

# DANMARKS NATIONALBANK

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## Oversight of the financial infrastructure

- Denmark has a safe and efficient payments infrastructure that is well equipped to handle operational incidents.
- The best hackers are becoming increasingly specialised and sophisticated, and external events such as Russia's attack on Ukraine entail new derived cyber risks. It is therefore essential that there continues to be focus on the establishment of safeguards against cyber attacks within the infrastructure.
- The cyber threat cannot be eliminated. It is therefore important that work is done both individually and jointly to strengthen data protection and the ability to restore systems after a serious cyber attack.

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**Infrastructure of critical importance to society**

**kr. 641 billion**

is settled on average on each banking day for payments in the core systems.

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**Collaboration across the financial sector**

**Increase cyber resilience**

with the key players and broadly in society.

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## Denmark has a safe and efficient payments infrastructure

An efficient and safe payments infrastructure is a prerequisite for the exchange of goods and services. If the infrastructure systems do not work, it will create disruptions that, in a worst-case scenario, can threaten financial stability and damage the economy.

The payments infrastructure is a network of different systems enabling consumers, companies and financial players to exchange payments and securities transactions with each other. In 2021, on an average day, electronic payments amounting to kr. 641 billion were sent through the central systems in the Danish payments infrastructure, see the flow of payments in the overview chart in box 1.

Because of the critical role of the payments infrastructure, Danmarks Nationalbank oversees that the core systems comply with the requirements regarding safety and efficiency in the international standards. This oversight also includes the most important payment solutions. The core systems and solutions in the Danish financial infrastructure are described in box 1.

This report presents the main conclusions of the oversight and the key areas of significance to the Danish financial infrastructure in 2021.

### **The infrastructure is safe, efficient and stable**

The conclusion of Danmarks Nationalbank's oversight is that the Danish payments infrastructure is efficient and resilient.

Operational reliability was high in 2021, with few disruptions in the exchange of payments and the settlement of securities transactions. Furthermore, the core systems and solutions largely comply with the requirements of international standards, and work is done on an ongoing basis to strengthen security and comply with Danmarks Nationalbank's recommendations for improvements.

### **A number of external challenges have been handled in recent years**

Changes in the risk outlook mean that the requirements for a secure and resilient infrastructure are becoming increasingly stringent. A recent example was that the covid-19 pandemic meant that there was a need to quickly adapt the operation of the payments infrastructure systems/solutions to a situation in which

### **Danmarks Nationalbank's oversight**

Danmarks Nationalbank oversees that payments and financial transactions in Denmark can be completed safely and efficiently. Its oversight comprises the core systems and solutions in the Danish payments infrastructure:

- Kronos2 (interbank payments)
- the Sumclearing, Intradagclearing and Straksclearing (retail payments)
- Euronext Securities Copenhagen's settlement system (securities transactions)
- Dankort, Betalingsservice and credit transfers (the main payment solutions)
- International systems of relevance to Denmark.

Danmarks Nationalbank's oversight is based on international standards and guidelines and is described in its oversight policy ([link](#)).

the employees worked extensively from home. Remote access via VPN connections from private homes brought new opportunities, but also entailed a number of new risks. It is therefore positive that the systems/solutions handled risks during the covid-19 pandemic so that there was no impact on the operational reliability of the payments infrastructure.

Another issue that requires ongoing attention is the management of risks connected with external suppliers. In the past few years, there have been several security incidents that stemmed from vulnerabilities in software and services from third-party providers. The most prominent examples are the hacker attack against the network monitoring solution SolarWinds Orion<sup>1</sup> and the vulnerability in the open-source logging module Log4j<sup>2</sup>.

1 Hackers had placed a malicious code in SolarWind's Orion software, which made it possible for unauthorised parties to access the systems of the organisation using the product was used.

2 A vulnerability was found in Apache Log4j, which is an open-source logging library commonly used by apps and services across the Internet. If the vulnerability is not fixed, attackers can potentially break into systems, steal passwords and logins, extract data and infect networks with malicious software.

## The Danish payments infrastructure

Box 1

Each banking day<sup>1</sup>, payments averaging kr. 641 billion, corresponding to almost one fourth of GDP, are settled via the Danish payments infrastructure.

Danmarks Nationalbank's payment system, Kronos2, plays a central role in this infrastructure, both when it comes to the settlement of large, time-critical payments between banks (interbank payments) and by virtue of Danmarks Nationalbank's role as settlement bank for other payment and settlement systems.

Retail payments are payments between consumers, firms and public authorities, e.g. by payment cards, mobile phones or as credit transfers. When payments have been initiated and handled by a number of intermediaries, depending on their type, they are finally calculated and reconciled in the Sumclearing, Intradagclearing or Straksclearing system, the financial sector's retail payment systems. Settlement is subsequently effected through Kronos2 in accounts at Danmarks Nationalbank. The retail payment systems are owned by Finance Denmark.

Securities transactions may be entered into in different types of marketplaces, for instance the stock exchange, trading platforms or over-the-counter through a bank or broker. For professional investors, the subsequent settlement of transactions takes place on the trans-European securities settlement platform Target2-Securities (T2S), owned by the European Central Bank (ECB). Participation in T2S requires a dedicated cash account with Danmarks Nationalbank and a securities account with Euronext Securities Copenhagen (ES-CPH).

