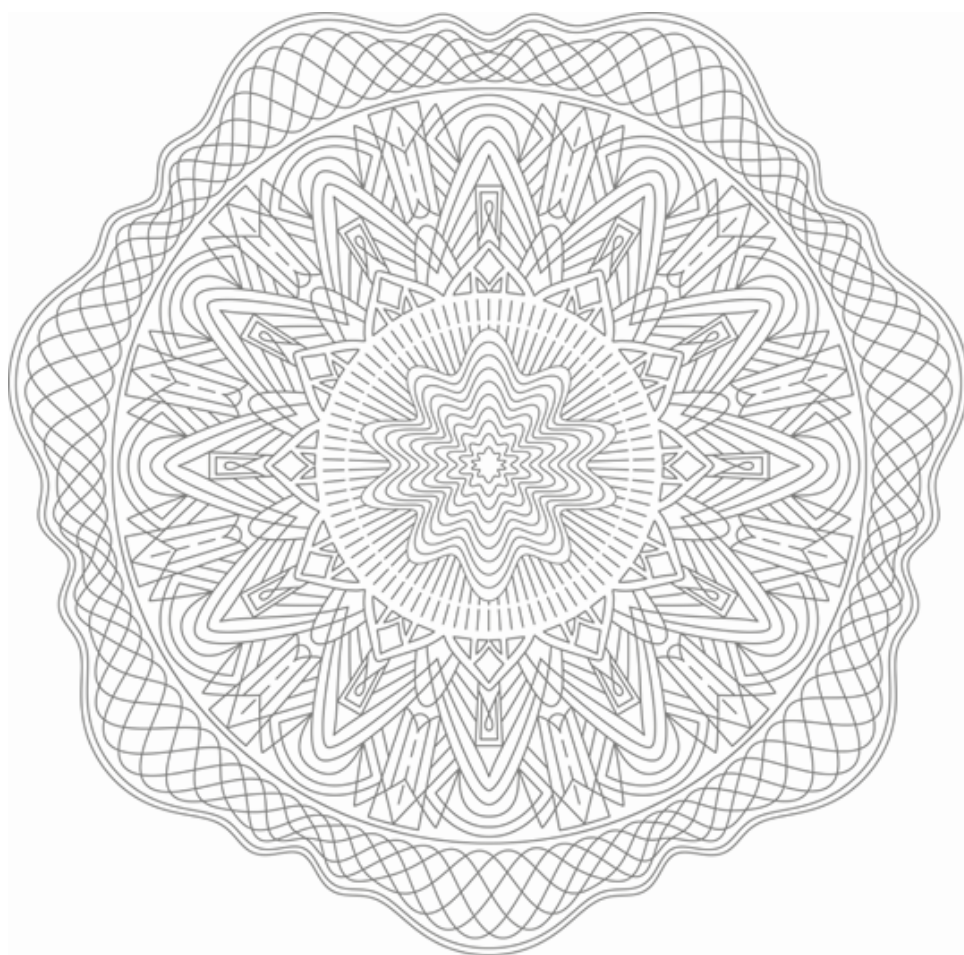




Disclosure Report on BAHTNET Self-Assessment against the Principles for Financial Market Infrastructures



May 2018

Payment and Bond Department

Bank of Thailand

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1. Executive Summary

1.1 Overview of the Payment and Settlement Systems in Thailand

Thailand's payment systems consist of large value payment system (LVPS) and retail payment systems (RPSs), all regulated and overseen by the Bank of Thailand (BOT). The BOT itself owns and operates the only LVPS in Thailand, BAHTNET (Bank of Thailand Automated High-value Transfer Network), and ICAS (Imaged Cheque Clearing and Archive System), a major RPS. Other RPSs for interbank fund transfers operated by the private sector comprise the National Interbank Transaction Management and Exchange Company Limited (NITMX) and Processing Center Company Limited (PCC); serving single and bulk payments, and internet and mobile transfer respectively.

On the securities and capital markets side, fixed-income securities traded Over-the-Counter (OTC) are settled through Thailand Securities Depository Co.,Ltd. (TSD), whereas fixed-income securities, equities, and derivatives traded on the stock exchange are cleared and settled through Thailand Clearing House Co.,Ltd. (TCH). Both TSD and TCH are the subsidiaries of the Stock Exchange of Thailand (SET) and under the Securities and Exchange Commission (SEC)'s oversight.

1.2 Recent and Future Development

Under the Bank of Thailand Act B.E. 2485 (BOT Act) and the amendments, the BOT's major role is to maintain monetary stability, financial institution system stability, and payment systems stability. The Payment Systems Committee (PSC) is established under Sections 17(4), 28/11 and 28/12 of the law, as an FMI's board, to formulate the policies relating to payment systems and interbank clearing system with the goal to sustain the country's payment systems efficiency and stability. The PSC also stipulated that the oversight of these payment systems should be conducted in compliance with the Principles for Financial Market Infrastructures (PFMIs).

1.2.1 Recent development

(1) Since the Financial Sector Assessment Program (FSAP) was conducted in 2007, major developments have been implemented to mitigate risks in BAHTNET as follows:

- Cross-border PvP (Payment versus Payment) linkage between BAHTNET and USD CHATS for THB/USD FX settlements, as an alternative to mitigate FX settlement risks has been established in 2014;

- Securities Requirement for Settlement (SRS) to mitigate settlement risks resulting from net settlements was launched in 2015;
- BAHTNET is certified to ISO27001 to be in line with international security standards in 2015;
- Code of Conduct for Security Management System was published in 2016;
- Arrangements for cooperative oversight among domestic and international authorities and cross-border infrastructures were strengthened in 2017;
- Monitoring Dashboard for the BOT and participants to monitor liquidity and manage suspicious transactions in BAHTNET was implemented in 2017;
- BAHTNET platform was upgraded for system capacity enhancement in 2017;
- Security of BAHTNET is strengthened by enforcing participants' compliance with ISO27001 and SWIFT Customer Security Program (CSP) in 2018;
- Enacted the Payment Systems Act in 2018.

(2) BAHTNET self-assessment against PFMI was undertaken in 2016. Actions that were taken to address the gaps as follows:

- Annual review of haircuts has been implemented since 2017;
- The management of Operational Risk with regard to system availability and performance stress test have been conducted regularly since 2017;
- Rules and regulation in regard to the Finality of Payment and Default Procedures according to the Payment Systems Act are implemented in 2018;
- Comprehensive BAHTNET Risk Management Framework, which provides clarity and details on Risk Policy, Risk Governance and Risk Appetite, is developed in 2018;
- Responses to the CPSS-IOSCO Disclosure Framework has been conducted regularly and the disclosure of BAHTNET Self-Assessment Report is published in 2018.

