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ATM Network Infrastructure Migration Strategy from Bank to PT XYZ

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Abstract.
Purpose: This study addresses PT XYZ's technical challenges in optimizing the Automatic Teller Machine (ATM) network infrastructure, which caused service disruptions and customer complaints during the initial pilot migration. The research aims to solve the network availability problem by designing a reliable migration strategy, thereby improving service quality and strengthening partnerships with banks.
Methods: A qualitative case study analysis was conducted, combining stakeholder interviews with technical evaluations. The Data Center WAN zone deployment followed the waterfall methodology for structured network and security appliance implementation, while remote ATM migrations used an incremental approach. Service Level Agreement (SLA) metrics were monitored to measure performance.
Result: The solution improved the ATM network average SLA from 98.31% to 99.53%. Stakeholder feedback confirmed the effectiveness of the phased migration and enhanced operational reliability. This demonstrates the benefit of direct ATM WAN network re-engineering in eliminating legacy infrastructure complexity.
Novelty: The study provides actionable benchmarks for ATM network implementation, including phased migration steps combined with high availability WAN topology. The implementation and migration method presents a replicable model for similar financial institutions in emerging markets.

Keywords: ATM, IT network migration, WAN, Waterfall, Incremental migration
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INTRODUCTION

In the face of rapidly expanding digital transactions, Automatic Teller Machines (ATM) continue to play a significant role in Indonesia. ASPI has published statistics showing that the number of debit card transactions has remained consistently high over the years [1]. From its beginning, ATM has evolved into an essential resource for customers, facilitating many financial transactions, including cash disbursement and account balance checks. However, these services heavily depend on the underlying network infrastructure, defined as hardware and configuration protocol connecting ATMs to the controller server [2]. As ATM operate in a wide range of environments, from urban to rural areas, designing the appropriate and secure network infrastructure becomes crucial [3], [4].

This study presents a case study of PT XYZ, a financial switching company in Indonesia. PT XYZ helps banks reduce their Total Cost of Ownership (TCO) by managing their ATMs. Previously, banks managed the entire ATM system, premises, and network infrastructure independently. The project began with a pilot migration involving 224 ATMs, utilizing the existing network infrastructure. This pilot was implemented from June to August 2023 and spread across Java Island, Indonesia. Specifically, this pilot migration was installing a new ATM Application and changing ATM controller servers from the Bank's Data Centers to controller servers developed by PT XYZ within PT XYZ's own Data Centers. The outcome of this piloting phase was that the network Service Level Agreement (SLA) target of 99.6% was not achieved. Instead, an average performance of only 98.31% was recorded over the subsequent six months (September 2023 – February 2024) (see Figure 1). This failure resulted in increased customer complaints and a decline in daily transaction volumes, highlighting the operational risks of infrastructure transitions.

Previous research has explored various network technologies relevant to ATM operations and IT migrations, though with specific limitations concerning our study's focus. Firstly, studies on ATM network

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connectivity and redundancy have investigated approaches such as adding secondary connections by combining single VSAT providers with additional 4G/LTE links [5] and exploring the feasibility of replacing satellite communication with Machine-to-Machine (M2M) mobile networks [6]. Secondly, work has been conducted on WAN network migration and SDWAN implementation, detailing the design and migration of corporate WAN networks from traditional setups to SDWAN technology [7], [8]. Furthermore, research on general network redundancy and service provider evaluations has focused on ensuring proper network resilience for corporate environments [9]. Despite these valuable contributions, a critical research gap remains unaddressed: these works do not address the unique challenges involved in transferring ATM network ownership from banks to third-party partners. This specific transition introduces complexities related to improving existing WAN network DC infrastructure for enhanced robustness and proper capacity planning, managing diverse network transmission services offered by telecommunication providers, and ensuring seamless operational continuity during handover.

