



Assessment of Kronos

According to Core Principles for Systemically
Important Payment Systems

March 2012

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1. Introduction

Kronos, Danmarks Nationalbank's real-time gross settlement (RTGS) system for the settlement of payments in Danish kroner, plays a key role in the Danish payments infrastructure, as Kronos settles payments on behalf of banks and mortgage banks in Denmark. On a daily basis, payments worth an average of around kr. 250 billion are settled. Therefore, it is essential that payments via Kronos are settled in a reassuring manner. A safe and efficient RTGS system contributes to financial stability.

Danmarks Nationalbank oversees systemically important payment and settlement systems to ensure the safety and efficiency of these systems. The oversight function involves assessing the systems' observance of international standards and recommendations. Kronos is one of three systemically important Danish payment and settlement systems.¹ The objective of this report is to assess whether Kronos observes the Core Principles for Systemically Important Payment Systems, CPSIPS.

Chapter 2 of this report describes the key elements of Kronos and the role of Kronos in the financial infrastructure. Chapter 3 presents the assessment of Kronos against the CPSIPS.

1.1 DANMARKS NATIONALBANK'S OVERSIGHT FUNCTION

Danmarks Nationalbank's overall role in relation to payment and settlement systems is defined in section 1 of the Danmarks Nationalbank Act, which states that the objective of Danmarks Nationalbank is to "maintain a safe and secure currency system in Denmark, and to facilitate and regulate the traffic in money and the extension of credit". Danmarks Nationalbank's oversight function is derived from this section. In 2006, Danmarks Nationalbank's responsibility for oversight of payment systems was also enshrined in the Danish Securities Trading Act². Pursuant to section 86(2) of this act, Danmarks Nationalbank is to oversee systemically important payment systems.

As Kronos is at the hub of the Danish payments infrastructure, it is systemically important. Virtually all krone-denominated payments,

¹ The two other systems are the Sumclearing and VP settlement. The Sumclearing is a multilateral net settlement system for clearing and settlement of retail payments. VP settlement is a multilateral net settlement system for clearing and settlement of securities transactions, etc.

² Consolidated Act No. 959 of 11 August 2010.

except cash payments and payments between customers of the same bank, are settled via Kronos. Settlement is effected either through an interconnected payment or settlement system or as an interbank payment transferred directly between the banks' accounts at Danmarks Nationalbank. As Danmarks Nationalbank sets interest rates through monetary-policy operations settled via Kronos, Kronos is also an important tool in Danmarks Nationalbank's monetary policy.

In practice, Danmarks Nationalbank's oversight function entails that Danmarks Nationalbank regularly assesses whether the systemically important payment and settlement systems observe international standards. The scope and contents of Danmarks Nationalbank's oversight function are described in more detail in Danmarks Nationalbank (2007).

1.2 DELIMITATION

The Kronos system comprises an IT infrastructure, i.e. hardware, software and telecommunications lines, as well as rules and procedures governing the system.

The assessment of Kronos includes the Kronos terminal (participants' "Internet banking" access to Kronos) and the Poseidon module, which translates payment messages between the Kronos terminal and SWIFT. Also included are the communication lines connecting the systems, participants and Danmarks Nationalbank. The actual booking of transactions in Kronos is effected via accounts at Danmarks Nationalbank in Danmarks Nationalbank's bookkeeping system DN-bogføring. This function is included in the assessment.

Pledging of collateral for intraday credit via Kronos is handled through Danmarks Nationalbank's collateral pledging system (the Tier List System) and the collateral custody account system (S-System), which is operated by VP. The Tier List System and the S-System are not included in this assessment report. The plan is to assess the collateral pledging systems in a separate internal analysis in 2011-2012. Pledging of collateral via the automatic collateralisation arrangement, managed by VP, is not assessed in this report either.

The assessment includes transactions settled via Kronos. Other systems that settle via Kronos are not included separately in this assessment report. These systems are the DN Inquiry and Transfer System for handling monetary-policy operations and cash depots; Scandinavian Cash Pool, SCP, the pan-Scandinavian system for pledging of cross-border collateral; FUTOP clearing centre; Continuous Linked Settlement, CLS, the international settlement system for foreign-exchange

transactions (included in an assessment report prepared by the CLS Oversight Committee); and the Sumclearing and VP settlement. Danmarks Nationalbank prepares separate assessment reports for the Sumclearing and VP.¹

1.3 CORE PRINCIPLES FOR SYSTEMICALLY IMPORTANT PAYMENT SYSTEMS

Kronos is assessed in relation to the "Core Principles for Systemically Important Payment Systems" (CPSIPS), issued by the Committee on Payment and Settlement Systems under the Bank for International Settlements (BIS).² CPSIPS comprises 10 Core Principles against which Kronos is assessed and evaluated. These Core Principles determine the overall requirements to be met by a well-functioning payment system in relation to risk management and efficiency.

Chapter 3 of this assessment report contains a section on each Core Principle. Each section assesses the degree of observance of the Core Principle, summarises any recommendations for Kronos identified as a result of the assessment and provides an in-depth description of Kronos in relation to the Core Principle. The description also serves as justification for the assessment made.

New international principles for financial market infrastructures are being developed. These new principles and their possible implications for Kronos are addressed in section 3.11 and, in some cases, they are included in individual sections on the current Core Principles under the heading of "New international principles".

Five categories are applied when assessing the degree of observance of each Core Principle: *observed*, *broadly observed*, *partly observed*, *non-observed* and *not applicable*.

- ◆ **Observed** – used whenever all assessment criteria are generally met without any significant deficiencies.
- ◆ **Broadly observed** – used whenever only minor shortcomings are found, which do not raise major concerns, and when corrective actions to achieve full observance of the CP are scheduled and realistically achievable within a prescribed period of time.
- ◆ **Partly observed** – used whenever the shortcomings are sufficient to raise doubts about the ability to achieve observance within a reasonable time frame.

¹ The reports are available at www.nationalbanken.dk.

² See BIS (2001).

- ◆ **Non-observed** – used whenever major shortcomings are found in adhering to the assessment criteria.
- ◆ **Not applicable** – used whenever the CP does not apply given the structural, legal and institutional conditions.

The assessment of Kronos in relation to the Core Principles has been performed by Payment Systems at Danmarks Nationalbank. The assessment is based on self-assessment under which Accounting at Danmarks Nationalbank, the system owner of Kronos, responds to a number of questions relating to each of the 10 Core Principles. In addition to this self-assessment, general legislation, rules (including Danmarks Nationalbank's terms and conditions for accounts), agreements, user manuals, procedures and system descriptions, etc., for Kronos are included in the assessment basis. The assessment is based on information collected until end-October 2011.

1.4 SUMMARY

The table below shows the overall conclusions for Kronos in relation to the individual Core Principles:

Core Principle no.		Assessment
I	Legal basis	Observed
II	Understanding financial risks	Observed
III	Management of financial risks	Observed
IV	Prompt final settlement	Observed
V	Settlement in multilateral netting systems	Not applicable
VI	Settlement assets	Observed
VII	Security and operational reliability	Broadly observed
VIII	Efficiency	Observed
IX	Access criteria	Observed
X	Governance	Observed

The assessment report includes a number of comments and recommendations in relation to Kronos, but in most cases the Core Principle is nonetheless *observed*. Only Core Principle VII did not result in

this top assessment. Comments and recommendations are summarised below:

Core Principle II

- The "Kronos Getting Started" user manual should be updated to reflect, *inter alia*, that since 2008 euro-denominated payments have been settled via Target2 – not via the Kronos terminal. The lack of updating is inexpedient, especially since no training is offered to new participants and new users employed by existing participants.

Core Principle VII

Recommendation resulting in *Broadly Observed*:

- It is recommended that, in future, Kronos risk analyses be performed in connection with major system changes. Moreover, the risk analysis should be updated on a regular basis, e.g. annually. Performance and follow-up on risk analyses should be considered an ongoing process.

Other recommendations for Core Principle VII:

- There are no standard procedures for monitoring technological advances and assessing whether such advances should result in changes to Kronos, e.g. in technical components or updating of security standards. It is recommended that such procedures be established.
- The overall risk assessment for business continuity of payment systems from 2007, including Danmarks Nationalbank's role as settlement bank, should be updated to reflect that the National Service Desk has been relocated and that Target was replaced by Target2 in 2008.
- Procedures should be implemented for periodic testing of the Kronos security measures to ensure that system security complies with the requirements specified and that any weaknesses can be identified and addressed.
- The agreement with BEC on the development and operation of Kronos should be updated to formalise the ongoing collaboration and existing follow-up process and to clarify and/or tighten requirements in a few respects.
- BEC has two SWIFT lines, but uses the same network operator for both lines. In other words, the network operator represents a potential single point of failure. It is recommended that a risk assessment be

performed in relation to continuing with only one network operator. The risk should be weighed against the costs of using two network operators.

- Implementing procedures for periodic testing of crisis management and communication policy in relation to Kronos should be considered.
- Although Danmarks Nationalbank currently finds that a four-hour time frame is sufficient for switching between centres 1 and 2 in Kronos, it should be assessed on a regular basis whether the time frame of a maximum of four hours for switching between centres is still sufficient.

Core Principle VIII

- The agreement between Danmarks Nationalbank and BEC stipulates that Kronos must be able to process up to 1,000 cross-border payments per hour. Cross-border payments are no longer settled via Kronos, and during peak hours Kronos settles more than 1,000 payments per hour. In practice, capacity is sufficient, but the agreement should reflect the actual need.

Core Principle IX

- The Kronos terminal is currently available in Danish only. Translating it into English should be considered to eliminate language barriers for foreign participants.
- Kronos has no standard procedures for the suspension and exclusion of participants. Such procedures should be developed.

1.5 FOLLOW-UP

Concurrently with the completion of this assessment report, efforts have been made to comply with the recommendations of the report.

A risk analysis of the IT security of Kronos is being performed and is expected to be completed in the 1st half of 2012. The risk analysis will be revisited on a regular basis or in case of major system changes. As a result, Core Principle VII is expected to be fully observed.

In March 2012, a revision of the agreement between Danmarks Nationalbank and BEC was initiated, and in connection with a planned restructuring of Kronos operations, two network operators will be used for BEC's SWIFT lines, starting in April 2012. Other minor recommendations are also expected to be met during the 1st half of

2012, but an English version of the Kronos terminal will not be developed at present. This would be very cost-intensive – also in light of the fact that only one foreign participant is currently using Kronos on a regular basis. A Kronos Quick Guide is available in English and telephone support is also provided. If more foreign participants are connected to Kronos in the future, the possibility of implementing an English version of Kronos will be reconsidered.

2. Description of Kronos¹

Kronos is a real-time gross settlement (RTGS) system that is used for real-time settlement of individual, primarily large or time-critical, payments in Danish kroner. Kronos is used mainly for interbank payments and payments between account holders at Danmarks Nationalbank; for the settlement of monetary-policy transactions in Denmark; and for the settlement of payments in Danish kroner on behalf of other settlement systems in the Danish payments infrastructure: the Sumclearing, VP, CLS and FUTOP. Settlement of payments for the Sumclearing, VP, CLS and FUTOP typically takes place via separate settlement accounts in Kronos for the respective systems.

In 2010, an average of 3,068 payments were settled via Kronos every day, at an average daily value of kr. 238.4 billion, cf. Table 1. The average value of a single payment was kr. 77.7 million. Kronos does not operate with any upper or lower limit on the size of individual payments, but in practice, only 1 per cent of the payments are lower than kr. 1,000 and only 1 per cent are higher than kr. 10 billion.

PAYMENTS SETTLED VIA KRONOS, AVERAGE PER DAY					Table 1
Kr. Billion	2006	2007	2008	2009	2010
Interbank payments	132.2	124.1	119.8	105.5	108.1
Open-market operations	32.3	54.9	88.7	70.3	29.4
Transfers to settlement systems	87.8	93.0	97.2	99.1	99.6
Other transactions	1.8	2.1	2.0	1.2	1.2
Total	254.0	274.1	307.7	276.0	238.4

Note: Transactions are calculated as debit transactions via current accounts at Danmarks Nationalbank. Hence transfers to other payment and settlement systems exclude use of automatic collateralisation, for which debit transactions are made via separate accounts.

Source: Danmarks Nationalbank.

Kronos was launched on 19 November 2001 to replace the previous RTGS system for Danish kroner: DN Inquiry and Transfer System.

¹ For further information on Kronos and the Danish payments infrastructure, see Danmarks Nationalbank (2005).