1.2.2 Future Development: Next Generation BAHTNET

Although BAHTNET has been improved periodically to enhance efficiency and ensure system stability, the changing payment landscape and technological advancement are a driving force in shaping Thailand's core payment infrastructures. In this regard, the

BOT is in the process of developing a three-year plan for the next generation of BAHTNET, focusing on 3 areas: Functionality, Interoperability, and New Technology.

Firstly, system functionality will be enhanced to support changing demands and achieve greater system resilience, hence mitigating settlement risks in line with international standards. Secondly, the BOT foresees the importance of preparation for connectivity among domestic and cross-border payment infrastructures, which will help facilitate digital economy and economic expansion. Lastly, the BOT will explore blockchain technology to improve system efficiency and provide innovative payment services.

2. General Information of BAHTNET

2.1 BAHTNET Overview

BAHTNET, deemed as Systemically Important Payment System or Financial Market Infrastructure (FMI) in Thailand, was developed by the BOT and launched in 1995 to serve as the backbone infrastructure for interbank high-value funds transfer settlement.

BAHTNET serves large value interbank funds transfer in Thai Baht (THB) on Real Time Gross Settlement (RTGS) basis, third party funds transfer for bank customers and the government (through Government Fiscal Management Information System or GFMS), and settlement for cash leg of the government bonds trading, along with inquiry services. Other services include final settlements for net position of retail payment systems and the net position for cash leg of securities settlements, as well as providing a platform for transmitting and receiving messages between the BOT and financial institutions and other eligible organizations who have an obligation to maintain deposit or settlement accounts at the BOT (Participants).

In 2017, BAHTNET handled 4.22 million transactions, valued at 890 trillion THB (averaging 17,309 transactions and 3.65 trillion THB per working day).

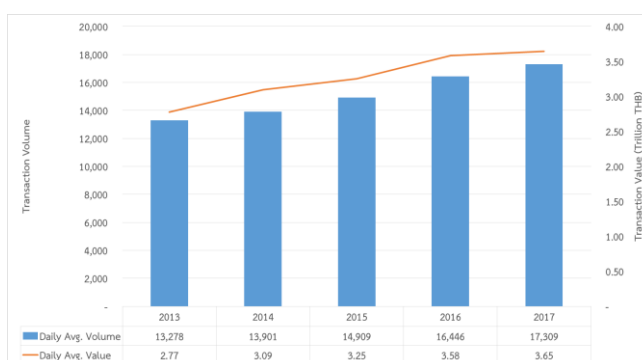


Figure 1: BAHTNET funds transfer volume and value

2.2 BAHTNET Governance Structure

2.2.1 Line of Responsibilities and Accountabilities:

The oversight and the operation of BAHTNET are under a separate line of command in order to achieve the balance of power, as well as to ensure clear and transparent responsibilities and accountabilities. At present, the BOT's responsibilities related to payment systems are as follows:

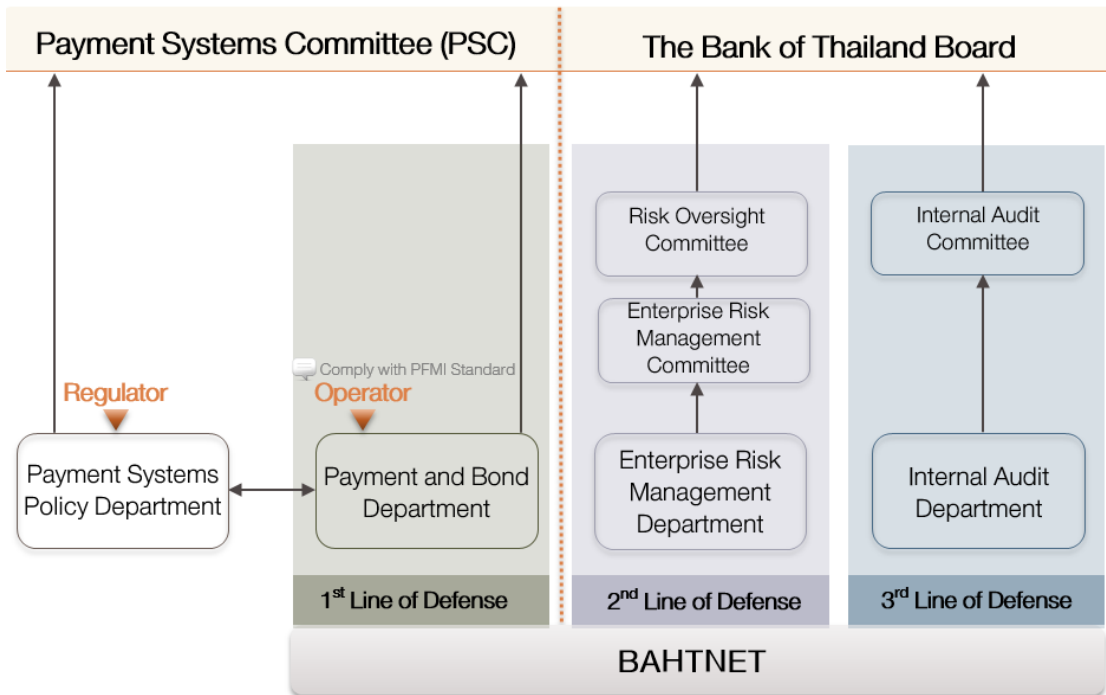


Figure 2: Lines of Defense

2.2.2 Lines of Defense

Several departments in the BOT are involved in ensuring safe, sound, and good governance of BAHTNET. The Payment and Bond Department (PBD), as the BAHTNET operator, is the first line of defense. The PBD is accountable for establishing the BAHTNET risk management framework and for any policy issues related to risk management, efficiency and safety of BAHTNET, the PBD has to notify the PSC which acts as the FMI's board.

The Enterprise Risk Management Department serves as the second line of defense, overseeing operational risk and the exercise of Business Continuity Plan (BCP) for the systems operated by the BOT.

The Internal Audit Department serves as the third line of defense, responsible for auditing the operation of BAHTNET system and risk management including compliance with the rules and duties of the BOT as prescribed in BAHTNET regulations. The audit result is reported to the Audit Committee, chaired by an outside expert.

2.2.3 Oversight of BAHTNET

The Payment Systems Department (PSD) oversees BAHTNET through a five-step process: 1) on-going oversight and monitoring 2) assessment 3) on-site examination 4) report to the Payment Systems Committee (PSC) and 5) inducing changes where necessary.

Information collected from the on-going oversight and monitoring is assessed against the PFMI standards and on-site examination will be undertaken as deemed necessary. The scope and issue of an on-site examination will depend on findings as identified in self-assessment reports based on PFMI-compliance and internal/external audit reports. In this regard, if the PSD finds a particular gap from its assessment, the PSD shall report the gap and propose recommendations for the PSC's approval and take necessary actions.