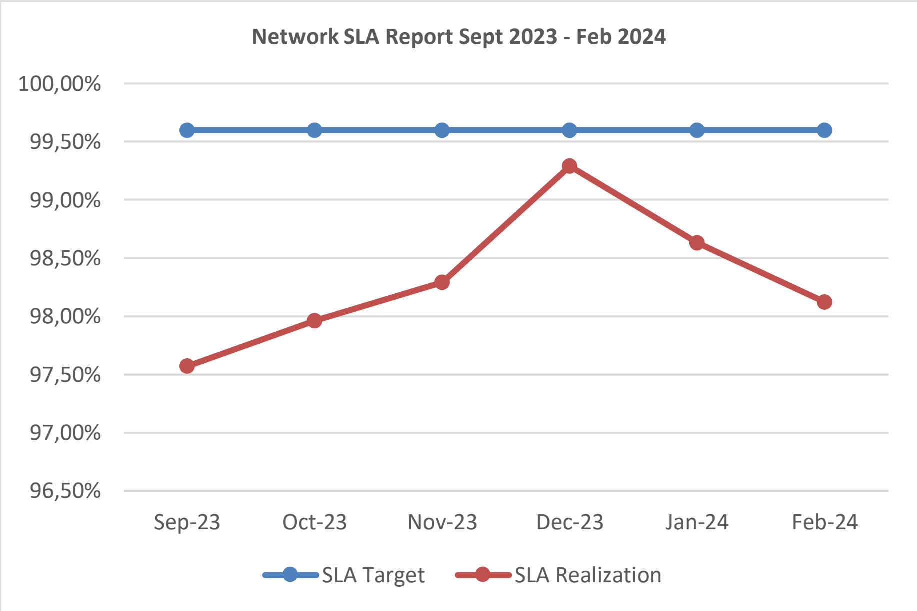

Figure 1. ATM network SLA performance report September 2023 – February 2024

This paper aims to present a comprehensive preparation for ATM network migration by developing the existing IT network infrastructure. To leverage business opportunities, the ATM network needs to be improved to gain the confidence of bank executives and maintain their trust in PT XYZ's ability to manage the ATM network. The research employs qualitative methods beginning with direct observation, followed by interviews with key stakeholders. These methods enable thorough problem identification and subsequent validation of proposed solutions through stakeholder feedback.

This research contributes to the field of information technology infrastructure by creating a migration strategy using a phased / incremental method for ATM network transitions combined with redundant WAN design, an area that has received limited attention in emerging markets. The study identifies optimal steps to minimize operational risks and enhance efficiency during ownership transfers from banks to PT XYZ. Practically, the findings provide a strategy for seamless transitions, ensuring service continuity while addressing critical pain points such as network availability and reliability. The strategy's applications extend beyond PT XYZ, serving as a benchmark for similar ATM or branch network migrations in Indonesia's financial sector.

METHODS

This paper is structured as follows: First, it examines the current state of ATM networks. Second, it analyzes the system requirements to determine IT needs. The design and deployment of the network infrastructure are then detailed, followed by the migration activity. Migration strategies in the context of an IT project offer three options: Big Bang, Parallel, and Incremental (Phased) migration [10]. Factors such as the criticality of services, downtime tolerance, resource availability, and the complexity of the infrastructure are key factors in determining the most suitable strategy [11], [12]. The Big Bang strategy involves a rapid, all-at-once transition [12]. Parallel migration means the simultaneous operation of both the old and new systems during the migration period [13]. On the other hand, incremental migration supports a gradual, step-by-step implementation [14]. Adopting this incremental method for ATM network migration means that the transition is not executed simultaneously across all locations but proceeds sequentially, moving from one location to the next. This phased approach empowers the project team to implement necessary adjustments at each migration stage based on real-world experience [15].

This study adopted a qualitative case study approach to investigate the ATM network infrastructure migration process. This methodology was chosen over experimental or modeling methods due to the real-world problem within PT XYZ's specific operational context. The approach, conversely, allowed for an in-depth analysis of organizational roadmap & system requirements, revealing the "how" and "why" behind migration decisions and outcomes that quantitative approaches might overlook. This involved collecting data through interviews with key stakeholders and internal company documents to identify issues and analyze requirements, complemented by direct observation of the infrastructure and migration activities [8], [16]. Interviews were conducted with key stakeholders SVP of IT and Product Managers. Data validation was performed with the Head of IT Network to ensure the validity and recommendation of the research.

AS-IS State

PT XYZ operates a payment network that electronically routes and authorizes payment transactions between different financial institutions. For instance, when customers transfer funds from one bank to another via ATM, the transaction data flows through PT XYZ. The connection between Bank Core Systems and PT XYZ's Core Banking Switching (CBS) system was established initially (see Figure 2) via the Data Center (DC) Extranet network zone used for host-to-host connectivity. Initially, ATMs connect to the ATM controller server within the bank's Data Center. At that time, PT XYZ was already supporting the bank with ATM physical machine maintenance only; the bank team still manages the ATM application, including the ATM Controller and all of the network infrastructure components.