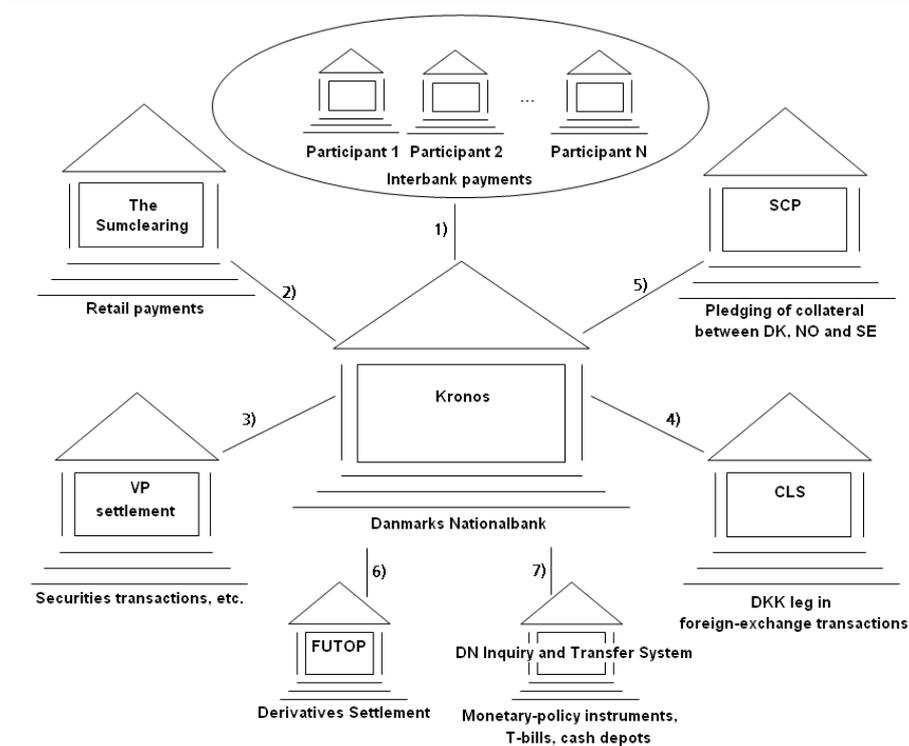
2.1 THE ROLE OF KRONOS IN THE DANISH PAYMENTS INFRASTRUCTURE

Kronos is at the hub of Danish payment systems, cf. Chart 1. Most banks – including all major banks – and mortgage banks in Denmark hold accounts at Danmarks Nationalbank in the same way that private individuals hold accounts with retail banks. In other words, Danmarks Nationalbank acts as banker to the banks for payments in Danish kroner. In addition to banks, a number of payment and settlement systems and clearing centres hold accounts at Danmarks Nationalbank.

Kronos is the system for processing payments into and out of the banks' accounts at Danmarks Nationalbank. Krone-denominated payments involving more than one bank are ultimately settled via Danmarks Nationalbank – either through a payment or settlement system, or as an interbank payment settled directly between the banks' accounts at Danmarks Nationalbank.

SETTLEMENT VIA KRONOS

Chart 1



As Chart 1 shows, several payment types are settled via Kronos:

- Re 1) Interbank payments are payments between two financial institutions in the interbank market, also known as the money market. These payments are settled individually immediately after Danmarks Nationalbank's receipt of the payment instructions. If both institutions are Kronos participants, the payment may be settled via their current accounts at Danmarks Nationalbank. If the institutions are not Kronos participants, they may settle the payment via correspondent banks that are Kronos participants. Kronos participants may also settle payments via Kronos on behalf of their customers, i.e. customer payments.
- Re 2) The Sumclearing is the Danish Bankers Association's system for settlement of retail payments. Nearly all Danish retail payments are settled via this system, e.g. Dankort transactions, Betalingservice (direct debit), credit transfers. The system is operated by Nets. The final transfer of funds between Sumclearing participants takes place via accounts at Danmarks Nationalbank.
- Re 3) VP settlement is VP's system for settlement of securities transactions and periodic payments (interest, repayments and dividend). For securities transactions, the securities leg is settled through VP, while the cash leg is settled via the participants' accounts at Danmarks Nationalbank.
- Re 4) CLS is an international system for settlement, primarily of foreign-exchange transactions, in 17 currencies. CLS Bank International was established in 2002 by some of the world's largest banks. The Danish krone joined CLS in 2003, after which pay-ins and pay-outs for settlement of the krone leg of participants' foreign-exchange transactions take place over CLS Bank's account at Danmarks Nationalbank. In 2007, CLS was extended to include settlement of payments relating to credit derivatives.
- Re 5) SCP (Scandinavian Cash Pool) is a system for pledging of cross-border collateral for intraday credit in Danish and Norwegian kroner and Swedish kronor. The system was established in 2003 and is available to credit institutions in Denmark, Norway and Sweden that participate in the payment systems of their respective central banks.
- Re 6) FUTOP is a clearing centre for clearing and settling transactions in futures and options in Danish securities. Clearing and settlement is performed by OMX Derivatives Markets/Stockholmsbörsen AB. Danmarks Nationalbank makes accounts available for the

administration of margin requirements for transactions. Settlement of net positions takes place via participants' current accounts at Danmarks Nationalbank.

Re 7) DN Inquiry and Transfer System was Danmarks Nationalbank's RTGS system from 1981 until it was replaced by Kronos in 2001. The system is currently used for handling of monetary-policy instruments and cash depots.

2.2 OWNERSHIP

Kronos is owned by Danmarks Nationalbank. The Accounting Department is the system owner and has operational responsibility for the system. The actual operation of the system has been outsourced to Bankernes EDB Central, BEC, entailing that BEC is the system operator with responsibility for day-to-day operations of hardware and software developed for Kronos. BEC operates several major systems owned by Danmarks Nationalbank. An agreement has been drawn up between Danmarks Nationalbank and BEC to govern responsibility, rights and obligations: "Agreement between Danmarks Nationalbank and BEC on data processing services" (in Danish only). The contract has a number of sub-appendices relating to the individual systems operated by BEC on behalf of Danmarks Nationalbank, including Kronos. BEC in turn has outsourced all operations to JN Data, but this is of no consequence for the agreement between BEC and Danmarks Nationalbank.

2.3 OPENING HOURS

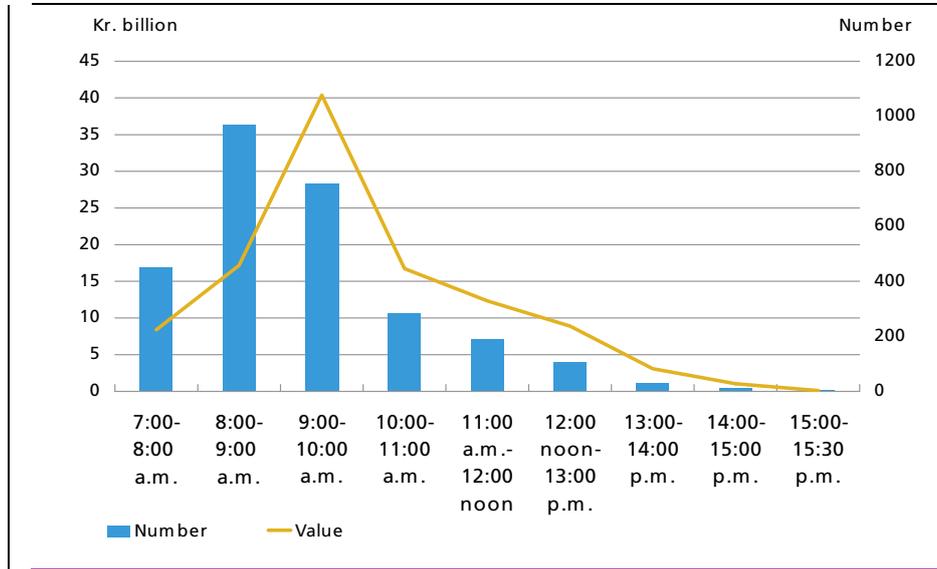
Kronos is open for krone payments on all Danish banking days between 7:00 a.m. and 3.30 p.m. In addition, it is open between 4:00 and 4:30 p.m. for transfers from current accounts to settlement accounts for the night-time Sumclearing and VP settlements.

VP and the Sumclearing are able to settle payments in settlement accounts outside Kronos' opening hours. Settlement has been scheduled to enable participants, as far as possible, to use the same liquidity for various settlements. On conclusion of the settlement, the balance of the settlement accounts is automatically transferred back to the participants' current accounts. The Sumclearing has usually been finally settled before Kronos opens at 7:00 a.m. VP runs six settlement batches for securities transactions and another four settlement batches, some of which take place during the day, others at night. In terms of value, most of the VP settlement takes places outside Kronos' opening hours.

At 7:00 a.m., participants begin to execute the day's interbank payments. Payments may be executed all day until Kronos closes at 3:30 p.m., but most payments are settled in the morning, cf. Chart 2.

INTERBANK PAYMENTS VIA KRONOS IN 2010, BROKEN DOWN BY TIME OF PAYMENT, AVERAGE PER DAY

Chart 2



In 2015, opening hours will be extended to 4:45 p.m. as part of the implementation of Target2-Securities (T2S) in Denmark. Future settlement procedures will also be changed as a result of T2S.

2.4 PARTICIPANTS AND ACCESS CRITERIA

All holders of current accounts at Danmarks Nationalbank must participate in Kronos, and to become a current-account holder, participation in Kronos is required. Kronos participants must be connected to a data processing centre.

Kronos participants are primarily banks, mortgage banks and branches of foreign credit institutions. Investment firms may also participate in Kronos. All participants must be subject to supervision by the Danish Financial Supervisory Authority or subject to supervision in another EU member state or a country with which the EU has concluded a cooperation agreement on supervision in the home country. In addition, other entities may participate if, in the assessment of Danmarks Nationalbank, they play a significant role in relation to the settlement of

payments. Examples include CLS Bank and Euroclear Bank. At end-2010, Kronos had 121 participants.

2.5 ACCOUNT STRUCTURE

In Kronos, transactions are settled between accounts at Danmarks Nationalbank. The account structure at Danmarks Nationalbank is governed by *Documentation for monetary-policy instruments and settlement of payments in DKK, EUR, SEK and ISK* ("terms and conditions for accounts").

All account holders must hold a mandatory current account in Danish kroner. Account holders may also have connected accounts for the settlement of monetary-policy operations, as well as various settlement accounts related to settlement of payment and securities settlement systems at Danmarks Nationalbank. Current-account holders may request one or more of the following accounts:

- Sumclearing account
- VP settlement accounts, including settlement accounts for trading transactions and periodic runs and a PvP settlement account
- Automatic collateralisation account
- CLS settlement account
- SCP loan accounts and pledged collateral accounts

Current-accounts accrue interest at the monetary-policy interest rate, i.e. the current-account rate. Interest is calculated on the basis of the balance when the monetary-policy day ends at 3:30 p.m. Settlement accounts do not accrue interest and no interest is charged for intraday credit. At the end of the monetary-policy day, all intraday current-account overdrafts must be covered, and settlement accounts must be emptied.

2.6 THE STRUCTURE OF KRONOS

Kronos comprises two modules that can be selected as required: the basic module and the Poseidon module.

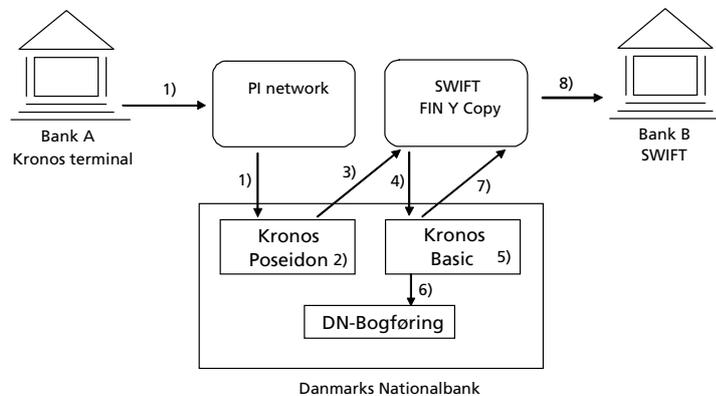
All participants have access to the **basic module** that gives access to execute payments manually via the Kronos terminal, which uses its own network, the PI network. The PI network is a closed network linking together the data centres of Danish banks, VP Securities (VP), Nets and Danmarks Nationalbank. Basically, the Kronos terminal is the participants' Internet banking access to Kronos. Participants can use the

terminal for settling payments and keeping up-to-date on account movements and status.

The Poseidon module is an optional module for participants wishing to remit payments in the SWIFT¹ format. Participants with SWIFT typically have their own automated systems that are designed to facilitate Straight-Through Processing (STP), i.e. processing of payments without manual intervention. The Poseidon module automatically translates payment messages between the Kronos terminal and SWIFT, enabling participants with and without SWIFT to remit payments to each other, although they do not use the same network language, cf. Chart 3. Participants who have opted for the Poseidon module are charged separately for this module, as well as for the "translation" of payment messages to/from the SWIFT format.