2.2.4 Cooperative Oversight over other FMI Linkages

In order to ensure safety, reliability, and efficiency of the payment systems linkages, the BOT has established cooperative oversight arrangements with relevant domestic and international regulators. Such arrangements cover oversight information, potential risks from system linkages and participants in the linked systems, risk management frameworks, as well as related requirements, rules and regulations. At present, the BOT has established cooperative oversight arrangements with the following domestic and overseas regulatory authorities:

(1) The Securities and Exchange Commission (SEC) which regulates Central Securities Depositories, Securities Settlement Systems (SSS), and Central Counterparties (CCP). The Memorandum of Understanding (MOU) between the BOT and the SEC on cooperative oversight for Delivery versus Payment (DvP) linkage states

that both are obligated to share oversight information under both normal and emergency circumstances.

(2) The Hong Kong Monetary Authority (HKMA) that regulates the USD CHATS which is linked with BAHTNET for cross-border Payment Versus Payment (PvP). The BOT and the HKMA share oversight information on the RTGS system and would consult and cooperate in accordance with the MOU on cooperative oversight for PVP linkage, which includes necessary communication and information sharing in the event affecting the RTGS system on both sides.

2.3 BAHTNET Services

BAHTNET services are defined in BAHTNET Regulations which are available via BOT website and circulars.

2.3.1 Participants

The BOT adopts open and fair access criteria for bank and non-bank participants. The classification of participants are as follows:

(1) Direct Participant: Participant who is authorized to send and receive funds transfer, as well as to perform other functions in the BAHTNET system.

(2) Associate Participant: Participant who is authorized to use BAHTNET services via a direct participant's BAHTNET Workstation Subsystem.

Both types of participants are required to maintain their own current accounts at the BOT. At the end of 2017, there are 62 BAHTNET participants, consisting of 58 direct participants and 4 associate participants.

2.3.2 Access Channel

BAHTNET provides two access channels for participants:

(1) SWIFT Network: Participants with high volume and value transactions send and receive funds transfer messages, in accordance with SWIFT message standards through the SWIFT network. Participants can link their internal system with BAHTNET in a Straight-through Processing (STP) manner, thereby increasing efficiency in the system.

(2) BAHTNET Web Service: Non-SWIFT participants can access BAHTNET through the Bank of Thailand Electronic Financial Services (BOT-EFS). Participants can send and receive messages through BAHTNET Web service, with the message format developed in line with the SWIFT message standard.

Both SWIFT and non-SWIFT participants, are required to use BAHTNET Web service for inquiries of account balance and movement, which include functions for queue management, transactions and liquidity monitoring and reports. Moreover, SWIFT participants can use BAHTNET Web service as their backup channel.

2.2.3 BAHTNET Functions

The system operates daily from 8:30 to 17:30, except on bank holidays. It offers the following services:

(1) Interbank Funds Transfer: Allow a participant to transfer funds from its account to another participant's account or between its own accounts.

(2) Third Party Funds Transfer: Allow a participant to transfer funds as ordered by its client, from the client's account at the bank to a beneficiary account at the recipient bank. In accordance with each bank's Service Level Agreement, funds are available for the beneficiary on the same day basis.

(3) Multilateral Funds Transfer (MFT): Allow a number of simultaneous debit/credit funds transfer accordingly to the net positions from clearinghouse to be settled across participants' accounts. A clearinghouse that relies on BAHTNET settlement service can transmit MFT for the interbank settlement of net positions resulting from retail payments and capital market transactions.

(4) Government Payment Transaction: Permit government agencies to directly transmit data from the Government Fiscal Management Information System (GFMS) for the Comptroller General's Department, to BAHTNET in order to facilitate revenue submission and budget disbursement.

(5) Securities Settlement: Allow the settlement of cash leg for securities transactions to be settled in BAHTNET. Securities transactions and settlements are performed through TSD's Post Trade Integration (PTI) system. The BOT and TSD/TCH have developed the RTGS-DvP linkage to facilitate the Delivery Versus Payment linkage for government securities traded on the OTC market.

(6) FX Settlement: Allow participants to simultaneously transfer funds for foreign exchange settlements in Thai Baht (THB) in Thailand and US Dollar (USD) in Hong Kong under the BAHTNET and USD CHATS linkage. Transactions are settled through the linkage on PVP gross settlement basis.

(7) Inquiry: Allow participants to access the information pertaining to their own deposit/settlement accounts at the BOT, e.g. the account balance, account movements, and the status of 'in queue' and processed transactions.

(8) Bilateral Communication: Allow a participant to communicate with one another via the BAHTNET system at any time during the operating hours.

(9) Message Broadcast: Permit the BOT to broadcast messages to all participants and a participant, through its request to the BOT, to broadcast messages to all other participants.

2.3.4 Security Management

As the development of BAHTNET is based on RTGS basis to support high-value funds transfer, the BOT maintains high-security standards to ensure the system's reliability and resilience.

Participants transmitting messages to BAHTNET via SWIFT channel must comply with the SWIFT security standards. Participants transmitting messages via BOT-EFS Web channel must have a private key and token to create the digital signature required for the verification of electronic activities.

In order to enhance information security management, BAHTNET was certified to ISO27001 in 2015. The BOT also published Code of Conduct for Security Management System in 2016. Furthermore, all BAHTNET participants are required to keep their BAHTNET workstations in compliance with ISO27001 and SWIFT Customer Security Program (CSP) by 2018.

2.3.5 Settlement Procedures and Risk Management

Several incentives and risk management measures have been put in place for both participants and the BOT to manage risks arising from BAHTNET operations as follows:

(1) Liquidity Risk Management: The BOT provides liquidity saving mechanism on real time basis as follows:

- Intraday Liquidity Facility (ILF): The facility provides participants intraday liquidity against eligible collaterals to support liquidity management. The BOT provides ILF on the fully collateralized basis to BAHTNET participants who are financial institutions. The collaterals are valued on a daily mark-to-market basis with the same haircut rate applied by the BOT Financial Markets Operation.

- **Queuing Mechanism:** The mechanism that puts transfer instructions with insufficient funds in the sending institution's account on hold. The sending institution can re-assign the priority of pending instructions in their queues through its workstation.

- **Gridlock Resolution:** The algorithm that solves the problem for sets of unsettled transactions initiated by subsets of participants resulting from insufficient funds in their accounts.

- **Throughput Guideline:** BAHTNET participants are required to transfer at least 30 percent of their daily settlement value by noon and at least 70 percent by 15:00. This condition is imposed to ensure smooth operation of the settlement process and to avoid heavy congestion of instructions and liquidity in the afternoon.