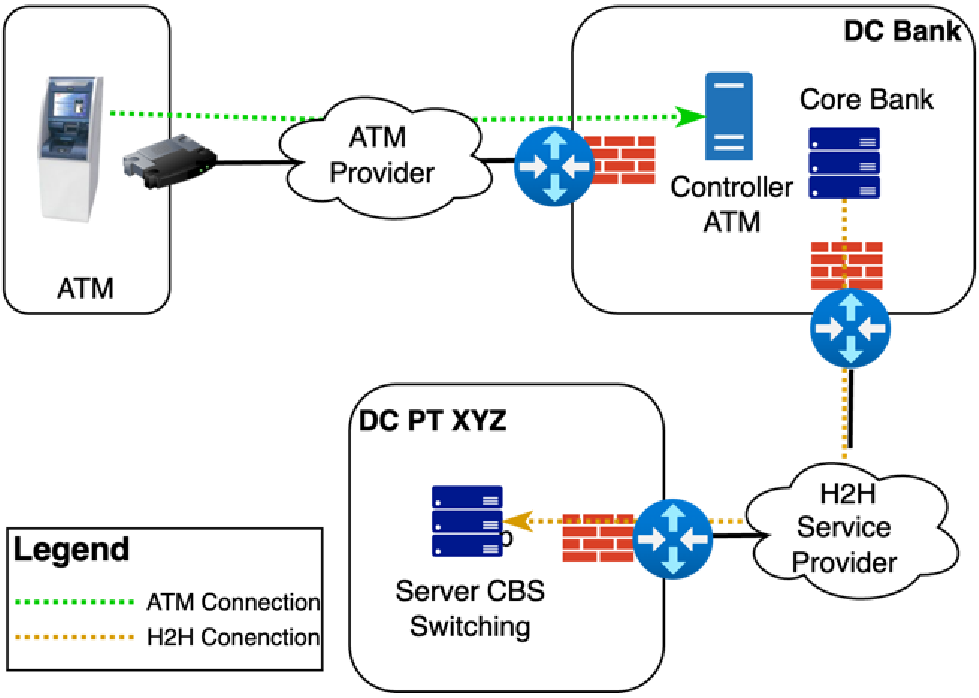

Figure 2. Existing network infrastructure

The transition of ATM migration started with a focus on migrating the ATM platform system only. The activity involved reconfiguring the operating systems and applications on the ATMs. Following this reconfiguration, the ATMs were then connected to the ATM controller server located within PT XYZ's DC, as shown in Figure 3. This action effectively transfers the ATM system functionality to PT XYZ, leveraging the developed ATM Controller Server for use by the Bank.

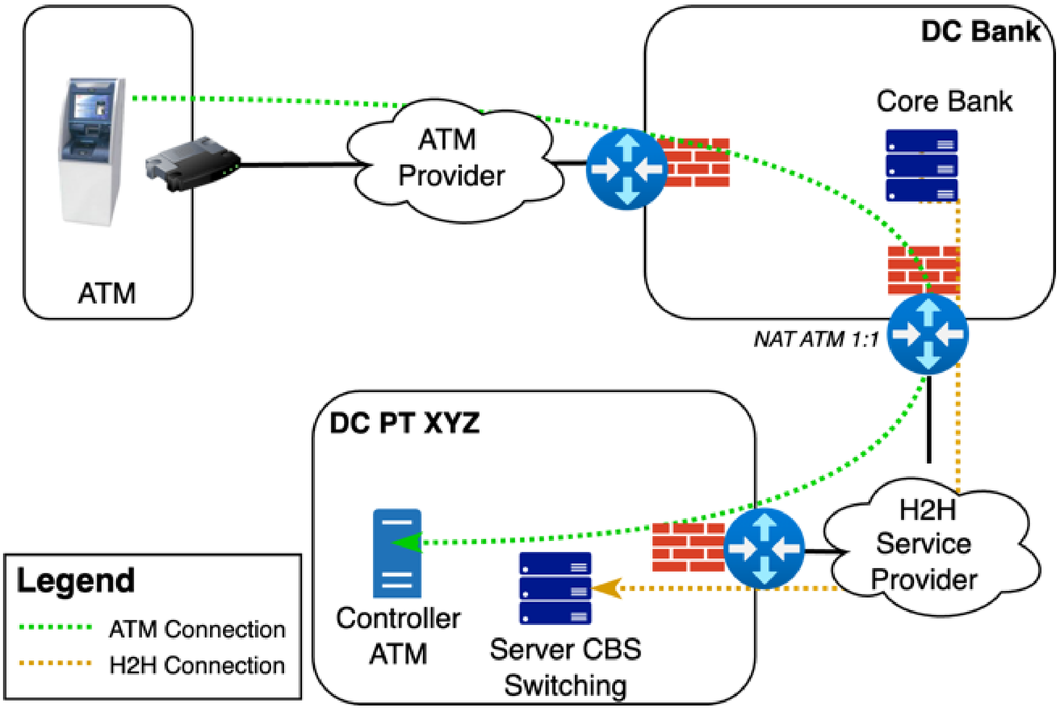

Figure 3. Transition stage network infrastructure

However, during this transition stage, the ATM network infrastructure remains managed by the Bank. Consequently, the communication path between the ATMs and the controller server did not directly route to PT XYZ's DC. Instead, it transits the Bank's DC before reaching the server at PT XYZ's facilities. To accommodate this interim arrangement, Router was implemented at the bank's DC to perform 1:1 Network Address Translation (NAT) of the ATM IP addresses. The purpose of NAT implementation is to prevent IP address conflicts with PT XYZ's existing network.