PAYMENT IN KRONOS VIA THE POSEIDON MODULE

Chart 3



- 1) Bank A remits payment message to Kronos (Poseidon) from the Kronos terminal via the PI network
- 2) Kronos (Poseidon) validates the payment message
- 3) Kronos (Poseidon) translates the payment message into a SWIFT message, which is sent to FIN Y Copy
- 4) FIN Y Copy copies parts of the payment message, which are sent to Kronos
- 5) Kronos validates the SWIFT payment message
- 6) Kronos checks for adequate cover and books the payment to DN-Bogføring
- 7) Kronos sends confirmation that the payment has been booked to FIN Y Copy
- 8) FIN Y Copy sends a SWIFT message to the recipient bank B

Participants with SWIFT typically remit nearly all payments via SWIFT, while participants without SWIFT remit all their payments manually via the Kronos terminal. To accommodate both large and small participants, Kronos does not require participants to have SWIFT to be able to remit

¹ SWIFT (Society for Worldwide Interbank Financial Telecommunication) is a secure global network for financial communication.

and receive payments via Kronos. Participants with SWIFT may opt to remit payments via the Kronos terminal where advantageous.

2.7 KRONOS FUNCTIONS

The Kronos terminal allows participants to enter payments, view entries in own accounts, monitor and manage queued payments, monitor clearing and settlement procedures and receive news from Danmarks Nationalbank, as well as downloading historical entries.

Participants may choose between four types of payment:

- Payments to other account holders (could be remitted via an MT202 SWIFT message)
- Transfers between own accounts
- Payments to and from a customer (could be remitted via an MT103 SWIFT message)
- Transfers of funds to bridge accounts for cash depots in connection with distribution of cash from a depot.

Account holders with SWIFT may choose to settle payments to other account holders with SWIFT via SWIFT messages. Account holders who have opted for the Poseidon module may remit SWIFT payments to all Kronos participants.

In addition, participants are able to create standing orders, i.e. fixed transfers from a current account to the connected settlement accounts used for transferring liquidity to e.g. the Sumclearing or VP settlement.

Kronos offers participants two queuing facilities, a liquidity queue and a value date queue, to support their liquidity management. Kronos allows participants with SWIFT to remit payments for settlement on a future value date up to 14 banking days before the value date. The Kronos terminal gives participants access to view and cancel payments in their value date queue.

If there are insufficient funds for payments remitted for settlement, these payments are placed in the participant's liquidity queue until adequate funds are available in the current account. Kronos seeks to settle payments in the order in which they are received, i.e. the FIFO¹ principle. If there is insufficient cover for the first payment, the subsequent payments in the queue will not be settled either. However, participants may opt for a bypass function, whereby it is nevertheless sought to settle the subsequent payments. If there are unsettled

¹ First-In, First-Out.

payments in the liquidity queue when Kronos closes, these payments are rejected.

Kronos has an optimisation procedure, the gridlock resolution mechanism, for ongoing check of liquidity queues for gridlocks, i.e. situations where several participants' payments are mutually awaiting each other's settlement. Gridlocks are resolved by settling a group of payments simultaneously, provided that no participants' accounts are then overdrawn.

2.8 PRICES

According to Danmarks Nationalbank's pricing policy for Kronos, external costs for operation and development of Kronos are charged to participants, while internal costs are paid by Danmarks Nationalbank. External expenses cover expenses to BEC. Internal costs are Danmarks Nationalbank's costs in relation to e.g. staff and IT.

For each participant, the pricing structure has two components:

1. A monthly fee to cover current fixed operating costs and any costs related to development of Kronos.
2. A variable monthly consumption charge to cover the individual account holder's actual use of the system.

There is no connection fee for new participants. The monthly fee depends on the individual participant's choice of modules in Kronos and a distribution key based on the participant's volume of working capital. This entails that large banks, which typically settle many payments via Kronos, pay a significantly higher monthly fee, while small participants pay less. The variable monthly consumption charge depends on the number and type of transactions settled by a participant.

The price per payment is set out in the price list in Table 2. Under the Kronos pricing structure, the price of a payment falls with the number of payments settled by the participant. This gives participants settling many payments an incentive to settle payments individually via Kronos rather than netting mutual payments before settlement. Bilateral netting of payments before settlement increases participants' credit risk towards each other, resulting in less secure settlement of payments.

TRANSACTION PRICES IN KRONOS		Table 2
Price per transaction in kr.		
Payments		
Domestic payment: ¹⁾		
0 – 1,000 payments per month		1.00
1,001 – 2,500 payments per month		0.50
2,501 – 5,000 payments per month		0.25
5,001 →		0.10
Own transfers, including standing orders ¹⁾		1.00
Poseidon/SWIFT payment from terminal account holder ²⁾		3.57
Poseidon/SWIFT payment to terminal account holder		3.56
The Kronos terminal		
Handling fee per license per month		35.00
Terminal update per update		0.015
SWIFT service messages		
SWIFT MT 900, MT 910, MT 941, MT 942, MT 298sub251, MT 298sub999 ...		1.00

Note: The prices stated have been calculated using the euro exchange rate applying at end-January 2011. The price of Poseidon payments and SWIFT service messages varies with the exchange rate of the euro, as Danmarks Nationalbank's SWIFT costs are settled in euro. For invoicing purposes, the exchange rate at the time of invoicing is applied.

¹⁾ Rejected domestic payments are free of charge.

²⁾ The Poseidon transaction price is paid by account holders with SWIFT who have activated the Poseidon module, whether or not payments are remitted to or received from terminal account holders. For remitted payments, the transaction price of a domestic payment must be added to the transaction price.

2.9 INTRADAY CREDIT EXTENSION AND PLEDGING OF COLLATERAL

As a consequence of the continuous individual settlement of all payments in an RTGS system such as Kronos, participants have a large intraday liquidity requirement. In order to ensure that participants have sufficient liquidity for flexible settlement of payments, Danmarks Nationalbank offers participants access to intraday credit. This facility comprises overdrafts on the account holders' current accounts at Danmarks Nationalbank and is extended against a broad range of securities as collateral.

Account holders can pledge collateral for intraday credit by way of *traditional pledging of collateral*, *certificates of deposit* and through various arrangements: *automatic collateralisation* (floating charge)¹⁾,

¹⁾ Automatic collateralisation relates to collateral for intraday credit in Danish kroner. Under the automatic collateralisation arrangement, account holders pledge collateral in the form of securities in one or more appointed custody accounts at VP, typically their trading accounts. Unlike traditional pledging of collateral, automatic collateralisation does not bind specific assets in a custody account. Instead, part of the value of the account holder's securities less a haircut is pledged to Danmarks Nationalbank – corresponding to the credit extended. The account holder is free to dispose of the securities in the custody account, provided that the total value of the account exceeds the total credit under the automatic collateralisation arrangement.

Scandinavian Cash Pool (SCP) and the manual Nordic correspondent central banking model (CCBM).

The **collateral value** of the securities pledged is calculated on the basis of the market value, less a valuation haircut. The haircuts applied are based on the liquidity of the securities and their remaining term to maturity. If euro-denominated securities are pledged as collateral for credit facilities in Danish kroner, a currency haircut is also deducted.

The collateral basis is limited to securities for which the underlying legislation ensures high credit quality. The permanent collateral basis for credit facilities in Danish kroner comprises the following securities denominated in Danish kroner or euro:

- Securities issued by the Kingdom of Denmark.
- Bonds guaranteed by the Kingdom of Denmark.
- Bonds issued by KommuneKredit and Danish Ship Finance.
- Mortgage bonds and covered bonds (SDOs) issued by institutions subject to the Danish Financial Business Act.
- Junior covered bonds issued pursuant to section 33(e) of the Danish Mortgage-Credit Loans and Mortgage-Credit Bonds etc. Act or section 152(b) of the Danish Financial Business Act.
- Bonds issued by Føroya Landstýri (the Faroese government).
- As from 1 October 2011: banks' lending of good quality.

Furthermore, Danmarks Nationalbank has temporarily expanded the collateral basis for credit facilities in Danish kroner during the financial crisis. The temporary expansion currently includes shares in companies jointly owned by the banks (sector company shares) and – until the expiry in 2013 – government-guaranteed unsecured debt issued by banks and mortgage banks (bank bonds), government-guaranteed junior covered bonds that are not included in the permanent collateral basis, cf. above, and SPV bonds issued on the basis of government-guaranteed loans to Danish banks and mortgage banks.

Pledging of collateral at Danmarks Nationalbank is described in more detail in Poffet (2010).

Pledging of collateral is administered through several IT systems: the Tier List System, the collateral custody account system S-System and Kronos.

Danmarks Nationalbank's Tier List System generates tier lists on a daily basis for Danish kroner and euro, specifying the securities that may be pledged to Danmarks Nationalbank and the collateral value of the individual securities. At 1:00 p.m. on all banking days, the tier lists are transmitted to VP, the operator of the collateral custody account system S-System. Based on the tier lists submitted, S-System calculates the

collateral value of each account holder's collateral custody account(s), which are transmitted to BEC, the system operator of Kronos.¹ BEC uses the collateral value of the collateral custody account(s) to calculate each account holder's line, i.e. the overall liquidity available to each participant.

¹ S-System also transmits a list of the collateral values calculated to Target2. This is not relevant to the assessment of Kronos.

3. Review of Kronos According to the Core Principles

This chapter reviews each of the ten Core Principles for Systemically Important Payment Systems. For each Core Principle, the chapter provides a brief assessment of whether the Core Principle is observed, supplemented by recommendations, if applicable, to Kronos. Although a Core Principle is assessed to be observed, comments with proposals for improvement may be provided. This is followed by a detailed description of the basis for the assessment of the Core Principle.

3.1 CORE PRINCIPLE I – LEGAL BASIS

The system should have a well-founded legal basis under all relevant jurisdictions.

3.1.1 Assessment

Observed.

Danish legislation and regulations and the contractual basis for Kronos generally provide a consistent, complete and reliable legal basis for Kronos. The legal basis is adequate and enforceable in relevant situations. All payments via Kronos are final and irrevocable once the amount has been debited/credited to the remitter's/payment recipient's account, even in the event of a participant's subsequent insolvency.

3.1.2 Justification

The legal basis for Kronos comprises:

- The Danmarks Nationalbank Act of 1936
- Relevant Danish legislation¹
- The contractual basis for Kronos

¹ All legislation, etc., adopted by the Folketing (Danish Parliament), is publicly available (in Danish) at retsinformation.dk. In addition, key financial sector legislation is available in English at the website of the Danish Financial Supervisory Authority at www.finanstilsynet.dk.

The Danmarks Nationalbank Act of 1936

Section 1 of the Danmarks Nationalbank Act of 1936 states that Danmarks Nationalbank shall "maintain a safe and secure currency system in Denmark, and facilitate and regulate the traffic in money and the extension of credit". This section provides the legal basis for Danmarks Nationalbank's operation of the Kronos payment system and also forms the basis of Danmarks Nationalbank's oversight of systemically important payment and settlement systems. Since 1 March 2006, the oversight function of Danmarks Nationalbank has also been enshrined in section 86(2) of the Danish Securities Trading Act.

General legislation

Danish statutory rules that are relevant to Kronos are set out e.g. in Danish law of contracts (freedom of contract) and in the provisions of the Danish Securities Trading Act, implementing the Settlement Finality Directive, cf. below. The provisions address issues in relation to the finality of payments and access to realisation of collateral. Relevant provisions are described below:

Principle of freedom of contract

Agreements entered into between two or more parties are extensively protected under the *general principle of freedom of contract* in Danish law. Danmarks Nationalbank is regarded as a special administrative unit and preparation of terms and conditions for accounts, including the Kronos rules, is a general administrative act, falling within the remit of Danmarks Nationalbank as a central bank. This entails that the terms and conditions for accounts are not up for negotiation (as opposed to traditional contractual relationships). On the other hand, Danmarks Nationalbank is subject to a number of administrative rules and basic principles in the preparation of the terms and conditions for accounts.

Statutory provisions on electronic payments

Payments via electronic transfers are recognised as legally valid, and electronic entries are accepted by Danish courts as sufficient documentation.

Finality provisions

Kronos is a designated payment system under the provisions of the Settlement Finality Directive¹ implemented in the Danish Securities

¹ Directive of the European Parliament and of the Council of 19 May 1998 on settlement finality in payment and securities settlement systems.

Trading Act. Overall, the Settlement Finality Directive focuses on two issues, viz. settlement finality in payment and settlement systems and the option to satisfy claims by realising collateral, irrespective of a participant's possible insolvency.

In compliance with section 57c of the Danish Securities Trading Act (implementing articles 3 and 5 of the Settlement Finality Directive), Kronos includes provisions on

- when a transfer order is considered to have been entered into the system
- the point in time when a transfer order that has been entered into the system can no longer be revoked by a participant or a third party.

Under the terms and conditions for accounts, a Kronos transaction has taken place when it is registered to the current account. A transaction between two or more account holders at Danmarks Nationalbank has taken place when it is registered to all accounts at Danmarks Nationalbank that are affected by the transaction.