(2) Settlement Risk Management: The BOT has launched the Securities Requirement for Settlement (SRS) facility to mitigate settlement risks of MFT in case that a participant has insufficient funds to complete a settlement.

(3) Credit Risk Management: With BAHTNET's provision of funds transfer based on an RTGS basis, the instruction will result in the immediate transfer of funds from the sending institution's account to the receiving institution's account. To avoid credit risk, the collaterals are marked to market and a prudent haircut policy is applied.

(4) Operational Risk Management:

- **Target System Availability:** Operational risk is addressed to ensure high degree of security and operational reliability in normal and emergency circumstances. To make sure that BAHTNET provides smooth functioning of payment systems, the BOT monitors BAHTNET's system availability and establishes standard incident reporting systems, processes and procedures.

- **Business Continuity Plan (BCP):** The BOT has developed a BCP to cope with a wide range of incidents and failures. Various scenarios and staffs' responsibility are analyzed and reviewed on an annual basis. BCP testing with participants are undertaken as specified in the manual and participants are requested to regularly take part in the contingency and disaster plan testing. Furthermore, participants are required to exercise their BCPs at least once a year and the top management is obliged to notify the BOT of the exercise completion.

- **Backup Solutions:** The BOT sets up the replicated backup site with similar hardware and software and allows real-time replication of data, to ensure continuous operation in case of natural disasters or system failures. In this regard, the Service Level Agreement (SLA) has been established and RTO is set at 2 hours. The BOT also establishes an additional data center in order to obtain higher resilience.

2.3.6 BAHTNET Fee

Currently, the BOT implements an operating cost recovery pricing policy. As approved by the PSC, the BOT conducts a review of the cost recovery and pricing policy every 2 years or when there are changes that may impact BAHTNET.

Monthly fee is charged based on types of membership and tariff is levied based on service channels and time of payment instructions.

| Time Zone | 8.30-12.00 | 12.00-16.00 | 16.00-17.30 |
|------------------|-------------------|--------------------|--------------------|
| SWIFT | 5 BAHT | 10 BAHT | 200 BAHT |
| Web | 8 BAHT | 16 BAHT | 200 BAHT |

3. Principle-by-Principle Summary Narrative Disclosure

This self-assessment is conducted by the Payment and Bond Department which is responsible for the day-to-day operation of the RTGS Service. The latest self-assessment was undertaken in July 2017.

Principle 1 – Legal Basis

An FMI should have a well-founded, clear, transparent, and enforceable legal basis for each material aspect of its activities in all relevant jurisdictions.

The BOT Act and the amendments empowers the BOT to establish and operate the payment systems and to conduct any activities in accordance with the BOT rules and regulations to maintain payment system stability.

PSC is established under the BOT Act to monitor and oversee the payment systems operated by the BOT. The PSC designates BAHTNET as a systemically important payment system, being the payment infrastructure for high-value interbank settlements.

The Payment Systems Act B.E. 2561 (2018) provides a comprehensive legislative framework for the issues of settlement finality protection in BAHTNET which is a designated payment system as stipulated under the Act. Any funds transfer instruction, clearing or settlement instruction submitted to BAHTNET before the court's rehabilitation order or the court's receiving order can continue to be processed until the end of day in accordance with systems' rules and regulations. Such transactions are deemed final and irrevocable. The provision of protection covers collaterals used in BAHTNET in case of participant insolvency.

The Payment Systems Act empowers the BOT to establish rules and regulations to ensure that the payment systems are operated in an efficient, safe and sound manner.

The BOT's rules and regulations for BAHTNET are clearly stated, understandable and consistent with relevant laws and regulations. BAHTNET participants are required to sign the Letter of Agreement for BAHTNET Service Usage in order to legally bind themselves with the rules, regulations, and procedures as specified by the BOT.

The BOT Act, the Payment Systems Act and the Letter of Agreement for BAHTNET Service Usage provide well-founded, clear, transparent, and enforceable legal basis for material aspects of BAHTNET activities.

Principle 2 – Governance

An FMI should have governance arrangements that are clear and transparent, promote the safety and efficiency of the FMI, and support the stability of the broader financial system, other relevant public interest considerations, and the objectives of relevant stakeholders.

As stipulated in the BOT Act, the BOT is tasked to maintain monetary stability, financial institution system stability, and payment systems stability. As such, the BOT has established, promoted the establishment of, and managed efficient, safe, and sound payment systems.

The objectives of BAHTNET are clearly defined as the RTGS infrastructure for interbank large-value funds transfer to support financial activities and promote payment systems stability. BAHTNET is owned, operated and overseen by the BOT under the segregation of responsibilities and accountabilities of the PBD and PSD.

As mentioned in Principle 1, the PSC is established under the BOT Act to formulate the policies relating to payment systems and interbank clearing system. The PSC comprises the BOT Governor, two BOT Deputy Governors, Chairman of the Thai Banker's Association and three external experts – one with knowledge in information technology and two more representing the business sector and government sector. By virtue of the Payment Systems Act, the PSC's responsibilities are: monitoring and overseeing BAHTNET with the priority placed on safety and efficiency of the system; ensuring that BAHTNET is in compliance with the PFMLs; and reviewing and approving BAHTNET's risk management framework. Supporting the PSC are the PSD and the PBD.

The PSD's main duties are to formulate the policies in developing key infrastructures and services for payment systems and oversee BAHTNET and other payment systems. The PBD's main responsibilities are to manage the day-to-day operations of BAHTNET as well as their associated risks, enhance the systems and infrastructure, address business needs, and establish framework as approved by the PSC. The PSD submits the payment systems stability report to the PSC on a quarterly basis and the PBD regularly reports major incidents and operational system availability to the PSC.

The governance structure is documented; the composition of the committee and organizational structures are disclosed on the BOT's website.

Principle 3 – Framework for the Comprehensive Management of Risks

An FMI should have a sound risk-management framework for comprehensively managing legal, credit, liquidity, operational, and other risks.

The PSC has approved the Payment Risk Management Framework in consistent with the enterprise risk management bank-wide's framework and international standards such as ISO 30001 and COSO ERM. The PBD, as the BAHTNET operator, has established BAHTNET Risk Management Framework in order to effectively manage interrelated risks.

The risk framework encompasses risk policy, risk management process and risk appetite for legal and compliance, reputational, general business, operation, liquidity, credit and systematic risks. The detailed sub-level risks are identified in the Risk Register, which includes sub-level risks of the above 7 key risks especially cyber threat (See Principle 17) and those associated with Exchange of Value Settlement (See Principle 12).

BAHTNET implements the 'three lines of defense' model, whereby the first line of defense is assigned to the PBD and the second and third line of defense are the responsibility of the ERMD and the IAD, respectively. The PBD is responsible for the identification, assessment, monitoring and management of risks that directly arises from the operation.

