	Excellent
Item 3	The system improves coordination with fellow officers.	4.70	Excellent
Item 4	The system enables me to respond more quickly during operations.	4.80	Excellent
Item 5	Overall, the system is useful for communication tasks.	4.90	Excellent
Total Mean		4.78	Excellent

having an effective interface were mentioned by the respondents as reasoning in favor of wide applicability on RCEU12. This is in agreement with the variables listed by the Sorce and Issa (2021) in the Extended Technology Acceptance Model (TAM) indicating that perceived usefulness and ease-of-use are important in influencing technology acceptance in an organizational context. The mean value was 4.78.

The respondents gave high ratings to the PTToI system in terms of responsiveness, uptime and voice communication and voice communication was observed to be accurate as compared to fluctuation in bandwidth.

Table 5: Satisfaction (Mean = 4.84, Excellent)

Section 3: Satisfaction (To assess users are pleased with their experience using the PTToI application)		**Mean**	**Interpretation**
Item 1	It was simple to use this system.	5.00	Excellent
Item 2	It was easy to find the information I needed.	4.85	Excellent
Item 3	The system responds quickly enough to be effective	4.70	Excellent
Item 4	It was felt comfortable using the system.	4.85	Excellent
Item 5	Overall, I am satisfied with how easy it is to use this system.	4.85	Excellent
Total Mean		4.84	Excellent

The findings are the reflection of analysis patterns of user experience that emphasize reliability and quality of communication in the design of mobile applications (Sabukunze and Arakaza, 2021). Section 4 has shown a mean of 4.84 that validates the usefulness of RCEU12 in enabling secure internal communication.

Fundamental communication functions are executed with a high level of reliability on this system and real-time transmission of voice with multiuser authentication and channel administration were permitted. There were also

Table 6: Satisfaction (Mean = 4.84, Excellent)

Section 4: Functionality (To evaluate and verify that all essential functions work as designed and meet user requirements.)		**Mean**	**Interpretation**
Item 1	The system performs all necessary communication functions for my work.	4.55	Excellent
Item 2	All features of the system operate as intended without major issues.	4.35	Excellent
Item 3	The system allows me to accomplish communication tasks efficiently.	4.60	Excellent
Item 4	The system integrates well with other tools and technologies I use.	4.45	Excellent
Item 5	The system provides all the functions required by the Communications and Electronics Service.	4.55	Excellent
Total Mean		4.50	Excellent

sub second audio transfer. In a bandwidth constrained setting, minor latency may be experienced nonetheless without compromising security habits and following the reliability standards. These results support the evidence of other studies that point to the importance of usability and functionality in adopting technology (Camilleri, Troise, and Kozak, 2023). The average score in the section was 4.50 which concurred with the other positive dimensions scores.

The accessibility scored high as the users were able to access the channels through laptops and mobile devices through a normal internet connection. RCEU12 was characterized by operations that were safe, stable and scalable. The findings provide best practice in mobile

Table 7: Accessibility (Mean = 4.67, Excellent)

Section 5: Accessibility (To ensures that the PTToI system remains available and functional regardless of the user's location or internet connectivity.)		**Mean**	**Interpretation**
Item 1	I can access the system whenever I need it without barriers.	4.70	Excellent
Item 2	The system is available across multiple devices I use.	4.70	Excellent
Item 3	The system works well even with limited network connectivity.	4.65	Excellent
Item 4	The system accommodates users with different technical skill levels.	4.60	Excellent
Item 5	The system's design supports accessibility needs of all users.	4.70	Excellent
Total Mean		4.67	Excellent

application design in the accessible form in which cross-device compatibility and consistency of user experience are crucial (Chandarana and Gada, 2024). The average of 4.67 was in line with other positive ratings.

The overall assessment score of 4.73 (Excellent) represents a very impressive fact according to the core criteria of performance, providing all five core criteria consistently, with each of the core criteria scoring above the excellent level on the weighted-mean interpretation scale. PTToI demonstrated all its superiority: it offered a convenient interface with a friendly operation-friendly

Table 8: System Evaluation - Overall Results

Usability	4.72	Excellent
Acceptance	4.78	Excellent
Satisfaction	4.84	Excellent
Functionality	4.5	Excellent
Accessibility	4.67	Excellent
Overall Weighted Mean	4.73	Excellent

benefits in daily use and offered great functionality at the same time, guaranteeing and supporting access on the broad level. According to the users, this system is simple to learn and use, it enhances coordination of communication, and offers dependable responsiveness in any case of network conditions, and it is usually available in multiple devices. All these combined strengths resulted in a perfect assessment point in general. The feedback on all the evaluation dimensions has been positive and consistent and, therefore, serves to demonstrate the technical soundness of the system, user-friendliness of the design, as well as readiness to operate to meet all the requirements and expectations of RCEU12.

CONCLUSIONS

This paper designed and tested the Push-to-Talk over Internet (PTToI) system for the Regional Communications and Electronics Unit 12 (RCEU12) of the Philippine National Police (PNP), aiming to improve communication efficiency. The system enables

faster message delivery, stable connections, and secure, encrypted real-time voice communication.

Evaluation results confirm PTToI's effectiveness in law enforcement missions. WebRTC supports browser-based audio, Firebase ensures secure authentication, and React. js provides a responsive interface for coordination. These features justify the system's excellent ratings in reliability, mobility, and secure data handling, making it a viable replacement for traditional radio systems.

The system aligns with RCEU12's operational requirements, enabling direct field-to-command communication and serving as a technical reference for IT curricula. Recommendations include: PRO12 adopting PTToI to enhance security and reduce costs; RCEU12 sustaining development through modernization and assessments; police officers receiving thorough training; Holy Trinity College integrating the study into IT programs; and future researchers exploring AI-driven voice analysis, offline messaging, and IoT integration.

In summary, PTToI is secure, scalable, and user-friendly, strengthening teamwork, information sharing, and operational effectiveness. Its implementation offers a model for advancing police communication and academic study.

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