System Requirement

In operating the ATM service for banks, discussions with the Product Manager team explained that the new system's advantage lies in the implementation of the Bank 4.0 concept. According to Brett King, one of the benefits of Bank 4.0 is to facilitate the availability of banking services in real-time and seamlessly integrated into customers' daily activities [17]. Financial services, including ATMs, should prioritize customer experience and be embedded within the technologies utilized in everyday life. The data communication requirements for the ATM system platform can be categorized into the following types:

1) Transaction Data: This data information related to each transaction performed by a customer at the ATM.
2) Electronic Journal (EJ) and logs: The EJ provides a detailed record of every activity or transaction conducted by a customer at the ATM. EJ and ATM logs are transmitted in real-time to the server. This information is valuable for auditing, analysis, and troubleshooting to reduce complaint resolution time.
3) CCTV Snapshot: A CCTV snapshot is captured for each customer transaction at the ATM. The data should be available on a next-day basis by the Bank's operations team.
4) Endpoint Management: The function facilitates remote ATM operation and maintains the security and integrity of the ATM's Operating System (OS). This function includes access management, automation of routine tasks such as system maintenance, user management, and other configuration changes.

TO-BE Design & Deployment

The main problem with the existing condition was that the ATM was not directly connected to PT XYZ's DC. Figure 4 shows the proposed topology based on the existing condition that most of the connectivity was using a traditional network. To facilitate a smooth transition, the design allows for two environment options: a traditional WAN and SD-WAN environment will coexist by design, as existing networks will remain in use under certain conditions [18]. This paper details the deployment of the WAN network zone with a traditional router, while SDWAN router development is planned for 2026.