On risk mitigation, the BOT adopts an incentive and penalty approach to bind BAHTNET participants in managing and containing potential risks. Among the incentives, there is a time-zone fee discount for participants that submit transactions before noon, and the throughput guideline discount for participants that are able to settle 30% of their transfer value before noon and 70% before 15:00. Participants are subjected to penalties, which are set to avoid critical congestion right before the closing hours. Consequently, time-zone penalties are imposed on those who submit payment instructions from 16:00 onwards.

On risk monitoring, BAHTNET has a real-time monitoring screen that provides essential information including Early Warning Indicator (EWI) that shows liquidity problem of BAHTNET participants through their activities. These activities are such as failure to buy back Intraday Liquidity Facilities (ILF) securities by the end of day.

Scenarios are treated differently depending on severity. Moreover, the BOT has conducted assessment simulations of each risk, its impacts, and the effectiveness of

associated countermeasures. The scenarios include major participants' IT breakdown or collateral value deterioration.

BAHTNET Risk Management Framework and its supplements are reviewed at least once a year or when there are major changes to the risk environment, such as new activities or system changes, especially Cyber Security.

Principle 4 – Credit Risk

An FMI should effectively measure, monitor, and manage its credit exposures to participants and those arising from its payment, clearing, and settlement processes. An FMI should maintain sufficient financial resources to cover its credit exposure to each participant fully with a high degree of confidence.

Due to the RTGS characteristics, BAHTNET is designed to eliminate credit risk posed by participants upon the system or operator. Funds transfer transactions will be completed only if the sender's account has sufficient funds to cover the transaction amount. For securities settlements, the securities leg and cash leg will be simultaneously settled in DvP model 1. Therefore, the system does not pose credit risk to participants.

Though the BOT does not face credit risk from the settlement process, there remains credit risk through interest-free intraday liquidity under the ILF to participants or through activating SRS measure in the case that participants fail to buy back their collateralized securities by the end of day. Under these circumstances, the BOT may face both current and potential future credit exposure.

The current exposure occurs when participants fail to buy back their collateralized securities either from ILF or SRS by the end of day. The BOT's risk exposure equals to the remaining securities that participants fail to buy back. The potential future exposure occurs when participants fail to buy back the overnight loan and their collaterals are permanently seized by the BOT. The BOT has to sell the collaterals to cover losses. The residual exposure can occur due to fluctuations in market value of the securities.

In order to minimize credit risk, the BOT has established the credit risk framework for BAHTNET covering the collateralization scheme as well as the mark-to-market and prudent haircut policy as follows;

1) Intraday Liquidity Facilities (ILF)

The BOT provides interest-free intraday liquidity to participants against eligible collaterals. To obtain the liquidity, participants are required to have highly quality and liquid securities for a repurchase transaction. A haircut is applied to the securities used as collaterals, with the rates varying accordingly to the type and maturity of the securities as determined in BOT Notification.

2) Securities Requirement for Settlement (SRS)

The BOT provides the SRS facility to mitigate settlement risks of MFT due to insufficient funds. Participants are required to pledge collaterals against the exposure arising from net settlements of retail payments such as cheque clearing and interbank retail funds transfer. The securities pledged shall not be less than the Potential Debit Position (PDP) value as calculated twice a year by the BOT.

3) Collateral and Haircut Policy

Type of accepted securities

BAHTNET does not set a value limit for intraday credit provision because only high quality and liquid securities such as BOT bonds, Government bonds, State-owned Enterprises (SOEs) bonds are accepted as eligible collaterals. On top of that, a prudent haircut policy is imposed.

Haircut policy:

The BOT buys participants' collaterals based on the mark-to-market price with a haircut formulated by the Enterprise Risk Management Department and the Financial Markets Department.

Principle 5 – Collateral

A payment system that requires collateral to manage its or its participants' credit exposure should accept collateral with low credit, liquidity, and market risks. A payment system should also set and enforce appropriately conservative haircuts and concentration limits.

As mentioned in Principle 4, the BOT accepts only highest quality collaterals for intraday liquidity facilities and sets prudential haircuts under the Repurchase Agreement mechanism.

Collaterals are valued on a daily mark-to-market basis with haircuts which vary on securities' type and maturity. The volatility of collateral values are reviewed annually and the haircuts are adjusted accordingly. The Enterprise Risk Management Department is responsible for haircut procedures while the Risk Management Committee validates the procedures on an annual basis.

Principle 7 – Liquidity Risk

An FMI should effectively measure, monitor, and manage its liquidity risk. An FMI should maintain sufficient liquid resources in all relevant currencies to effect same-day and, where appropriate, intraday and multiday settlement of payment obligations with a high degree of confidence under a wide range of potential stress scenarios that should include, but not be limited to, the default of the participant and its affiliates that would generate the largest aggregate liquidity obligation for the FMI in extreme but plausible market conditions.

The initial sources of liquidity in BAHTNET are from participants' opening balances in Deposit/Settlement Account and the maturity of their money market placements with the BOT. Moreover, the BOT provides a variety of tools and mechanisms to manage liquidity risk and ensure sufficient liquidity in the system as follows:

1. Queuing Mechanism: Puts the transactions that have insufficient liquidity in a queue and immediately settles the transactions when the sending banks' accounts have sufficient funds. The queuing mechanism allows the sending institution to prioritize pending transactions through their workstation. The unsettled payment instructions, which are in the queue by the end of the day, will be deleted from the system.

2. Gridlock Resolution: Aims at solving a situation when several transfer instructions among several participants cannot be executed due to insufficient funds in one or more of their accounts. When the instructions from various institutions stand in queue and form a loop of funds transfers, the system will search for the group of instructions that, if executed, will result in a positive net position for each of the transferors. When these instructions are found, the system will offset all related transactions and post them to each account simultaneously.

3. Intraday Liquidity Facilities (ILF): Provides liquidity against eligible collaterals. The BOT provides fully collateralized intraday facilities. The ILF is available for both direct and associate participants who are financial institutions under the BOT's supervision. Participants who are non-financial institutions such as securities companies and government agencies do not have access to the facility.

4. Securities Requirements for Settlement (SRS): Provides liquidity to mitigate the settlement risk of MFT transactions. In addition to ILF, the BOT requires participants involved in MFT to reserve collaterals against the exposure arising from net clearing positions from retail payments which are settled through BAHTNET such as cheque clearing and interbank retail funds transfer. Participants are required to reserve collaterals no less than their highest Potential Debit Positions based on the historical net debit position of their net settlements.

5. Pricing Incentive: Encourages early submission of funds transfer instructions through fees set according to time of instruction (time-zone).