All payments in Kronos are thus final and irrevocable, even in the event of a participant's insolvency, when the amount has been debited/credited to the account.

Netting provisions

Multilateral netting is recognised in Danish law, also in the event of insolvency proceedings against a participant, cf. section 57 of the Danish Securities Trading Act.

Since Kronos is an RTGS system in which all payments are settled individually and immediately after the payment instruction, the netting provisions are generally not relevant. The Kronos gridlock resolution mechanism does, however, include a netting element. The gridlock resolution mechanism, which must be activated manually, has never been applied.

Moreover, the recognition of netting is key to a smooth settlement procedure in Kronos, given that several multilateral netting systems settle transactions via Kronos, cf. section 2.1.1.

Statutory provisions on access to interest from pledging

In Danish law, the scope of the right of pledge generally depends on the agreement between the pledgor and the pledgee. Under "Deed of Pledge for Credit Facilities in Danish Kroner at Danmarks Nationalbank", Danmarks Nationalbank's right of pledge over securities comprises redemptions and interest on securities pledged that fall due before the time of realisation. Redemptions and interest are deposited to yield

accounts that are pledged to Danmarks Nationalbank as collateral for any debt owed by the institution to Danmarks Nationalbank now or in the future.

Provisions on enforcement of securities claims

Collateral (provided in the form of securities or cash) may be realised immediately if a previous agreement to this effect has been concluded, cf. section 57b(2) of the Danish Securities Trading Act. Such agreement has been concluded between Danmarks Nationalbank and the individual account holder under the above Deed of Pledge. It appears from this Deed of Pledge that should Danmarks Nationalbank wish to enforce its collateral rights to the securities registered to the account, Danmarks Nationalbank shall be entitled without prior legal action or warning to realise such securities in the manner determined by Danmarks Nationalbank. Furthermore, Danmarks Nationalbank shall be entitled to take over ownership of the securities so pledged.

Collateral for credit facilities in Kronos cannot be rendered null and void under sections 70(1) or 72(2) of the Danish Insolvency Act.¹ This appears from section 57b(1) of the Danish Securities Trading Act (implementing article 9 of the Settlement Finality Directive), which states that collateral provided towards a payment system registered in accordance with section 57a, a clearing centre or a central bank is not affected by the insolvency of the participant.²

Contractual basis for Kronos

The contractual basis for Kronos comprises the documentation for the settlement of payments in Danish kroner ("terms and conditions for accounts"), forming part of "*Documentation for monetary-policy instruments and settlement of payments in DKK, EUR, SEK and ISK*".³ The terms and conditions for accounts govern all relations between account holders and Danmarks Nationalbank in connection with the settlement of payments in Danish kroner at Danmarks Nationalbank. By signing the "Request for a Current Account in Danish Kroner at Danmarks Nationalbank", the account holder accepts the terms and conditions for accounts.

The terms and conditions for accounts are supplemented by the rules for connection to and use of Kronos, which can be found at Danmarks

¹ However, the collateral must have been provided without undue delay after the shortage of collateral occurred, and the collateral must have been provided in accordance with normal procedures. These conditions are observed by Kronos.

² It should be noted that the issue of pledge for antecedent debt is not de facto relevant with respect to Kronos, as a participant's maximum intraday credit is calculated based on collateral pledged prior to the extension of the credit facility.

³ Cf. Danmarks Nationalbank (2010).

Nationalbank's website. Danmarks Nationalbank's terms and conditions for accounts and rules for connection are publicly available, e.g. at Danmarks Nationalbank's website.

In addition to the terms and conditions for accounts, Danmarks Nationalbank has entered into settlement agreements with the owners of the other settlement systems, including e.g. VP and the Danish Bankers Association, which owns the Sumclearing system. The settlement agreements govern the terms for cash settlement via the participants' settlement accounts at Danmarks Nationalbank and specify the services to be performed by each party and when and how these services are to be performed, and include agreements on contingency procedures, as well as provisions on how the participants are to act in the event of insolvency, etc. among the participants.

The actual operation of Kronos has been outsourced to BEC, the provider of IT services to Danmarks Nationalbank. This outsourcing relationship is governed by "Agreement between Danmarks Nationalbank and BEC on data processing services" (in Danish only).

Participation in Kronos

All participants must accept the terms and conditions for accounts, thereby accepting that Kronos is governed by Danish law, which has implemented the provisions of the Settlement Finality Directive.

Foreign participants¹ are subject to the terms and conditions for accounts in the same manner as Danish participants. Foreign participants who are non-EU residents must document their home country's legal recognition of the finality and irrevocability of payments transacted via Kronos, even in the event of insolvency proceedings against the participant. Foreign participants who are EU residents are subject to the Settlement Finality Directive.

Exclusion of participants

Participation in Kronos requires that account holders open a current account in Danish kroner. Under clause 3 of "Terms and Conditions for a Current Account in Danish kroner", Danmarks Nationalbank is entitled, at any time and without notice, to terminate the current account and/or exclude the account holder from the monetary-policy instruments, regardless of whether a breach has occurred, and to require the immediate repayment of any outstanding balance. If the outstanding balance is not repaid, Danmarks Nationalbank is entitled to seek

¹ "Terms and Conditions for a Current Account in Danish kroner at Danmarks Nationalbank" set out the foreign institutions that may open a current account at Danmarks Nationalbank, and hence be connected to Kronos.

fulfilment without notice against the collateral pledged by the account holder.

Insolvency

In the event of a participant's insolvency, Danmarks Nationalbank will immediately block all accounts, including the current account and settlement accounts for outgoing payments. However, prior to blocking, any settlement will be effected via settlement accounts if Danmarks Nationalbank has submitted irrevocable credit lines for the system using the settlement accounts in question. At the end of the monetary-policy day on which the insolvency order was issued, usually at 3:30 p.m., the current account is also blocked for incoming payments to the institution, which will subsequently be rejected. Until the account is blocked for incoming payments, all payments will be accepted and credited to the institution's current account.

Immediately after the insolvency – or as soon as Kronos opens – Kronos notifies all participants of the insolvency and provides information on the rules governing outgoing and incoming payments, respectively. At the end of the monetary-policy day, Kronos notifies the participants that the current account of the insolvent participant is blocked for incoming payments and is closed.

No account balances can be paid to the estate until Danmarks Nationalbank has made sure that Danmarks Nationalbank does not have any claims that may be offset against the balance.

Resolution through the Financial Stability Company

Act No. 721 of 25 June 2010 makes provision for the resolution of a distressed bank through the Financial Stability Company as an alternative to insolvency.

If a distressed bank chooses to be taken over by the Financial Stability Company under the resolution scheme (Bank Rescue Package 3), the Financial Stability Company forms and capitalises a new Financial Stability subsidiary, which acquires the assets and part of the liabilities of the distressed bank. In Kronos, resolution under Bank Rescue Package 3 is effected by the new institution taking over the former institution's account setup unchanged.

Once the Financial Stability Company has announced that the institution has been taken over by the Financial Stability Company, Kronos also notifies its participants accordingly and informs them that the new institution has taken over the former institution's account setup at Danmarks Nationalbank.

3.2 CORE PRINCIPEL II – UNDERSTANDING FINANCIAL RISKS

The system's rules and procedures should enable participants to have a clear understanding of the system's impact on each of the financial risks they incur through participation in it.

3.2.1 Assessment

Observed.

Rules and procedures for Kronos, set out in the terms and conditions for accounts, etc., provide a detailed description of the structure, functionalities, associated risks and risk management of Kronos. Collectively, this information enables participants to have a clear understanding of the financial risks they incur through their participation in Kronos.

The terms and conditions for accounts and the "Kronos Getting Started" user manual are easily accessible at Danmarks Nationalbank's website in Danish and English.

The terms and conditions for accounts are updated regularly and kept up-to-date. The "Kronos Getting Started" manual should be updated, however, as it fails to reflect e.g. that, since 2008, euro-denominated payments have been settled in Target2 – not through the Kronos terminal. This is inexpedient, especially since no training is offered to new participants and new users employed by existing participants.

3.2.2 Justification

The Kronos rules and procedures are described in "*Documentation for monetary-policy instruments and settlement of payments in DKK, EUR, SEK and ISK*"¹ ("terms and conditions for accounts"). Settlement of payments in Danish kroner, Swedish kronor and Icelandic kroner is effected via Kronos, while settlement of euro is effected via Target2. Settlement of Swedish kronor and Icelandic kroner takes place only via VP settlement accounts in connection with VP's Kronos settlement and, consequently, is not discussed separately in this assessment report.

The terms and conditions for accounts provide a description of:

- The terminology used

¹ Cf. Danmarks Nationalbank (2010).

- Right of signatures, power of attorney and power of attorney to another participant
- Execution of transactions
- Contingency procedures
- Obligation to participate in tests
- Corrections of incorrect transactions
- Danmarks Nationalbank's responsibilities and rights
- Governing law and venue
- Statements of account, notifications and requests
- Operating days
- Fees and prices
- Four chapters on settlement of Danish kroner, Swedish kronor, Icelandic kroner and euro, respectively. Each chapter sets out the rules for the various types of account that may be used for the relevant currency, as well as terms and conditions for obtaining credit and for collateral.
- A chapter containing fax formats for settlement using contingency procedures.

The terms and conditions for accounts are supplemented by a number of documents on prices, collateral, the tier list of eligible securities, technical specifications for connection to Kronos, authorisations and the "Kronos Getting Started" user manual¹, describing how to use the Kronos terminal, including how to settle payments, use of liquidity facilities, standing orders and regular monitoring of account status.

Danmarks Nationalbank has also published "Payment Systems in Denmark"², describing e.g. the payments infrastructure in Denmark, the workings of the various payment and settlement systems and associated risks.

Between them, the terms and conditions for accounts and the supplementary material provide a detailed and elaborate description of Kronos and the financial risks that may be incurred by Kronos participants.

Availability and updating

The terms and conditions for accounts are easily available at Danmarks Nationalbank's website in Danish and English. This also applies to relevant supplementary material, including the "Kronos Getting

¹ Danmarks Nationalbank (2001).

² Danmarks Nationalbank (2005).

Started" user manual, "Payment Systems in Denmark", the Kronos¹ price list and the tier list² for eligible collateral. However, the tier list is not available in English.

The Accounting Department in Danmarks Nationalbank ensures that the terms and conditions for accounts are always updated by designating an employee responsible for ongoing updating of the terms and conditions for accounts. Changes to the terms and conditions for accounts are prepared by Legal Affairs at Danmarks Nationalbank.

The "Kronos Getting Started" user manual should be updated to reflect that, since 2008, euro-denominated payments have been settled via Target2 – not through Kronos. Also, there is no description of VP settlement's batch 60. Furthermore, the user manual should not describe how to use SWIFT messages MT100 and MT205, which are no longer used in Kronos.

Participants are encouraged to familiarise themselves with the workings of Kronos, since, when ordering a current account, they are required to sign a statement to the effect that they have understood and accept the terms and conditions of accounts. In addition, participants have to pass regular tests of contingency procedures.

Structure and settlement cycle of Kronos

The structure and settlement cycle of Kronos are described in the terms and conditions for accounts and in *Payment Systems in Denmark*. The terms and conditions for accounts describe the specific settlement times, while *Payment Systems in Denmark* provides an overall description of the structure and settlement procedure of Kronos.

Once a year, in December, Danmarks Nationalbank invites Kronos participants to attend a meeting to discuss issues such as the settlement procedure over the turn of the year – when particularly large amounts are settled via Kronos. The objective is to ensure that the participants understand the settlement procedure of the various settlement batches, including deadlines for the transfer of liquidity to the settlement batches, so that they can contribute to smooth settlement.

In addition, Kronos participants may endorse "Aftale om afgivne betalinger i DKK over foliokonto i Nationalbanken og om god valør" (in Danish only – guidelines for large payments via Kronos) with the Danish Bankers Association. The objective of the agreement is to ensure efficient management of krone liquidity in the Danish interbank market

¹ www.nationalbanken.dk, see "Rules", "Payments – Rules and Provisions", "Pricing Structure Kronos" under "More Information".

² www.nationalbanken.dk, see "Rules", "Pledging of collateral", "More Information", "List of securities accepted as collateral for credit facilities in Danish kroner" and "List of securities accepted as collateral for credit facilities in euro".

and ensure that customers do not suffer value-date losses on transfers of kr. 5 million or more via current accounts at Danmarks Nationalbank. The agreement e.g. governs settlement times for money-market transactions in Danish kroner to the effect that these are usually settled by 1:00 p.m.¹ and payments on behalf of customers and banks are settled by 2:00 p.m.² Most large Danish banks have accepted the agreement.