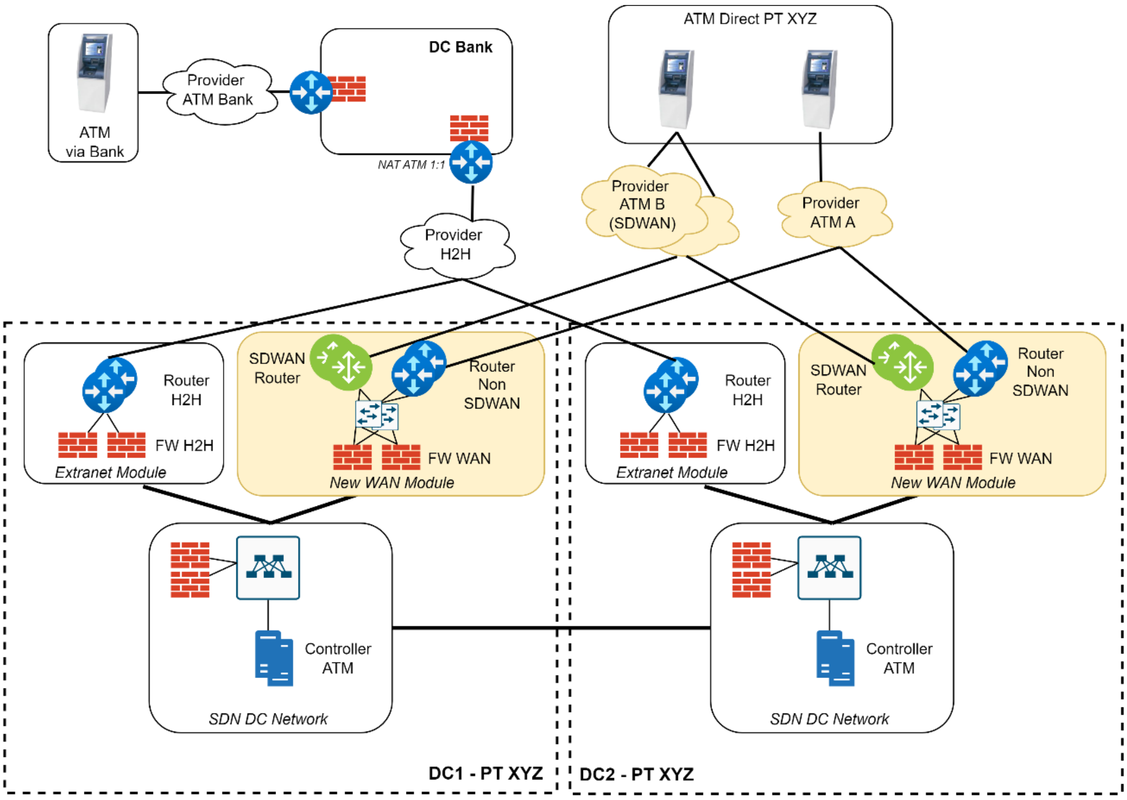

Figure 4. ATM network existing and new topology

Table 1. New WAN Module Network Infrastructure Device

Device	Model	Specification
Router Cisco	C8500-12X	12-Port 1/10G SFP+ Port, *Multicore* Intel X86 CPU, 4M IPv4/IPv6 Routes with 16GB RAM
Switch Cisco	C9300X-12Y-E	12-Port 1G/10G /25G SFP port, with 1Tbps switching capacity
Firewall Fortinet	Fortigate 1801F	25-port 1G/10G, 164 Gbps IPv4 throughput. 10.000 FW policy

Each ATM connects to PT XYZ's DC through a new WAN zone. This topological design provides each ATM with two available network communication options. ATMs can utilize a non-SDWAN network exclusively, or they can combine two types of network transmission and be configured with SD-WAN concurrently to enhance high availability, as demonstrated by Andromeda in their ATM implementation [5]. Each service provider connects to both DCs using an active-active network configuration. This configuration enables ATMs to dynamically adapt and connect to the active server.

The following Table 1 is a list of the new devices implemented as a hub for a WAN ATM network. Devices and connectivity were configured with a fully redundant 1:1 design between DC 1 and DC 2. After the deployment of routers in each DC as a hub, service provider backhaul links were integrated. At the routing level, hub-and-spoke connectivity utilizes the BGP dynamic routing protocol. Firewall was configured with active-standby. Transparent mode was applied to the Firewall to enable all connectivity between ATMs to Servers can use dynamic routing combining BGP for WAN and OSPF for internal DC routing protocol.

To ensure the integrity, confidentiality, and availability of financial transactions within this design, the underlying architecture adheres strictly to industry-leading security standards and best practices. Network architecture design, particularly in financial services, inherently demands high levels of security and reliability. In this context, the Payment Card Industry Data Security Standard (PCI-DSS) serves as an indispensable foundation for every entity involved in payment card processing, including PT XYZ's ATM network operations. This standard mandates that all systems storing, processing, or transmitting transaction data must follow security requirements, from the ATMs themselves to the entire network infrastructure connecting them to servers and banking systems. PCI-DSS v3.2.1 outlines six key data security and network categories, encompassing the establishment and maintenance of firewalls, protection of stored and transmitted data, vulnerability management, strong access control implementation, regular network monitoring and testing, and comprehensive information security policies [19]. Consequently, strict network segmentation between Card Data Environment (CDE) traffic and non-CDE traffic, as well as between production and development environments, becomes crucial. This is achieved through physical or logical segmentation with firewall policies or Access Control Lists (ACLs).

To ensure PCI-DSS compliance and establish a multi-layered defense against evolving cyber threats, Cisco SAFE (Security Architecture for Enterprise) was adopted as a comprehensive network security architecture guide. The Cisco SAFE approach emphasizes implementing security controls across every layer of the network, from the ATM endpoint, through the WAN communication path, up to the Data Center [20]. To accommodate this requirement, private leased-line providers over the Internet were chosen to ensure end-to-end connectivity is adopted. Within the Data Center, robust network segmentation with layered Next-Generation Firewalls (NGFW) for inter-segment traffic inspection, and strict ACL implementation on routers and switches to restrict unnecessary communication are essential to isolate the production CDE environment and minimize lateral movement by attackers. The architectural design detailed in this study, with its strict adherence to these rigorous standards, not only provides a secure and compliant framework for such migrations but also actively mitigates risks related to data exposure and operational discontinuity during handover. Thus, this proposed architecture not only addresses PT XYZ's specific challenges but also serves as a blueprint and benchmark for other financial institutions, particularly in ensuring security and compliance with bank environments.

New devices in the WAN zone were implemented using the waterfall methodology as shown in Fig. 4 with a yellow highlight. This methodology was selected for its structured, sequential nature, which suits a development approach with well-defined requirements and needs [21]. This approach was particularly suitable given that the scope, timeline, and precise requirements for implementing these network devices and firewalls were identified before the project was started. Its structured progression allowed for detailed planning and design, which is crucial for foundational network components. As a result, this helped reduce risks related to ensuring stability and best practice setup for critical financial infrastructure, minimizing potential service disruptions during deployment. In contrast, the Agile approach could be considered if rapid iteration and user feedback require dynamic adaptation during the project [22]. The following Table 2 is a comparison between the Waterfall and Agile methods.