6. Throughput Guideline: Encourages early submission of funds transfer instructions. The BOT requires participants that transfer 500 million Baht or more per day to submit transactions amounting to at least 30 percent of expected total value of that day or the average value of the same fortnight of the previous month, whichever the lowest, by noon. And at least 70 percent of such amount by 15:00.

In addition, BAHTNET provides real-time tools to monitor participants' funds flow via their account balances and account movements which include their queued transaction status. Additionally, stations with web service also provided with warning feature.

Principle 8 – Settlement Finality

An FMI should provide clear and certain final settlement, at a minimum by the end of the value date. Where necessary or preferable, an FMI should provide final settlement intraday or in real time.

Each funds transfer transaction will be completed and considered final and irrevocable at the point as described below:

BAHTNET: The transaction is deemed final and irrevocable when fund is debited from the sending institution's account and credited to the receiving institution's account as specified in the transfer instruction. After the settlement is completed, the sending institution cannot revoke the transaction.

RDL (RTGS-DvP Linkage): The transaction is deemed final and irrevocable after fund is debited from the sending institution's account and credited to the receiving institution's account as specified in the sending institution's request, and the BOT has already notified the TSD of the transfer.

CSS (Central Settlement System): The transaction is considered final and irrevocable when fund is completely transferred from the net-debit sending institution's account to the net-credit receiving institution's account as specified in the MFT instruction. After the settlement is completed, the sending institution cannot revoke the transaction.

PvP (Payment versus Payment): The transaction is considered final and irrevocable when THB is debited from the sending institution's account and credited to the receiving institution's account in BAHTNET, and when USD is simultaneously debited from the sending institution's account and credited to the receiving institution's account in USD CHATS. Once the PvP process is completed, the THB transfer is deemed final and the sending institution cannot revoke the transaction.

The regulations specified above are disclosed to all BAHTNET participants and the public via the BOT website. The Payment Systems Act lays out the oversight and supervision framework for payment systems and services as well as addresses the essence of payment finality. Under the law, once a bankruptcy order or an order to wind up a participant or a resolution for voluntary winding up of a participant is passed, all transactions completed through the highly important payment system prior to the court's decision shall be final and irrevocable. The clause is to emphasize the high degree of legal certainty that finality will be achieved.

The final settlement in BAHTNET is completed on the value date only. However, in case of unexpected special holidays due to major disasters or political unrests, the forward value date will be invalid. Participants have to resend the transactions to the system on the first business day. The rule is also applied with DvP transactions.

For PVP linkage between BAHTNET and the HKMA's USD CHATS, the BOT and HKICL has established a communication BCP arrangement for unpredictable holidays that may occur because of disasters, political unrests and epidemics so as to ensure the smooth settlement of PVP transactions. Both operators will send broadcast messages to all participants in the RTGS system, instructing them to prepare transactions on the next business day. Both central banks have assigned persons to be a central point of contact.

Principle 9 – Money Settlements

An FMI should conduct its money settlements in central bank money where practical and available. If central bank money is not used, an FMI should minimize and strictly control the credit and liquidity risk arising from the use of commercial bank money.

BAHTNET conducts money settlements through central bank money; participants are required to maintain current or settlement accounts with the BOT. At present, the settlements are denominated only in THB. For PVP transactions, commercial bank money is used to settle the USD leg. The settlements via USD CHATS are conducted by the Hongkong and Shanghai Banking Corporation Limited (HSBC), the official settlement institution. HSBC is under the prudential supervision of HKMA which oversees USD CHATS, to ensure that credit and liquidity exposures in the payment systems are properly addressed.

For cross-border linkage, under the MOU on cooperative oversight arrangement, the BOT and HKMA share oversight information at all times, to ensure compliance of the systems and smooth operations and stability of the settlement bank.

Principle 12: Exchange-of-Value Settlement Systems

If an FMI settles transactions that involve the settlement of two linked obligations (for example, securities or foreign exchange transactions), it should eliminate principal risk by conditioning the final settlement of one obligation upon the final settlement of the other.

There are two types of Exchange-of-Value settlements in BAHTNET: (1) delivery versus payment (DvP) linkage between the BOT and the TSD/TCH for government securities and equity settlements, and 2) payment versus payment (PvP) linkage between BAHTNET and the HKMA's USD CHATS for foreign exchange settlements. The final settlement of both obligation are linked under the BOT's specified rules and regulations as follow:

(1) DvP Linkage between the BOT and the TSD

For settlements of government securities traded in the over-the-counter market, the transaction is deemed final and irrevocable when funds transfer order is debited from the sending institution's account and credited to the receiving institution's account as specified in the transfer order on the settlement date. As soon as the funds transfer is completed, the BOT will accordingly notify the TSD (under DvP model 1- Gross-Gross). This eliminates principal risk associated with the transaction.

For the securities traded on the stock exchange, the ownership is transferred after the TCH confirms the MFT settlement (under DvP model 3- Net-Net). Once the MFT is settled, the funds transfer is considered final and irrevocable. Likewise, once the TSD transfers the securities' ownership, that transaction is considered final and irrevocable.

The SEC, which oversees TSD and TCH, has shared oversight information with the BOT according to the MOU on cooperative oversight for DvP linkage.

(2) PvP Linkage between BAHTNET and USD CHATS for FX Settlements

A PvP transaction is deemed final and irrevocable when THB is debited from the sending bank's account and credited to the receiving's account in BAHTNET and when USD is simultaneously debited from the sending bank's account and credited to the receiving institution's account in USD CHATS. For the USD leg, the PvP transaction is deemed final and irrevocable as stipulated in Payment Systems and Stored Value Facilities Ordinance: PSSVFO (Chapter 584 of the Laws of Hong Kong). In this connection, HKMA who oversees Hong Kong Interbank Clearing Limited (HKICL) shares

oversight information on its RTGS system with the BOT according to the MOU on cooperative oversight for PVP linkage.

Principle 13: Participant-Default Rules and Procedures

An FMI should have effective and clearly defined rules and procedures to manage a participant default. These rules and procedures should be designed to ensure that the FMI can take timely action to contain losses and liquidity pressures and continue to meet its obligations.

The BOT has adopted early warning indicator (EWI) to monitor pre-default signs which include participants' delay or failure to redeem ILF and the requests for SRS for its MFT settlements in case of shortfall. Furthermore, the BOT has imposed guidelines on BAHTNET's Participant Default Rules and Procedures and BAHTNET Operational Guidelines in the event of defaulting participant. Details of the Operational Guidelines are as follows;

- 1) Defaulting participant's asset handling: rights over the defaulting participant's assets
- 2) List of contact persons: details of relevant internal and external contact persons
- 3) Defaulting participant's account and communication channel handling: blockage of usage for its account and connectivity with the BAHTNET system
- 4) Pending transactions handling: handling of each type of unsettled transactions
- 5) Putting the default participant's possessions in to the debtor's estate

The BOT shall notify all related parties of the bankruptcy including the BOT's internal departments, external parties and BAHTNET's participants through broadcast message in the BAHTNET system and other communication channels as specified in the BOT Guidelines for BAHTNET's Participant Default Rules and Procedures.