Description of credit and liquidity risks

The financial risks that may be incurred by Kronos participants are described in detail e.g. in "Payment Systems in Denmark".³

Credit risk is not described in the terms and conditions for accounts, since Kronos always checks for adequate cover in the participant's account prior to executing a payment, entailing that credit risk situations cannot arise. When a payment has been settled, it is final, even if the participant is subject to insolvency proceedings. Since settlement takes place via accounts at Danmarks Nationalbank, participants do not incur any credit risk on the settlement bank either.

In terms of liquidity risk, the terms and conditions for accounts describe how Kronos processes transactions in a liquidity queue; the "Kronos Getting Started" user manual and the Kronos Quick guide describe how participants can use the Kronos value date and liquidity queue functions. Reference is also made to "Payment Systems in Denmark".

Discretionary powers

In the interests of monetary and foreign-exchange-policy, Danmarks Nationalbank is at any time entitled to waive the terms and conditions for accounts, without prior notice and without liability.⁴

Under Core Principle IX, Danmarks Nationalbank is also entitled to give participants access to Kronos if, in the assessment of Danmarks Nationalbank, they play a significant role in relation to the settlement of payments at Danmarks Nationalbank. Danmarks Nationalbank is also entitled at any time without notice to terminate a participant's current account and settlement accounts and/or exclude the account holder from the monetary-policy instruments, regardless of whether a breach

¹ Provided they have been agreed by 12 noon on the value date.

² For payments on behalf of customers, the receiving bank must be notified by 1:30 p.m.

³ Danmarks Nationalbank (2005), see e.g. section 4.2.

⁴ Cf. Danmarks Nationalbank (2010), General Terms and Conditions for Monetary-Policy Instruments and Settlement of Payments in Danish Kroner, Swedish Kronor and Icelandic Kroner at Danmarks Nationalbank, clause 12.

has occurred, and to require the immediate repayment of any outstanding balance, cf. Core Principle I.

No rules have been established for the use of the gridlock resolution mechanism.

Abnormal events

Abnormal events are events during which Kronos does not work in the usual manner and contingency procedures may be activated. The Kronos contingency procedures are described in the terms and conditions for accounts¹, which also include contingency forms to be used by participants to ensure uniform and secure activation of the contingency procedures. Time schedules are established based on specific situations and participants are notified through messages via Kronos, if possible, or by telephone, etc. If Danmarks Nationalbank has advance knowledge of future abnormal events, the Danmarks Nationalbank may choose to notify participants accordingly by letter. Contingency procedures are tested every six months to ensure that participants know in advance how to respond.

Training and information

Internal users at Danmarks Nationalbank, including new employees who are to work with Kronos, receive peer training from experienced employees in the National Service Desk, cf. Core Principle III, section 3.3.2. External users are expected to be familiar with the Kronos user manual at Danmarks Nationalbank's website. Currently, no Kronos training is offered to external participants. If new participants require guidance for the system in addition to the user manual, they may contact the National Service Desk at Danmarks Nationalbank, which serves as a helpdesk for Kronos. It might be advisable to offer appropriate training, especially to new participants and new staff with existing participants.

In general, participants' knowledge of Kronos is assessed to be satisfactory. But during the summer holiday period, there tend to be more current-account overdrafts at the end of the monetary-policy day, indicating that employee knowledge of Kronos declines during this period.

¹ Cf. Danmarks Nationalbank (2010), General Terms and Conditions for Monetary-Policy Instruments and Settlement of Payments in Danish Kroner, Swedish Kronor and Icelandic Kroner at Danmarks Nationalbank, clause 5.

New international oversight principles

The requirements for training of and information to participants are expected to be tightened in the forthcoming update of the international standards for payment and settlement systems, cf. section 3.11. In future, actual training/information to participants is likely to be required in order to comply with the stricter requirements.¹

¹ Cf. BIS (2011), principle 23.

3.3 CORE PRINCIPLE III – MANAGEMENT OF FINANCIAL RISKS

The system should have clearly defined procedures for the management of credit risks and liquidity risks, which specify the respective responsibilities of the system operator and the participants and which provide appropriate incentives to manage and contain those risks.

Since Kronos is an RTGS system that provides immediate and final settlement of payments, participants do not incur any credit risk on each other. Liquidity risk is minimised through the access to unlimited intraday credit at Danmarks Nationalbank against collateral, as well as various liquidity management tools available via Kronos.

3.3.1 Justification

Participants' credit risk

Since Kronos is an RTGS system in which all payments are settled immediately on a final and irrevocable basis on the crediting of the recipient's account at Danmarks Nationalbank, the participants incur no credit risks when using Kronos. Since settlement takes place via central-bank money in accounts at Danmarks Nationalbank, participants do not incur any credit risk on the settlement bank either.

Danmarks Nationalbank's credit risk

Danmarks Nationalbank incurs a credit risk on the Kronos participants by offering them access to credit. This risk is limited significantly as credit is granted against collateral. In other words, two events are required in order for Danmarks Nationalbank to lose money: a participant is to be subject to insolvency proceedings and the value of the participant's collateral must fall below the value of the credit granted. A list has been drawn up of securities eligible as collateral. The collateral basis is described in section 2.1.9.

The collateral value of the collateral basis is calculated as the market value of securities less a haircut. The market value of the securities eligible as collateral is updated on a daily basis – however, the closing price two banking days earlier is used.

Danmarks Nationalbank may still incur a loss in the event of the insolvency of a participant if the collateral pledged by this participant is not sufficient to cover its overdraft – e.g. if the market price of the collateral pledged decreases extremely fast or in case of errors in Danmarks Nationalbank's calculations of the value of the collateral pledged. In that case, Danmarks Nationalbank will file a claim against

the participant's estate, but Danmarks Nationalbank may ultimately have to cover a potential loss.

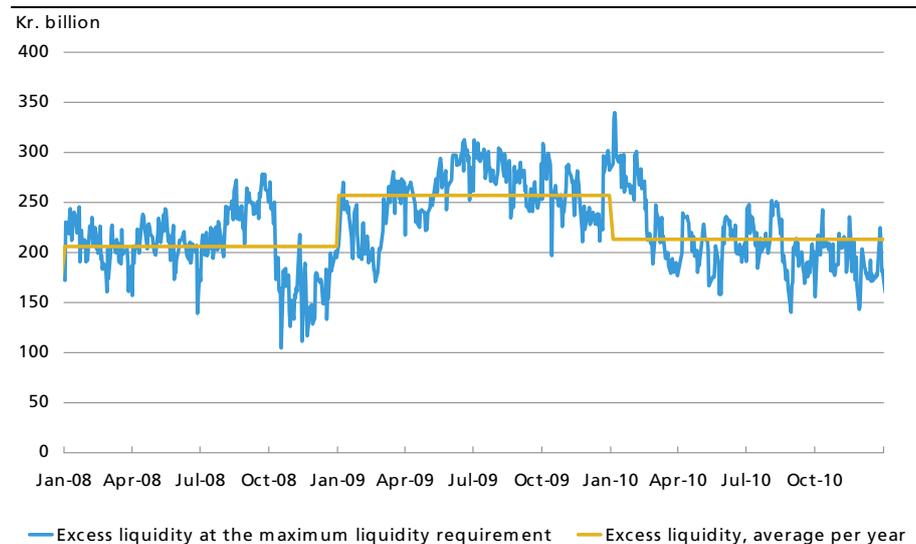
Liquidity risk

Participants' liquidity risk is limited through free access to intraday credit against pledging of collateral. Danmarks Nationalbank accepts a wide range of collateral, providing a satisfactory collateral basis. In general, participants have ample liquidity for settlement, cf. Chart 4. The collateral may quickly be exchanged for liquidity at Danmarks Nationalbank through automated procedures. Ample liquidity among participants ensures that, in general, participants' payments are settled smoothly via Kronos and that payments are rarely delayed. This serves to minimise liquidity risk.

Intraday credit must be repaid when Kronos closes at the end of the monetary-policy day (3:30 p.m.). To provide an incentive for participants to comply with this requirement, Danmarks Nationalbank imposes fines on participants in overdraft. This fine is 0.02 per cent of the overdraft, with a minimum of kr. 1,000 and a maximum of kr. 25,000. In the event of repeated overdrafts by a participant, Danmarks Nationalbank is entitled to terminate the overdraft access without notice or terminate the customer relationship with the participant in question.

EXCESS LIQUIDITY IN THE KRONOS SETTLEMENT

Chart 4



Note: Excess liquidity has been calculated as the participants' total available liquidity, i.e. their total maximum line with the addition of their current-account balances when Kronos opens at 7:00 a.m., less the participants' maximum liquidity requirement, i.e. the liquidity required by the participants to settle all payments during the day without delay.

Source: Danmarks Nationalbank.

Moreover, Kronos has a liquidity queue where payments are placed if the remitter does not have sufficient liquidity to settle the payment. The payment will remain in the liquidity queue until the participant has sufficient liquidity for the payment to be settled. Payments in the liquidity queue will be settled in the order in which they are received (the FIFO principle). Whenever the credit line of an account changes, Kronos automatically checks whether payments in the liquidity queue can be released. Participants may change the order of queued payments and select the "with bypass" functionality under which Kronos will attempt to settle, on an ongoing basis, payments in the liquidity queue which can be settled with the liquidity available.

Participants may place payments in a value date queue for up to 14 banking days before the payment is to be settled. The system also has a gridlock resolution mechanism, cf. section 2.1.7. If the gridlock resolution mechanism is activated, the liquidity queues of the participants involved will be locked while the gridlock resolution mechanism is running to prevent changes in the liquidity queues during the process.

The participants are responsible for managing their liquidity. They use their own tools, which are not part of Kronos, for liquidity management.

Ongoing oversight of Kronos

The National Service Desk at Danmarks Nationalbank, Accounting, is responsible for overseeing that all payments and settlements are effected according to established procedures and routines. The National Service Desk performs checks at established times every day to ensure timely oversight. The National Service Desk automatically receives alarms from Kronos if payments, etc. are delayed, allowing the National Service Desk to respond quickly.

BEC, Danmarks Nationalbank's Kronos system operator, has also installed a number of automatic controls and alarms that are activated in the event of operational disruptions, and it is regularly checked that the servers running Kronos are active.

Kronos also has functionalities that enable participants to monitor their transactions via Kronos on an ongoing basis. Individual participants are able to view payments settled, payments rejected and payments placed in liquidity and value date queues. Participants are also able to view a list of own standing orders for the various settlement batches and check whether the settlement batches have been completed. Finally, participants are able to view content and movements in own custody accounts. All information is available in real time. To view the latest

updates, it may be necessary for participants to initiate an update, since news through the Kronos terminal is updated every minute.

New international oversight principles

As part of the ongoing update of the international standards for payment and settlement systems, cf. section 3.11, additional recommendations are expected on the system owner's credit risk and use of collateral, which may be significant in the assessment of Kronos.¹

In the preliminary version of the new principles, it is recommended that financial infrastructures – such as payment systems – regularly measure and monitor their credit risk throughout the day. Therefore, a financial infrastructure should ensure that it has access to adequate information e.g. to assess, on an ongoing basis, the value of the collateral pledged, thereby measuring and monitoring the credit exposure of the system and the extent to which it is secured by the collateral pledged. In terms of Kronos, this will increase the need to value the collateral pledged using more updated market values than the current ones. At present, collateral is valued using closing prices dating back two days.

The new principles also recommend that systems should prevent participants from pledging excessive concentrations of certain assets as collateral because of potential concerns about the ability to liquidate the assets without significant price affects. A high concentration means that a participant pledges as collateral a high proportion of the total volume issued of a specific asset. The concentration of collateral can be managed by setting limits on the concentration of specific assets a participant may hold or by increasing the costs of pledging assets as collateral if these assets account for a high proportion of the total volume issued of this asset (concentration charges).

It is also recommended that collateral pledging systems should be sufficiently flexible in the day-to-day operational work to be able to handle current changes to the collateral pledging policy. Danmarks Nationalbank's collateral pledging system hardly meets this requirement – temporary measures during the financial crisis typically had to be implemented manually, with the inherent increase in operational risk.

¹ Cf. BIS (2011), principles 4 and 5.

3.4 CORE PRINCIPLE IV – PROMPT FINAL SETTLEMENT

The system should provide prompt final settlement on the day of value, preferably during the day and at a minimum at the end of the day.

3.4.1 Assessment

Observed.

Settlement of payments in Kronos is final and irrevocable when the amount has been debited to the remitter's account and credited to the recipient's account. After that, the payment cannot be revoked.

3.4.2 Justification

Payments are settled on a gross basis, i.e. individually, in real time. If the payment instructions are correct and there are sufficient funds available in the remitter's account to cover the payment, the payment is settled immediately. During the settlement process, the remitter's account is debited at the same time as the recipient's account is credited, and this settlement is final and irrevocable. In practice, it takes 2-3 seconds to settle a payment via Kronos in normal settlement.