Table 2. Waterfall & Agile comparison

Feature	Waterfall	Agile
Requirement	Well-defined, stable, and predictable at the start	Evolving, dynamic, iterative
Approach	Structured, sequential planning and execution	Adaptive, rapid iteration, flexible
Timeline	Strict	Loose
Risk Mitigation	Ensures stability, minimizes disruption, detailed setup	Prioritizes time to market, rapid feedback

Migration Strategy

Following the completion of the ATM WAN zone infrastructure development, the ATM network migration process was conducted using a phased (incremental) migration method. The effectiveness of this phased migration strategy has been demonstrated by Pratiwi in their implementation of SD-WAN branch routers [7]. In the first migration phase, there are 1200 ATMs have been migrated. The migration activity of the ATM network from its existing configuration via bank to a direct connection managed by PT XYZ involves the following four steps:

1) Preparation: Inventory of existing ATM data, including device information, location, and network connectivity details.
2) Choose Service Provider: Analysis of existing conditions to determine the optimal service provider strategy for migration.

3) Migration activity: Installation and configuration on remote sites.
4) Testing & monitoring: Network connectivity and application/transaction tests.

When choosing service providers to support the ATM network migration, several key considerations are crucial, as summarized in Table 2. Terrestrial networks, primarily suitable for ATMs in permanent locations such as bank branches, offer greater stability and bandwidth, along with low latency [23]. However, their limited coverage presents a significant drawback, restricting their use in geographically separated or less accessible areas. As another option, satellite networks (VSAT) can provide wide coverage, enabling connectivity in rural areas not covered by cellular radio or terrestrial infrastructure [24], [25]. While this reach is a key advantage, satellite communication introduces higher latency and is sensitive to weather-related interference, particularly during heavy rainfall [26] Alternatively, Machine to Machine (M2M)/Cellular Radio solutions offer quick installation and cost-effectiveness, making them suitable for ATMs with a high frequency of relocation, like ATMs in a vehicle [27], [28]. In scenarios where bandwidth guarantees are essential, Guaranteed-Bit Rate (GBR) offers a valuable option [29].

ATM network installations can proceed through two options: either by utilizing the existing service provider, then rerouting connectivity directly to the PT XYZ DC with new IP addresses, or by performing a new network installation. When utilizing the existing service provider, the migration activity is relatively efficient, requiring only 1 - 3 hours per location. On the other hand, new installations require deployment times as detailed in Table 3.

Table 3. Service provider consideration

Technology	Criteria	Advantages	Disadvantages	New Installation Time
Terrestrial Network	High Critical	Greater stability	Limited Coverage	14 – 30 Days
	High transactions	High Bandwidth	Less Mobility	
	Permanent location	Low latency		
Satellite / VSAT	Rural Area	Wide coverage area	High latency	5 – 7 Days
	Not covered by cellular radio/terrestrial	Independent Communication	Sensitive to bad weather	
			Limited Bandwidth	
M2M / Cellular Radio	High frequency of moving location	Quick Installation	Signal tends to be unstable	1 Day
	Difficulties with cable laying or antenna installation permits	Low Cost	without (GBR), bandwidth is shared with cellular phones	

RESULTS AND DISCUSSIONS

This chapter presents the research results and a detailed discussion. The results consist of the network devices' condition after migration and the end-to-end connectivity status. At the end of the chapter, we present a discussion of the important findings.

Device Resource Usage

Network performance evaluation shows that there is only a small increase in resource usage from the new installation compared with the migration of 1200 remote ATM connections. Table 3 shows CPU & memory usage before and after migration. The capacity planning for this study is designed to handle approximately 50,000 ATM locations across all cities in Indonesia. To further validate this capacity, the Cisco Router possesses a maximum routing table capacity of 4 million routes, which far exceeds the needs for 50,000 individual ATM routes. Similarly, the Firewall can handle up to 12 million concurrent sessions and process 750,000 new sessions per second, even when Next Generation Firewall policies and IPS functions are enabled. Figure 5 also indicates that the approximately 6000 sessions required for 1200 ATMs, and their associated Firewall memory consumption, are sufficient to accommodate planned ATM connections. This data, alongside the low current resource utilization shown in Table 4, proves that the new WAN network devices have sufficient capacity to support the anticipated growth in the number of ATM locations.