Principle 15: General Business Risk

An FMI should identify, monitor, and manage its general business risk and hold sufficient liquid net assets funded by equity to cover potential general business losses so that it can continue operations and services as a going concern if those losses materialize. Further, liquid net assets should at all times be sufficient to ensure a recovery or orderly wind-down of critical operations and services.

The BOT manages BAHTNET's general business risk in accordance with BAHTNET Risk Management Framework. BAHTNET's operating costs and its income are monitored and managed according to the BOT's cost recovery policy.

By virtue of Sections 8 and 44 of the Bank of Thailand Act B.E. 2485 (amended in B.E. 2551), the BOT is mandated to establish BAHTNET as the fundamental financial infrastructure for enhancing efficiencies of financial systems, with risks mitigated and cost lowered for financial institutions. Since the BOT owns and operates the BAHTNET system, the public objective is taken into account in the pricing policy. The operating cost is directly covered by participants, both direct and associate participants. The annual fee is charged based on types of membership and tariff is levied based on service channels and time of payment instructions.

The BOT uses forward-looking measures along with data-driven analysis to monitor and manage BAHTNET's general business risks, which include a significant decrease in transaction volume or unexpected and excessively large operating expenses. The BOT regularly monitors whether its projected income would cover the cost of operation. The cost recovery and pricing policy are reviewed every 2 years or when there is a significant change to the BAHTNET environment.

Principle 16: Custody and Investment Risks

An FMI should safeguard its own and its participants' assets and minimize the risk of loss on and delay in access to these assets. An FMI's investments should be in instruments with minimal credit, market, and liquidity risks.

Cash and securities are 2 types of assets used in transactions via BAHTNET.

Participants are required to open current/settlement accounts at the BOT to transfer and receive funds in BAHTNET as well as to obtain ILF against collaterals. Regarding the

securities used as collaterals, the BOT opens and holds securities accounts on behalf of participants at the TSD. The BOT also has a securities sub-account system.

Participants can buy or sell securities in their sub-accounts and the BOT's sub-accounts in order to manage their liquidity needs during the day. If participants want to increase collaterals in their sub-accounts, they can transfer securities from their own account at the TSD to the BOT account. This transfer will be completed through the RTGS-DvP linkage on a real time basis. On the other hand, participants can withdraw collaterals in their sub-accounts by sending a request via the sub-book system and through the RTGS-DvP linkage, the withdrawn collaterals will be transferred from the BOT's sub-account to the participants' on a real time basis.

Principle 17: Operational Risk

An FMI should identify the plausible sources of operational risks, both internal and external, and mitigate their impact through the use of appropriate systems, policies, procedures, and controls. Systems should be designed to ensure a high degree of security and operational reliability and should have adequate, scalable capacity. Business continuity management should aim for timely recovery of operations and fulfilment of the FMI's obligations, including in the event of a wide-scale or major disruption.

Operational risk can be categorized into 3 groups comprising:

- 1) Operation-related risk - an inadequate monitoring system or process
- 2) Personnel-related risk - an inadequate training for staff or control of fraud
- 3) Technical risk - the hardware or software failure, network or utilities

interruption

The BAHTNET operation team and IT infrastructure team have established a number of working procedures including checklists for daily operation and emergency situation. Policies and procedures are well documented in both electronic and hard copy. The operation status of BAHTNET is reported to relevant executives daily. Additionally, the IT department is responsible for monitoring IT infrastructure and resource usage of hardware, software and database in order to keep trace of resource status of the servers at all time.

BAHTNET system was certified by the ISO/IEC 27001: 2013 in ISMS in 2015 where the surveillance audit is required on an annual basis. Moreover, re-certification audit is required for certificate renewal every three years. In 2017, the BOT officially mandates all participants' workstation to be certified with ISO 27001 by the end of 2018.

Regarding single points of failure, the BAHTNET system was designed to have high availability and is equipped with state-of-the-art technologies to avoid single points of failure and ensure a high degree of operational reliability. All data of BAHTNET are replicated to the backup site in real-time manner. The backup site will be enabled in the case that natural disasters or system failure prevent the primary site from normal operations. In order to ensure a high degree of operational reliability of the PFMI, the recovery time for BAHTNET system is set at 2 hours after the discontinuance. It was designed for zero loss of data.

Furthermore, the BAHTNET's BCP reflects the objectives, policies and procedures which allow rapid recovery and timely resumption of critical operations following a wide-scale or major disruption e.g., disasters, unrests and epidemic. The fastest recovery to normal situation with the least impact is ensured. The BCP also defines solutions for each consequence, with clearly-specified responsibilities of participants and the BOT.

The BOT conducts an annual disaster recovery drill with participants and the connected FMIs including the TSD and HKMA. In addition, the disaster recovery test is conducted once there is a change or implementation of a new function to BAHTNET.

Principle 18: Access and Participation Requirements

An FMI should have objective, risk-based, and publicly disclosed criteria for participation, which permit fair and open access.

The criteria and requirements of BAHTNET participants are elaborated in the BAHTNET Regulations and the BOT Notifications in all aspects, namely financial, operational and legal requirements. Such requirements focus primarily on safety and efficiency of the BAHTNET system as well as the payment systems stability.

Therefore, the BOT allows financial institutions and specialized financial institutions which are subject to the BOT prudential supervision, government agencies as well as legal entities that the BOT deems appropriate to have access to BAHTNET services. To ensure a fair and least restrictive access, the BOT manages the access restrictions and

requirements, i.e., periodically review the criteria upon a policy change as well as examine and monitor participants' ongoing compliance. All of the regulations and notifications related to the criteria and requirements for participants are publicly disclosed on the BOT's website and circulated to all BAHTNET participants.

As part of BAHTNET's risk management, all participants are requested to submit their BCPs and annually organize a drill of their contingency plans. The BOT also imposes additional control and safety standard for BAHTNET workstation subsystem requiring all participants to have their workstation subsystems certified to ISO 27001, to enhance the safety and security of BAHTNET as a whole. The BOT closely monitors financial institutions whose risk profile deteriorates and coordinates with the BOT's Supervision Group or relevant supervisors for necessary actions.

Principle 19: Tiered Participation Arrangements

An FMI should identify, monitor, and manage the material risks to the FMI arising from tiered participation arrangements.