Control and rejection of payments

Before a payment is settled, it is checked that the payment instruction contains all necessary information for the settlement and that the remitter has sufficient funds available to cover the payment. For batch settlement¹ separate settlements accounts are used, which are locked and not accessible by the participants until settlement has been completed. This ensures that a participant cannot remove liquidity from a settlement account during a batch settlement, which in turn ensures that the settlement batch is not delayed or interrupted.

A payment is rejected if there are errors in the payment instruction in terms of time, value date, unknown recipient or unknown currency, or if the payment was remitted outside Kronos' opening hours.

If a payment cannot be settled due to lack of liquidity, the payment is placed in a liquidity queue. If there are payments in the liquidity queue when Kronos closes, these payments are rejected.

¹ Used by other payment and settlement systems for settlement via Kronos.

Reversal of payments

If a participant remits an incorrect transaction (e.g. to an incorrect participant or an incorrect amount), and the error is not caused by Danmarks Nationalbank, Danmarks Nationalbank does not correct the transaction, which is of no consequence to Danmarks Nationalbank. Any reversal of the incorrect transaction has to be agreed bilaterally between the remitter and the recipient.

If Danmarks Nationalbank is the cause of an incorrect transaction, Danmarks Nationalbank corrects the error insofar as possible. To this end, Danmarks Nationalbank is entitled to reverse the transaction.¹

¹ Cf. Danmarks Nationalbank (2010), General Terms and Conditions for Monetary-Policy Instruments and Settlement of Payments in Danish Kroner, Swedish Kronor and Icelandic Kroner at Danmarks Nationalbank, clause 7.

3.5 CORE PRINCIPLE V – SETTLEMENT IN MULTILATERAL NETTING SYSTEMS

A system in which multilateral netting takes place should, at a minimum, be capable of ensuring the timely completion of daily settlements in the event of an inability to settle by the participant with the largest single settlement obligation.

3.5.1 Assessment

Not applicable.

3.5.2 Justification

Kronos is an RTGS system in which all transactions are settled on a gross basis. Consequently, Core Principle V is not relevant to Kronos.

The gridlock resolution mechanism contains an element of netting; this mechanism has, however, never been applied. Kronos also settles payments on behalf of the Sumclearing and VP settlement (net settlement systems), but netting is effected in the respective systems *before* the payments are remitted to Kronos. CLS payments are also netted by CLS before settlement.

3.6 CORE PRINCIPLE VI – SETTLEMENT ASSETS

Assets used for settlement should preferably be a claim on the central bank; where other assets are used, they should carry little or no credit risk and little or no liquidity risk.

3.6.1 Assessment

Observed.

Kronos uses central-bank money for settlement.

3.6.2 Description

The most satisfactory settlement asset for systemically important payment systems is a claim on the central bank issuing the relevant currency. The reason is that a claim on the central bank is risk-free and can be easily exchanged for other liquid assets in the same currency.

Payments in Kronos are settled via the participants' accounts at Danmarks Nationalbank. The balances in these accounts are claims on Danmarks Nationalbank, and consequently settlement takes place in central-bank money.

3.7 CORE PRINCIPLE VII – SECURITY AND OPERATIONAL RELIABILITY

The system should ensure a high degree of security and operational reliability and should have contingency arrangements for timely completion of daily processing.

3.7.1 Assessment

Broadly observed.

Kronos is generally well documented and detailed procedures, instructions and system descriptions help to ensure operational reliability. Service Level Agreements (SLAs) have been drawn up, operating statistics are issued and there is ongoing registration and follow-up on incidents. However, the operating statistics show that Kronos availability is low compared with systems in other EU member states.

Danmarks Nationalbank has appropriate contingency arrangements and practical and simple contingency procedures for Kronos are in place which can ensure satisfactory business continuity at Danmarks Nationalbank in the event of major incidents. Contingency arrangements and procedures have been developed in collaboration with BEC, VP, etc. and are tested periodically. Similarly, the Kronos operator – i.e. BEC – has contingency plans, which are tested periodically. An agreement on two-centre operations has been concluded with BEC, and switching of operations between the two data centres can be completed within the agreed four-hour time frame. However, international best practice recommends a maximum of two hours. Danmarks Nationalbank has analysed local conditions and finds that, at present, a four-hour time frame is sufficient for Kronos.

Danmarks Nationalbank has a well-developed framework for operational risk management, based on international standards and recommendations. However, the implementation of the framework is not adequately addressed, as no Kronos risk analysis has been performed since 2003. The lack of an updated risk analysis makes it difficult to assess whether Kronos has adequate security measures in place to manage the security threat scenario of 2011.

It is recommended that, in future, Kronos risk analyses should be performed in connection with major system changes and that the risk

analysis should be updated on a regular basis, e.g. annually. The performance of and follow-up on risk analyses should be seen as an ongoing process.

Based on the recommendation above, Kronos is assessed to *Broadly Observe* Core Principle VII.

A number of other recommendations are made for Core Principle VII:

- Standard procedures are needed for monitoring technological advances and assessing whether these should result in changes to Kronos, e.g. in technical components or updating of system security standards. It is recommended that such procedures be established.
- The overall risk assessment for business continuity of payment systems from 2007, including Danmarks Nationalbank's role as settlement bank, should be updated to reflect that the National Service Desk has been relocated and that Target was replaced by Target2 in 2008.
- Procedures should be established for periodic testing of the Kronos security measures to ensure that the system security complies with the requirements specified and that any weaknesses can be identified and addressed.
- The agreement with BEC on the development and operation of Kronos should be updated to formalise the ongoing collaboration and existing follow-up, and the requirements of the agreement should be clarified and/or tightened in a few respects.
- BEC has two SWIFT lines, but uses the same network operator for both lines. Hence, the network operator represents a potential single point of failure. It is recommended that a risk assessment be prepared in relation to continuing with only one network operator. Risk should be weighed against the costs of using two network operators.
- Establishing procedures for periodic testing of crisis management and communication policy should be considered.
- Although Danmarks Nationalbank currently finds that a four-hour time frame is sufficient for switching between centres 1 and 2 for Kronos, it should be assessed on a regular basis whether the time frame of a maximum of four hours is still sufficient.

3.7.2 Justification

Security

Danmarks Nationalbank's approach to identification and management of operational risks is described in the internal document "Framework for operational risk management at Danmarks Nationalbank", which also includes Danmarks Nationalbank's security policy. The objective is for operational risk management to help to ensure that Danmarks Nationalbank's business activities can be performed with quality and professionalism, care, efficiency, security and control. The framework for operational risk management applies to all Danmarks Nationalbank's business operations and related production environments, irrespective of location. The framework is supplemented by detailed objectives and guidelines, describing how the framework is implemented in practice.

The framework for operational risk management is based on international standards and recommendations for operational risk management, classification, security, procedures and business continuity such as 'Sound Practices for the Management and Supervision of Operational Risk – February 2003' by the Bank for International Settlements and the ISO 27000 series on Information Security Management Systems, 2007.

Danmarks Nationalbank reviews the applicable framework on an annual basis and implements changes, if required. The framework for operational risk management has been approved by Danmarks Nationalbank's Board of Governors.

The framework for operational risk management is based on generally accepted security requirements in terms of confidentiality, integrity, and availability. These security requirements are incorporated into the design of Kronos. For instance, confidentiality and integrity are ensured through encryption and hash functions, as the Kronos terminal is a web application using Secure Socket Layer (SSL) for data transmission. Moreover, BEC requires participants to connect to BEC's data processing centre through a safe connection. Alternatively, payments may be remitted through the SWIFT network where confidentiality and integrity are ensured through encryption and other cryptographic mechanisms.

No standard procedures have been established for monitoring technological advances and assessing whether such advances should result in changes to Kronos, e.g. in technical components or updating of system security standards and implementation of any changes. Today, this is effected on an ad hoc basis, but it is recommended that standard procedures be established. It should also be specified who is responsible for this area.

Risk analyses

The regular performance of risk analyses is not adequate, either in terms of Danmarks Nationalbank's framework for operational risk management or in terms of CPSIPS. No Kronos risk analysis has been performed since 2003. The lack of an updated risk analysis makes it difficult to assess whether Kronos has adequate security measures in place to manage the security threat scenario of 2011. Work on a new risk assessment has been initiated, but a period of eight years between risk assessments is not acceptable.

It is recommended that, in future, Kronos risk analyses be performed in connection with major system changes and that the risk analysis be updated regularly, e.g. annually. Performance of risk analyses should be an ongoing process in which the system security policy and security objectives are reviewed, security threats and probabilities are established, any countermeasures are identified and residual risk is assessed; if the residual risk is too high, further countermeasures should be established and implemented.

In 2007, an overall risk assessment for business continuity of payment systems was performed, including Danmarks Nationalbank's role as settlement bank. This assessment should also be updated to reflect that the National Service Desk has been relocated and that, in 2008, Target was replaced by Target2, which is a separate system, while Target was part of Kronos.

According to the recommendations under Core Principle VII, the Kronos security measures should be tested on a regular basis to ensure that the system security complies with the requirements specified and that any weaknesses can be identified and addressed. Procedures should be established for periodic security testing, such as vulnerability scanning, penetration testing, secure code review, etc.

Since periodic testing of the Kronos security measures is not performed and there are no updated risk assessments of the system, it is difficult to assess whether Kronos has adequate security measures in place to manage the security threat scenario of 2011.

Outsourcing

System development and operation of Kronos, as well as supporting hardware and basic software, have been outsourced to BEC. BEC in turn has outsourced operations to JN Data. This has no impact on the recommendations in this report. BEC has a contractual obligation¹ to

¹ "Agreement between Danmarks Nationalbank and BEC on data processing services" (in Danish only).

comply with Danmarks Nationalbank's framework for operational risk management. This applies irrespective of the outsourcing to JN Data.

Danmarks Nationalbank and BEC have a security forum, which convenes 2-4 times a year to discuss security aspects of significance to Danmarks Nationalbank. This forum e.g. discusses risk assessments, projects and routines of significance to operations and protection of Danmarks Nationalbank's systems and data at BEC, as well as results and testing of BEC's contingency plans, security incidents, etc.

The collaboration between Danmarks Nationalbank and BEC on the operation and development of Kronos is governed by an agreement from 2002. Although the collaboration has worked satisfactorily within the framework of the current agreement, the Kronos agreement should be updated to formalise the ongoing collaboration and existing follow-up process and to clarify and/or tighten requirements in a few respects.

Audit

CPSIPS imposes no audit requirements, but it is stated that independent audit is a suitable method of providing assurance of the effectiveness of internal controls, such as security measures and procedures.

Danmarks Nationalbank's internal audit function conducts the audit of Kronos, selecting areas for audit review based on an assessment of materiality and risk. Danmarks Nationalbank's external auditors assess the internal system audit and *inter alia* review documentation and working papers.

The internal auditors also receive reporting data from the external BEC system auditors. In its capacity as a joint data processing centre, BEC is subject to "Executive Order on system audits in joint data processing centres" from October 2008. This entails annual audits of general IT controls, user systems and IT systems used for data exchange. General controls refer to basic IT security – not the security of specific IT systems. The auditors' statement does not specifically focus on Danmarks Nationalbank's systems, including Kronos, but on BEC's overall operations.

In 2008, Danmarks Nationalbank's internal auditors conducted a major review of the management of IT security for Kronos. In 2012, the internal auditors will also review the Kronos data processing, which is relevant given the significance of the system in the payments infrastructure.

Operational reliability

Service Level Agreements (SLAs) have been drawn up with BEC on the operation of Kronos and with VP Securities on the operation of the S-

System. Under the SLA with BEC, the system may only be unavailable for up to four hours once a year and for up to one hour once a month.

Routines and support

Elaborate and detailed routines and instructions have been developed for the day-to-day monitoring and support of Kronos. These routines and instructions are revised in connection with major system changes or when they expire after a two year-period. In addition, comprehensive and well-documented system descriptions are available in the form of the Kronos manuals.

The National Service Desk is staffed within Kronos' opening hours by experienced employees with extensive knowledge of Kronos who are able to provide support and assist participants in the event of problems. If the problems are more technical in nature, the National Service Desk may contact BEC within Kronos' opening hours. If support is required outside Kronos' opening hours, BEC will arrange for support staff to be available.

Incidents

In Kronos, minor incidents regularly occur, while major incidents are rare. During the last three years, two serious incidents have been registered. On 8 March 2010, a payment to an insolvent participant whose current account had been closed blocked all other Kronos payments. Until 9:30 a.m. when BEC solved the problem, no Kronos payments could be settled. The second incident, occurring on 13 October 2009, was not related to the operation of Kronos, but to a system failure at IBM, the IT service provider of Nets and VP, entailing that the Kronos automatic collateralisation arrangement did not work, since VP was unable to send updated values for the pledged custody accounts.

During the period from March 2010 until October 2011, more than one Kronos system failure per month has often been recorded, constituting a breach of the SLA with BEC. However, the system failures have typically lasted just a few minutes and the problems have subsequently been resolved. The assessment is that the incidents have been addressed and followed up on satisfactorily.