Table 4. Device resource usage

Device	CPU			Memory		
	Before	After	Increase	Before	After	Increase
Router Cisco	0,001%	0,09%	0,08%	11,51%	11,59%	0,08%
Switch Cisco	1,03%	1,2%	0,17%	19,88%	20,08%	0,31%
Firewall Fortinet	0,002 %	0,02%	0,018%	27,003%	30,24	3,2%

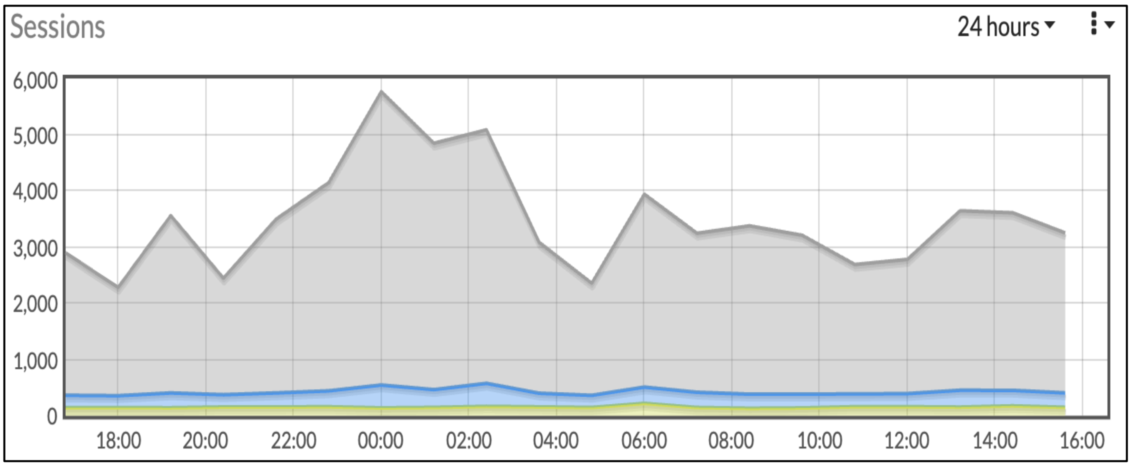

Figure 5. Firewall concurrent policy inspection session after migration

ATM Connectivity

Based on the monthly average data from the remote ATM network, Table 5 illustrates the differences and improvements observed before and after the migration for several ATM network media options. This measure proves that the proposed new network infrastructure can reduce network latency (round-trip time) and the number of network hops required to connect ATMs directly to PT XYZ. These enhancements in network performance are important for improving the responsiveness and overall user experience of ATM transactions.

Beyond the improved response time, the stabilization period from December 2024 to February 2025 indicated an increase in ATM availability SLA, averaging 99.53%, as illustrated in Figure 6. This is primarily attributed to the fact that the majority of the ATM network still relies on the existing provider. However, this improvement is quite significant when compared to the pre-migration period, where the average availability SLA data only reached 98.31%. Optimization efforts can be undertaken by conducting an in-depth evaluation of the network performance of each involved ATM service provider.

Table 5. Service Provider ATM remote links

Technology	Before Migration		After Migration	
	Round Trip	Network Hop	Round Trip	Network Hop
M2M	86 ms	15 hop	36 ms	9 hop
M2M with GBR	54 ms	14 hop	40 ms	9 hop
VSAT	827 ms	13 hop	758 ms	8 hop
MPLS	N/A (New)	N/A (New)	4,31ms	8 hop

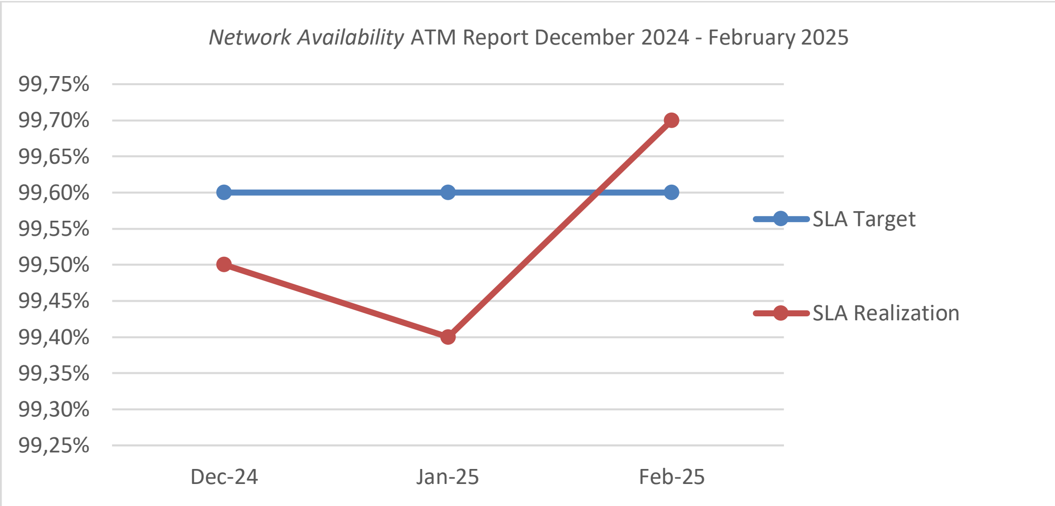

Figure 6. ATM network SLA after migration

Discussion

This study produces a blueprint for a network infrastructure migration strategy to guide companies that want to migrate from their existing WAN network connectivity to a new system. Based on the design topology and implementation strategy that have been explained, the benefits that PT. XYZ can involve several things that must be considered, including:

1) A well-designed architecture and an adaptive migration approach with incremental steps are paramount for ensuring robust ATM communication in regulated industries. The implementation of a highly scalable and redundant WAN design, such as the 1:1 active-active configuration between data centers and optimized WAN paths, represents a critical strategic principle for building network resilience. This resilience is essential for meeting the stringent uptime demands of critical financial infrastructure, directly contributing to continuous service availability and transaction integrity. Furthermore, adopting an incremental migration approach systematically mitigates the inherent risks of service disruption during complex infrastructure transitions. By breaking down the migration into manageable phases, potential issues can be identified and resolved on a smaller scale, thereby minimizing widespread impacts and safeguarding regulatory compliance during the handover of critical systems. This strategic balance between architectural robustness and adaptive deployment ensures both operational stability and adherence to industry standards.
2) While the new efficient topology and optimized WAN paths significantly reduced overall network latency, as demonstrated in Table 5, it is observed that VSAT connections still exhibit relatively higher latency (758 ms) compared to terrestrial or cellular alternatives. This is primarily attributed to the inherent physical distance to geostationary satellites, which dictates a minimum propagation delay [30], [31]. However, this latency was considerably improved from the pre-migration state (827 ms) due to the reduced number of network hops (from 13 to 8 for VSAT) and the more efficient routing to PT XYZ's Data Center. Critically, the provider's successful QoS optimization played a vital role in mitigating the impact of this inherent latency. This optimization ensured that sensitive transaction data received priority over less critical data streams, such as ATM logs and CCTV snapshots. As a result, ATM transactions were processed successfully without encountering any performance issues or disruptions, despite the underlying higher latency, validating the network's ability to prioritize mission-critical financial services.
3) During migration activity, good communication and coordination with all relevant parties, including the service provider team, the ATM vendor, and the Bank's IT team, is essential. Network communication must be prepared beforehand, and proper time management and work permits are critical to avoid delays.
4) A thorough analysis is key to deciding whether to use existing or new service providers and selecting the appropriate transmission media. This decision considers geographical reach, diverse redundancy needs, and compliance with regulations. For instance, terrestrial networks are primarily suitable for ATMs in permanent locations like bank branches, offering superior stability, high bandwidth, and low latency. By carefully evaluating and strategically combining these diverse transmission media, financial institutions can build a resilient network that mitigates connectivity risks.

5) Continuous performance monitoring and post-migration validation are essential for maintaining operational excellence following an IT infrastructure migration. This involves the strict of network monitoring tools to proactively identify bottlenecks and prevent poor operational performance. Leveraging real-time data applications and ATM logs facilitates efficient auditing, analysis, and troubleshooting, thereby reducing complaint resolution times. As demonstrated by the stabilization period from December 2024 to February 2025, which showed an increased ATM availability SLA of 99.53% (as illustrated in Figure 6), continuous monitoring is crucial for achieving improvements and driving future optimization through in-depth performance evaluations of all involved telecommunication service providers.

CONCLUSION

This research successfully developed a comprehensive ATM network infrastructure migration strategy from banks to PT XYZ. An incremental migration approach, supported by a resilient and well-defined network topology design, can enhance ATM service performance and reliability, as evidenced by the positive results. Based on the implications of this study, financial institutions can implement the proposed WAN design for the migration of thousands of remote ATMs or branches using an incremental migration approach to ensure the success of each stage. This initiative can enhance the company's competitiveness and convince banks to delegate ATM network operation to PT XYZ. Despite these achievements, this study has certain limitations. The current implementation primarily focuses on a traditional WAN environment; SD-WAN deployment can have more benefits, and many technical aspects can be explored. Additionally, research on the comprehensive cost-benefit analysis, comparing operational costs before and after migration, is important to assess if the shift in ATM network operation to PT XYZ increases company revenue. Furthermore, future research is advised to measure customer satisfaction with ATM services post-migration, which can be conducted through surveys, questionnaires, or other feedback collection methods. Research on the evolving security posture of transferring ATM network ownership to third-party partners would also provide valuable insights for the financial sector.

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