BAHTNET has 2 types of participants, namely, direct participants and associate participants. Direct participants are granted the BOT's permission to use BAHTNET services, whereas associate participants have the permission to use BAHTNET services via direct participant's BAHTNET Workstation Subsystem. Both direct and associate participants have to comply with the BOT Regulations related to BAHTNET in order to identify, monitor, and manage any material risks. They are also required to open their own currents or settlement accounts in BAHTNET and to directly submit required information as prescribed in the BAHTNET regulations.

The BOT examines all participants' nature of business. The BOT also invites those who expect small transfer volume to join BAHTNET as associate participants. In this respect, the BOT continuously monitors the activities of associate participants to ensure that their volumes and values are still within the appropriate capacity that direct participants can handle. The activities that could induce risks will be identified and managed accordingly.

The analytical work identifying potential risks from the customers of BAHTNET participants has been conducted. Only a small portion of third-party transactions in both volume and value were initiated by non-subsidiary customers and they currently pose

no concentration risk and are already covered by the liquidity facilities. The BOT will regularly review and conduct related analytic work.

Principle 21: Efficiency and Effectiveness

An FMI should be efficient and effective in meeting the requirements of its participants and the markets it serves.

As a national financial infrastructure, BAHTNET is designed to provide smooth interbank funds transfer and settlement services, to support financial and capital markets' transactions and maintain financial stability of the country. BAHTNET provides smooth services that meet the needs of its participants, namely interbank funds transfer, third party funds transfer, as well as capital and retail payment settlements. Additionally, BAHTNET provides the PvP settlement service between THB and USD to mitigate the FX settlement risk for its participants.

In case of a new initiative for system development driven by a change in payment environment and new technology, the BOT will discuss with relevant stakeholders including BAHTNET Advisory Group (AG) as well as other central banks to ensure an exchange of their views and capability among related parties in coping with the updated insights. The consultation forum with the advisory group is established as an important mechanism to ensure that services are provided in alignment with participants' needs. BAHTNET AG comprises representatives from the Thai Bankers' Association, the Association of International Banks, Specialized Financial Institutions (SFI), and the TSD. A development of new features or functions will be discussed with the BAHTNET AG to ensure that specific initiatives meet the needs of BAHTNET participants and the market, as well as being in line with international standards. The BAHTNET AG consultative meeting is held when necessary or at least annually. A specific working group can be set up under this framework in order to tackle the topic of interest.

Another mechanism to ensure that BAHTNET meets participants' needs is an industry survey. In general, participants' survey are undertaken when the BOT plans any feature improvement for BAHTNET. Furthermore, the BOT hosts hearing sessions with all participants as a 2-way communication platform for the announcement of plans, training, and industry wide testing.

In term of pricing, the BOT implements a cost recovery pricing policy, which means that the fees levied on participants must cover the BAHTNET operating cost. The pricing policy is reviewed at least every 2 years or when there is a significant change to the BAHTNET environment.

Principle 22: Communication Procedures and Standards

An FMI should use or at a minimum accommodate relevant internationally accepted communication procedures and standards in order to facilitate efficient payment, clearing, settlement, and recording.

BAHTNET has adopted internationally accepted communication standards which ensure communication between the BOT and participants in a timely, reliable, and accurate manner.

BAHTNET relies on 2 types of networks to communicate with participants: SWIFT Network (SWIFTNet) and BOT network (BOTNET/X). SWIFTNet uses communication in the SWIFT format and allows participants to develop an in-house system linkage for straight-through processing (STP) through the BOT. Meanwhile BOTNET/X is a Virtual Private Network (VPN) for which messages are in XML format developed in accordance with the SWIFT format. Note that BOTNET/X is a backup channel for SWIFT participants in the event that SWIFT is unavailable.

On communication channels, participants are able to connect with BOTNET/X through:

- BAHTNET Web channel: All BAHTNET participants are required to use this channel to inquire their information e.g., transaction status, account movement, reports, and etc.
- Host-to-Host Channel: the BOT uses this channel to link with the TSD to facilitate securities settlement as well as funds transfer transactions between government agencies and the Comptroller General's Department.

On message format, there are 2 types of message standards adopted in BAHTNET;

- SWIFT FIN Message: SWIFT participants can use SWIFT FIN Messages e.g. MT202 to send funds transfer messages and MT103 to send third-party funds transfer messages. BAHTNET will automatically convert the messages to BAHTNET XML format for settlement and further process. The messages are then converted back to SWIFT FIN message for transmission.

- BAHTNET XML: Non-SWIFT participants communicate via BAHTNET Web channel in BAHTNET XML format.

Communication between BAHTNET and USD CHATS is through Virtual Private Network (Internet Protocol) of international service providers. Transactions in the BAHTNET and USD CHATS systems are matched through the Cross Currency Payment Matching Processor (CCPMP) which is developed and owned by the HKMA.

Principle 23: Disclosure of Rules, Key Procedures, and Market Data

An FMI should have clear and comprehensive rules and procedures and should provide sufficient information to enable participants to have an accurate understanding of the risks, fees, and other material costs they incur by participating in the FMI. All relevant rules and key procedures should be publicly disclosed.

The rules and procedures, operational process of BAHTNET and other related systems/sub-systems are stated in the following documents;

- EFS
- BAHTNET Service
- ILF
- SRS

Although most documents are disclosed to the public, some are restricted for participants only as described below:

1. Public information such as rules, regulations, guidelines statistics, quantitative information, fee, Payment System Annual Report, and related articles/research are disclosed on the BOT Website.

2. Restricted documents such as BAHTNET user manual, meeting documents and attachments, training documents and annual BCP documents are on the Payment Systems' Corner of the BOT Website.

The BOT ensures participants' understanding of the rules, procedures and the risks associated with BAHTNET through training and system testing.

4. List of Resources

The following documents are publicly available:

- **BOT Laws And Regulations**

<https://www.bot.or.th/English/AboutBOT/LawsAndRegulations/Pages/default.aspx>

- **Committee**

<https://www.bot.or.th/English/AboutBOT/Committee/Pages/default.aspx>

- **Organization And Executives**

<https://www.bot.or.th/English/AboutBOT/OrganizationAndExecutives/Pages/OrganizationChart.aspx>

- **BOT's Payment System Services**

<https://www.bot.or.th/English/PaymentSystems/PSServices/Pages/default.aspx>

- **BAHTNET System**

<https://www.bot.or.th/English/PaymentSystems/PSServices/bahtnet/Pages/default.aspx>

- **Payment Systems Committee (PSC)**

<https://www.bot.or.th/English/PaymentSystems/PSC/Committee/Pages/default.aspx>

- **Statistics**

<https://www.bot.or.th/English/Statistics/PaymentSystems/Pages/default.aspx>

- **Financial Reports**

<https://www.bot.or.th/English/AboutBOT/FinancialReports/Pages/default.aspx>