The occurrence of minor incidents is reflected in a relatively large variation in operating statistics. During the period from January 2009 until and including October 2011, the availability of Kronos was below 99 per cent in 11 months, which is assessed as a fairly high number of months for a systemically important RTGS system. During the same period, system availability was 100 per cent in only eight months. The annual availability for Kronos in 2009, 2010 and 2011 (until and

including October) was 98.82 per cent, 99.02 per cent and 99.45 per cent, respectively. In its latest assessment report for Kronos, when the availability of Kronos was somewhat higher than now, the IMF stated that the number of incidents in Kronos was relatively high compared with systems in other EU member states.

All operational incidents in Kronos are recorded in a designated system at BEC. The National Service Desk at Danmarks Nationalbank also logs all incidents. Danmarks Nationalbank and BEC continuously update the status of each incident until the problem has been resolved. Incidents that are not directly related to BEC's operation of Kronos are logged only by the National Service Desk.

A monthly report is prepared of incidents in and around Danish RTGS systems and the collateral pledging system, which is communicated to relevant stakeholders at Danmarks Nationalbank. In addition, a separate appendix is prepared focusing specifically on incidents in systems outsourced to BEC. This appendix is discussed at the quarterly management meetings between BEC and Danmarks Nationalbank.

The reporting ensures structured follow-up with the system provider. In this process, valuable information is obtained, which may be used e.g. to identify operational risks and assess whether the system design is appropriate.

Change management procedures

The system development and maintenance of Kronos have been outsourced to BEC. BEC has separate production-like environments for the development and testing of system changes. System changes are implemented in accordance with a Change Management Procedure agreed between Danmarks Nationalbank and BEC, which complies with the usual practice. This procedure ensures *inter alia* that all change requests are analysed, prioritised and approved before the development work is initiated. A testing road map is prepared and test results are to be assessed in terms of listed acceptance criteria before implementation can be approved. Finally, manuals must be updated to reflect the agreed change.

Capacity

The latest measurement of Kronos' capacity, performed in 2010, shows that the system has sufficient capacity for settling payments. According to the measurement, Kronos has the capacity to settle approximately 7,000 payments per hour within its opening hours and the current load at peak hours is around 1,400 payments per hour. There are no procedures for systematic monitoring of Kronos' capacity, but in

connection with major system changes capacity is tested to measure the settlement time for a given number of payments. Due to the high excess capacity of Kronos, it is currently not assessed to be necessary to monitor and test capacity on a regular basis. In case of changes to the payment pattern in Kronos, it is recommended that periodic capacity testing be initiated.

SWIFT

In 2009, SWIFT prepared a Health Check Report on BEC's SWIFT environment, to which Danmarks Nationalbank is connected. The SWIFT report concludes that, in general, the systems are correctly installed and administered by competent staff but also emphasises that a few aspects should be addressed. These aspects are three red and six yellow flags regarding the setup at BEC. Red flags indicate high-risk critical errors that should be urgently addressed. Yellow flags warn of errors or conditions with medium risk that should be addressed in the medium term.

Subsequently, follow-up on the report has been performed and Danmarks Nationalbank and BEC have worked to "unflag" the red and yellow flags. However, one red and one yellow flag still remain. The red flag deals with use of only one network operator for the two SWIFT lines. As network operator errors may result in loss of connectivity – although two SWIFT lines have been established – there is increased risk of loss of connectivity with the SWIFT network. In other words, the network operator represents a potential single point of failure. It is recommended that a risk assessment be prepared in relation to continuing with only one network operator. The risk should be weighed against the costs of using two network operators.

Business continuity and contingency procedures

Danmarks Nationalbank's strategy for business continuity is described in "Framework for operational risk management at Danmarks Nationalbank". The objective is to ensure satisfactory business continuity at Danmarks Nationalbank in the event of major operational disruptions.

Testing of contingency procedures

Adequate and well-documented contingency procedures are in place for Kronos. These procedures have been developed in close collaboration with external parties, such as BEC, Nets, VP and CLS. The Kronos contingency procedures for the settlement of transactions are based on a simple and practical fax solution to be used by participants in case of

disruptions to Kronos. The fax formats are available in the terms and conditions for accounts (the chapter "Fax formats for emergency procedures concerning Danish kroner"). Most contingency procedures are tested every six months, but contingency procedures for CLS are tested every three months. Kronos participants have an obligation to participate in the testing of the contingency procedures. Follow-up is performed of any errors identified during the testing. Improvements are implemented and a new test is run to ensure that the error has been eliminated. However, it should be considered whether the participants' testing of the Kronos contingency procedures should be renewed, so that the exact same test is not necessarily repeated every six months. The most common error is that the fax is not signed by an authorised signatory; hence, it may be checked more specifically whether the participants' lists of authorised signatories are up-to-date.

Danmarks Nationalbank also has procedures for crisis management and an information communication policy that is applicable in the event of contingencies, including in relation to Kronos. No procedures are in place for periodic testing of these contingency procedures, but they were successfully tested ahead of a major operational restructuring in the 1st half of 2011. Establishing procedures for periodic testing of crisis management and communication policy in relation to Kronos should be considered.

Contingency arrangements

Danmarks Nationalbank has contingency arrangements in place for the National Service Desk. The contingency arrangements are comprised of a secondary site located at a sufficient distance from the primary site to ensure that they have different physical infrastructures. The National Service Desk has own computers at the secondary site, while the actual site is shared with other departments at Danmarks Nationalbank. The secondary site is tested every six months and subsequently a test report is prepared for the ECB, as well as a test report for internal follow-up at Danmarks Nationalbank.

As far as the actual operation of Kronos is concerned, Danmarks Nationalbank has entered into an agreement with BEC on the provision of two-centre operation. As a result of this agreement, BEC has two data centres located at an appropriate geographical distance. The primary and secondary data centres are linked through redundant optical fibre connections that enable real-time data mirroring. The secondary data centre must comply with the same general requirements for system security, data security and physical security as the primary data centre.

The secondary data centre has separate power supply, telephony, network, etc. BEC tests data centre switching four times a year.

Under the agreement between Danmarks Nationalbank and BEC, it must be possible to switch between centres within four hours, i.e. the maximum recovery time for Kronos after a system failure necessitating a switch of data centre is four hours – in practice, data centre switching may typically be performed considerably faster. International best practice stipulates a maximum recovery time of two hours. However, the assessment of what is appropriate for a specific payment system should take into account what is practical and efficient given the local conditions. Danmarks Nationalbank has examined the costs of reducing the recovery time from four to two hours and has found that the costs exceed the benefits of reducing the maximum recovery time. The Kronos payment pattern is stable, and settlement via Kronos generally takes place early in the settlement day, entailing that an average of 85 per cent of the total daily value of payments settled is settled at least four hours before closing time, including the most critical payments. Hence relatively few payments are affected in the event of a Kronos system failure in the afternoon, and if the system fails in the morning, there is time to restart Kronos and settle payments before the system closes.

At present, a recovery time of four hours is assessed to be sufficient. However, it should be considered regularly whether this still applies.

New international oversight principles

As part of the ongoing update of the international standards for payment and settlement systems, cf. section 3.11, several new operational recommendations are expected, which could lead to identification of new target areas for Kronos.¹

For instance, the new principles specifically recommend that a payment system should continuously monitor and test the actual system capacity and performance, e.g. by conducting frequent stress tests/capacity tests. As stated above, Kronos currently does not have a procedure for regular capacity testing. The new principles also address the issue of a system's interdependencies with external parties, such as service providers and critical participants. In this context, it is recommended *inter alia* that the system should specify minimum requirements for participants' operational reliability and contingency procedures to be observed by the most critical participants in the system and that the system should establish expectations for critical service providers. Kronos currently does not comply with such requirements.

¹ Cf. BIS (2011), principle 17.

The new principles prescribe that a system should be able to resume operations within two hours and ideally the back-up system should commence processing immediately. According to the new principles, the need and possibilities for a third site should also be considered. Despite the conclusions of the analysis of the specific Kronos conditions, entailing that a recovery time of four hours is assessed to be sufficient, it may be difficult to retain this exception in the future. This emphasises the importance of continuously reconsidering whether a recovery time of four hours is sufficient, cf. the recommendation above.

3.8 CORE PRINCIPLE VIII – EFFICIENCY

The system should provide a means of making payments which is practical for its users and efficient for the economy.

3.8.1 Assessment

Observed.

It is assessed that Kronos is practical for its users and efficient for the economy. User requirements are taken into account and opening hours and scheduling of settlement cycles are appropriate. Kronos is a well-functioning system – for the benefit of financial stability. In addition, Kronos is relatively inexpensive to operate.

The agreement between Danmarks Nationalbank and BEC stipulates that Kronos must be able to process up to 1,000 cross-border payments per hour. Kronos no longer settles cross-border payments, and during peak hours Kronos settles more than 1,000 payments per hour. In practice, capacity is sufficient, but the agreement should reflect the actual need.

3.8.2 Justification

Practical for its users

As the system was developed in close dialogue with the future participants, the original design of Kronos to a large extent took user needs and requirements into account. In line with Danmarks Nationalbank's general policy in this area, users participated in reference groups to ensure that user requests were included in the listing of requirements for Kronos.

Participants may also submit development requests for Kronos on an ongoing basis, e.g. by contacting the Kronos helpdesk, the National Service Desk, or by participating in RTGS user meetings. The users have not submitted any development requests for Kronos since the latest assessment report, and, accordingly, it is assessed that overall Kronos meets its users' needs and requirements.

Users are also invited to contribute inputs to the further development of Kronos. For instance, users were able to submit development requests for the future settlement procedure or for new Kronos functionalities in connection with the implementation of Target2-Securities (T2S) in Denmark. VP Securities is expected to join T2S in 2015.

There is still room for improvement in some areas when it comes to making Kronos more practical for its users. For example, the settlement of monetary-policy operations in Danish kroner could be migrated from the old DN Inquiry and Transfer System to Kronos.

Different participants have different needs in relation to a payment system. Kronos is flexible and practical for its users due to its structure with the Basic module – i.e. the Kronos terminal – and the Poseidon module for participants with SWIFT, cf. section 2.1.6. Kronos has been developed to support straight-through-processing (STP) for participants with SWIFT that have large transaction volumes. These participants are able to connect their own systems directly to Kronos. For small participants with small transaction volumes, it may not be worthwhile to invest in STP; instead they may use the Basic module as an online banking service without additional development costs. In addition to being practical for its users, this is also cost-effective for the economy.

Efficient for the economy

A payment system is regarded as efficient for the economy if it is cost-effective, i.e. the payment services provided by the system cannot be provided more inexpensively for the economy as a whole. If a payment system is cost-effective and practical to use, it is more likely to actually be used.

But it is difficult to assess whether a payment system is efficient for the economy. The assessment of system costs typically includes the *system costs* of clearing and settlement of payments, the *participants' costs* of preparing, remitting, receiving and processing payments and *liquidity costs*.

In addition, factors such as system capacity, cost level in relation to comparable payment systems and number of payments that are queued due to lack of liquidity may be used as indicators that a payment system is inefficient.

In addition to being practical for users, the above module structure of Kronos is also assessed to be cost-effective for the economy. Small participants have easy and inexpensive access to the Basic module without making additional investments in STP and a SWIFT address, which is worthwhile only for participants with a higher transaction volume.

At the same time, it is an advantage for all participants that they are able to enter payments for settlement directly via the Kronos terminal. Many systems, e.g. Target2, require payments to be initiated from the participant's own systems. In Kronos, even large participants who settle most of their payments through SWIFT can use the flexibility of the

Kronos terminal to settle urgent payments, e.g. settlement of transactions with same-day value that are to be completed shortly before the system closes at 3:30 p.m. The Kronos terminal also serves as back-up for settlement of the most critical payments if a bank's own system is down.

To promote the use of Kronos and avoid that participants net payments bilaterally before settlement, thereby incurring a credit risk on the counterparty until the payment has been settled, quantity discounts are offered to participants with many payments. The price per payment starts at kr. 1.00 for the first 1,000 payments per month and then falls to kr. 0.10 per payment for payments beyond the first 5,000 payments per month. The falling price structure helps to increase the use of Kronos for the benefit of financial stability.

Capacity

In practice, an average of approximately 3,200 payments are settled in Kronos per day, and the maximum number settled in one day was 5,145 payments. Most payments are settled between 8:00 a.m. and 9:00 a.m., during which time an average of just over 1,000 payments are settled every day.

In 2010, the capacity of Kronos was measured at 7,000 payments per hour. The system thus has excess capacity relative to the actual need. Excess system capacity is assessed to be appropriate, however, as this entails that, in the event of temporary system failures, Kronos can quickly settle unsettled payments that have been postponed due to the system failure.

The agreement between Danmarks Nationalbank and BEC, prescribing requirements to be met by BEC, stipulates that Kronos must be able to process up to 1,000 cross-border payments per hour. Kronos no longer settles cross-border payments, and during peak hours Kronos settles more than 1,000 payments per hour. In practice, capacity is sufficient, but the agreement should reflect the actual need.

Liquidity management and intraday credit

Part of the participants' cost of participating in Kronos is the cost of covering the need for intraday liquidity. In general, participants in Kronos have ample liquidity, i.e. substantial excess liquidity relative to the actual need, cf. section 3.3.2, Chart 4. There are no indications that the cost of intraday liquidity is such that it reduces the participants' use of Kronos.

Intraday liquidity is achieved against pledging of collateral. As described in section 2.1.9, Danmarks Nationalbank's collateral pledging

system comprises several elements, including traditional pledging of collateral, certificates of deposit and automatic collateralisation. Automatic collateralisation is practical for participants, as securities purchased may be used as collateral already in the settlement batch in which payment for the securities takes place. In addition, cross-border schemes such as SCP and Nordic CCBM, as well as the temporary schemes help to give participants flexible access to pledge collateral.

Furthermore, a FIFO algorithm with bypass helps to economise on participants' liquidity.

Opening hours and settlement cycles

The Kronos opening hours and scheduling of settlement cycles are assessed to be appropriate. Kronos opens at 7:00 a.m., entailing that participants have access to liquidity from early in the day. Kronos closes at 3:30 p.m., at the end of the monetary-policy day. Most payments are settled in the morning.

In addition, Kronos is open for transfers to settlement accounts from 4:00 p.m. to 4:30 p.m. This means that participants may use intraday liquidity in Danish kroner for night-time settlement cycles at VP settlement and the Sumclearing, which can then be covered on the following day. Night-time settlement has been scheduled to ensure that liquidity is released to participants before Kronos opens for payments at 7:00 a.m.

Danmarks Nationalbank's pricing policy

The price of participating in Kronos is determined on the basis of total operating and development costs, distributed among participants using a distribution key based on the participants' volume of working capital. In addition, a transaction fee is payable, cf. section 2.1.8. The Kronos pricing structure is published at Danmarks Nationalbank's website.

The design of the pricing policy is such that the largest banks with the largest number of payments pay most of the costs. If the participants' average costs per transaction via Kronos¹ are considered, the largest participants on average pay the smallest fee per transaction. The largest participants pay total costs to Danmarks Nationalbank of as little as a few Danish kroner per transaction, while the smallest participants pay an average cost of up to a few hundred Danish kroner per transaction. This difference is assessed to be reasonable, as total costs for the

¹ The average cost per transaction is calculated as the total amount invoiced to a participant in Kronos in monthly fee, user licences, account statements, subscription for services messages, etc. and payment per transaction divided by the number of transactions settled by the participant.

smallest participants are small – they do not necessarily settle transactions every month.

Danmarks Nationalbank re-invoices costs relating to operations to BEC and any development costs are re-invoiced to the participants. Danmarks Nationalbank's internal costs – e.g. payroll costs for Danmarks Nationalbank's employees and costs of premises – are borne by Danmarks Nationalbank. This entails that Danmarks Nationalbank subsidises Kronos. The rationale for Danmarks Nationalbank's policy of subsidising Kronos was published in "Payment Systems in Denmark", Danmarks Nationalbank (2005). One argument in favour of subsidising the system is that the benefits of safe and efficient payment systems may be greater for the system and society at large than for the individual participants. In contrast, Swedish and Norwegian RTGS systems are operated with full coverage of costs.

Seen in a Scandinavian perspective, the costs of operating Kronos are low. In 2009, Danmarks Nationalbank's total costs of operating Kronos were kr. 11 million, 42 per cent of which was covered by Danmarks Nationalbank. However, the relatively low costs are attributable e.g. to the fact that Kronos is older than the Norwegian and Swedish RTGS systems, and the original development costs of Kronos have been covered. Danmarks Nationalbank regularly compares and discusses parameters such as prices, service level and performance with other Nordic central banks operating RTGS systems.

New international oversight principles

The forthcoming update of the international standards for payment and settlement systems, cf. section 3.11, envisages that a system is to establish mechanisms for the regular review of its efficiency, including the system's cost and pricing structure, as well as the system's effectiveness, e.g. through periodic measurement of the system's progress against its goals and objectives. This may call for more regular initiatives in this field.

3.9 CORE PRINCIPLE IX – ACCESS CRITERIA

The system should have objective and publicly disclosed criteria for participation, which permit fair and open access.

3.9.1 Assessment

Observed.

The Kronos access criteria are publicly disclosed and permit access for many participants without significant limitations. The module structure of Kronos and the pricing structure make it attractive for both small and large banks to participate. Therefore, a very high proportion of banks and other financial institutions in the Danish market choose to participate in Kronos.

The Kronos terminal is currently available in Danish only. Translating it into English should be considered to eliminate language barriers for foreign participants.

Furthermore, Kronos has no standard procedures for the suspension and exclusion of participants. Such procedures should be developed.

3.9.2 Justification

The access criteria are published in the terms and conditions for accounts.¹ Kronos is open to all credit institutions and investment firms as well as branches of credit institutions and investment firms that are subject to supervision by the Danish Financial Supervisory Authority or subject to supervision in another EU member state or a country with which the EU has concluded a cooperation agreement on supervision in the home country. In addition, other participants may be granted access if, in the assessment of Danmarks Nationalbank, they play a significant role in relation to the settlement of payments at Danmarks Nationalbank. The access criteria impose no limitations in terms of participants' size or capital. The module structure of Kronos, cf. section 2.1.6, and the pricing structure, cf. section 2.1.8, also ensure flexibility and provide for fair and open access for all potential participants – regardless of size. Since intraday credit via Kronos is granted against

¹ Cf. Danmarks Nationalbank (2010), Terms and Conditions for a Current Account in Danish kroner at Danmarks Nationalbank, clauses 2 a and c.

collateral, the consideration of minimising Danmarks Nationalbank's credit risk does not prompt the need to further restrict access to Kronos.

Kronos has no indirect participants and the same rules apply to all participants. Financial institutions that do not hold accounts must use correspondent banks to gain access to the Danish payments infrastructure. The contractual relationship between direct participants and other parties that may enter into an agreement with a direct participant on the settlement of payments through this participant is of no consequence to Danmarks Nationalbank. A characteristic feature of Kronos is that it has many direct participants compared with the payment systems of other small Western European countries.¹

Exit from Kronos

Kronos participants are free to close their accounts and exit from Kronos at any time. The criteria for exit from Kronos are described in the terms and conditions for accounts.² Procedures are in place to govern a participant's exit – either voluntarily, as a result of insolvency or as a result of being taken over by the Financial Stability Company, cf. Core Principle I, section 3.1.2. However, procedures are needed for the suspension or exclusion of participants and such procedures should be developed.

Danmarks Nationalbank has discretionary powers to exclude a participant without notice and/or exclude the account holder from monetary-policy instruments, regardless of whether a breach has occurred, cf. also Core Principle I, section 3.1.2. Danmarks Nationalbank's discretionary powers have been introduced due to the fixed-exchange-rate policy and are not assessed to be problematic for Kronos.

Language barriers

The Kronos terminal is available in Danish only. In practice, it may be difficult for foreign participants to participate in Kronos on account of the language barrier. Translation of the Kronos terminal into English would address this issue and should be considered.

The Kronos user manual has been translated into English, as have the terms and conditions for accounts, etc. However, the user manual has not been updated, cf. Core Principle II, which should be a minimum if a foreign participant is expected to be able to settle payments on the basis of the user manual.

¹ Cf. Irene Madsen, The Financial Sector's Payments via Kronos, Danmarks Nationalbank, *Monetary Review*, 1st Quarter 2008.

² Cf. Danmarks Nationalbank (2010), Terms and Conditions for a Current Account in Danish kroner at Danmarks Nationalbank, clause 3.

3.10 CORE PRINCIPLE X – GOVERNANCE

The system's governance arrangements should be effective, accountable and transparent.

3.10.1 Assessment

Observed.

The Kronos governance structure is transparent and effective and Accounting, the system owner, collaborates closely with BEC, internal departments at Danmarks Nationalbank and the participants. This provides satisfactory conditions for accountable and effective governance of Kronos.

3.10.2 Justification

Kronos is owned by Danmarks Nationalbank. Information on Danmarks Nationalbank's Committee of Directors and the appointment of the Committee is publicly available at Danmarks Nationalbank's website, and each year "Report and Accounts" reports on Kronos.

Danmarks Nationalbank's Board of Governors has the overall responsibility for Kronos and makes decisions in terms of e.g. major investments in the development of Kronos. Accounting at Danmarks Nationalbank is the system owner and has the overall operational responsibility for Kronos. Operations have been outsourced to BEC and are governed through Service Level Agreements (SLAs) under the contract.

Accounting collaborates with several departments at Danmarks Nationalbank e.g. on IT and security aspects. In addition, Kronos is subject to internal audit to ensure that the guidelines for system operations are observed, and Payment Systems at Danmarks Nationalbank oversees that Kronos complies with international standards for payment systems and that satisfactory follow-up is performed of operational incidents.

Accounting continuously monitors that budgets for planned work on Kronos are met and that follow-up is performed of any deviations. Budgets for major changes to Kronos are subject to approval by Danmarks Nationalbank's Board of Governors.

According to Danmarks Nationalbank's project model, major system development work is always performed in collaboration with relevant stakeholders, and, as described under Core Principle VII, Kronos hosts RTGS user group meetings to which all participants are invited. Small

banks are typically represented by the Association of Local Banks, which safeguards the interest of approximately 90 local banks, savings banks and cooperative banks in Denmark, the Faroe Islands and Greenland.

Kronos is assessed to meet the needs of its participants and society at large.

The system has standard procedures for the dissemination of relevant information to its participants via messages in the Kronos terminal, letters and meetings.

Observance of the other Core Principles of this assessment report can be seen as an indication that Core Principle X is observed. Kronos observes eight of the ten Core Principles. Moreover, Core Principle V is *not applicable*, and Core Principle VII is *broadly observed*.

3.11 NEW CPSS-IOSCO OVERSIGHT PRINCIPLES

Under the auspices of BIS and based on the lessons learned from the financial crisis and the experience gained from the use of the existing Core Principles, work is currently underway to develop a set of new, updated international standards for payment and settlement systems. Currently, separate standards exist for different types of financial infrastructures. The existing standards are: "*Core principles for systemically important payment systems*", "*Recommendations for securities settlement systems*" and "*Recommendations for central counterparties*". The new standards, "*Principles for financial market infrastructures*", will combine the existing standards into a unified set of standards with a view to enhancing the consistency of oversight. The 24 new principles were issued for consultation until 29 July 2011.¹ The final principles are expected to be published at end-2012, and the final version may obviously be amended relative to the version that was issued for consultation until 29 July 2011.

New principles introduce new topics

The new principles are expected to introduce several topics not covered by the existing standards. Several of the principles in BIS (2011) are brand new relative to the ten existing standards in "*Core principles for systemically important payment systems*". Some of the new principles are irrelevant to Kronos. In other cases, the new principles seem unproblematic for Kronos to observe, while other new principles will result in new tasks.

For instance, one of the new principles calls for financial infrastructures to be able to identify, as a minimum, all risks that may arise from indirect participation in the system. In this context, indirect participants are participants that participate in the system as customers of other participants. This principle could be relevant to Kronos, although Kronos currently regards this type of participation as being of no consequence to the system. According to the preliminary version of the new principles, specific material risks to the system should be identified, and the system rules should ensure that information may be obtained on indirect participants, e.g. through direct participants.²

As a new aspect, the new principles also address the issue of interdependencies between the system assessed and other entities, e.g. service providers or other payment systems, settlement systems and CCPs

¹ BIS (2011).

² Cf. BIS (2011), principle 19.

with which the system is interconnected. According to the new principles, a financial infrastructure should regularly review the material risks it bears from and poses to other entities as a result of interdependencies. Moreover, a financial infrastructure should develop appropriate risk-management tools to address these risks.¹

As described under Core Principle II, the new principles are also expected to tighten requirements for training of and information to participants,² cf. section 3.2.2. As described under Core Principle III, several recommendations are expected for collateral³ and monitoring of a system's credit risk,⁴ cf. section 3.3.2. Moreover, as described under Core Principle VII, several new recommendations regarding operational practices are expected,⁵ cf. section 3.7.2.

Assessment according to the new principles

Danmarks Nationalbank will adopt the new principles for assessment of systemically important payment and settlement systems when the final version of the new principles is published.

¹ Cf. BIS (2011), principle 3.
² Cf. BIS (2011), principle 23.
³ Cf. BIS (2011), principle 5.
⁴ Cf. BIS (2011), principle 4.
⁵ Cf. BIS (2011), principle 17.

3.12 LITERATURE

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