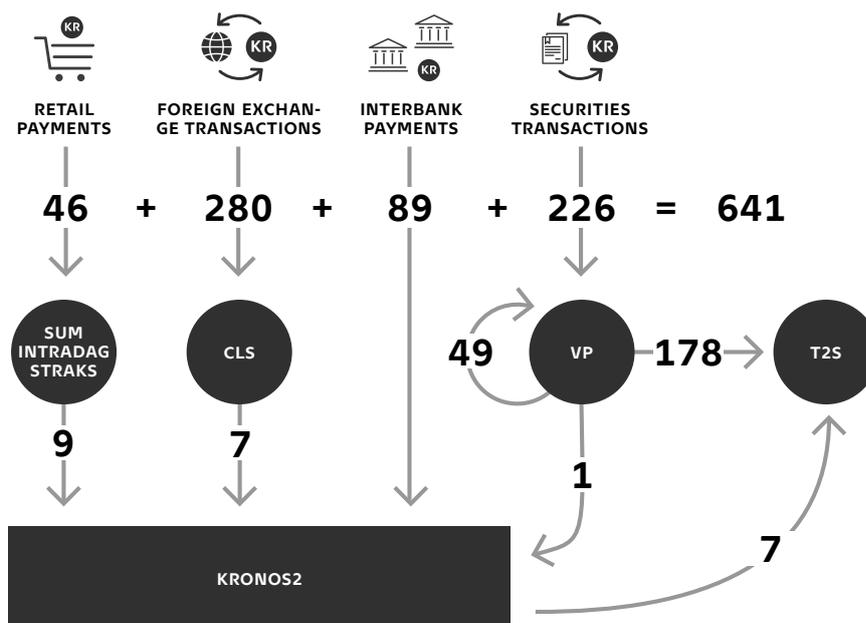
As the central securities depository, ES-CPH is thus responsible for current accounting for holdings of all Danish-issued securities on behalf of investors. Settlement of private investors' transactions takes place via the ES-CPH settlement, which is ES-CPH's own settlement system.

Foreign exchange transactions are settled through CLS, an international system for foreign exchange transactions. Danmarks Nationalbank makes accounts available to banks settling transactions through CLS. CLS is owned by large, international banks.

The three retail payment systems, CLS and VP settlement settle their participants' net positions through accounts in Kronos2. Net positions are calculated by offsetting participants' claims and obligations in the respective systems. Netting reduces participants' liquidity requirement for settlement considerably compared with a situation in which all payments are settled individually. For example, netting reduces the daily liquidity requirement for settlement of retail payments from kr. 46 billion to kr. 9 billion, equivalent to a reduction of 80 per cent.

On T2S, settlement of professional investors' transactions is also effected through netting. Liquidity for settlement is transferred from participants' dedicated cash accounts with Danmarks Nationalbank. Netting reduces participants' liquidity requirement from kr. 178 billion to kr. 7 billion, equivalent to a reduction of 96 per cent.

### Payment flows, kr. billion, averages per banking day in 2021



<sup>1</sup> Some types of payment can be made 24/7/365, others only during bank opening hours. But for all payments, final settlement and exchange of amounts between banks take place on banking days, i.e. when banks are open for business.

Danmarks Nationalbank's oversight shows that both the SolarWinds and Log4j vulnerabilities were present in core systems in the infrastructure, but also that those responsible for the specific systems managed to intervene without the vulnerabilities having any real operational consequences.

It is important that structured work is also done in the future to identify, mitigate and manage changes in the risk outlook. This also includes an effective contingency plan to contain new incidents before they have time to do serious damage. This applies especially in relation to the threat of cyber attacks.

### **Russia's war against Ukraine changes cyber threat**

Currently, Russia's attack on Ukraine has brought new derived risks in the cyber field. The reason for this is that the war is not only fought on the ground, but also in cyberspace. Although the Danish payments infrastructure is not regarded as being a direct target of state-sponsored Russian hacker groups, there may be an increased risk that the systems will be indirectly affected by cyber attacks targeted at the digital infrastructure in Ukraine.

Danmarks Nationalbank's oversight focuses continuously on the work with cyber resilience in the infrastructure systems and solutions, and Danmarks Nationalbank is also in a dialogue with the owners responsible regarding current risks connected with Russia's invasion of Ukraine. Overall, the dialogue shows that there are currently no signs of significant shifts in the threat outlook. However, there is a clear awareness that the threat landscape may quickly change. The situation is therefore being monitored closely by the owners, and a number of measures have been taken to increase preparedness and strengthen the cyber contingency plans. Furthermore, there is coordination and knowledge sharing

about risks and incidents across the sector under the auspices of the sectoral crisis response run by the Financial Sector Forum for Operational Resilience (FSOR). Danmarks Nationalbank is the secretariat for the sectoral crisis response, which – in addition to the infrastructure systems and solutions – also includes participation by the largest Danish banks, data centres, pension and insurance companies as well as relevant authorities and Nordic Financial CERT.<sup>3</sup>

### **A high level of cyber resilience must be continuously developed**

Danmarks Nationalbank assesses on an ongoing basis whether the payments infrastructure systems meet the requirements of international guidelines for cyber resilience.<sup>4</sup> So far, the assessments have ascertained that the cyber resilience of the systems is at a high level in most areas.<sup>5</sup> This picture is also seen in Danmarks Nationalbank's cyber surveys, where key players (large banks, insurance and pension companies, data centres and infrastructure) in the financial sector evaluate their own current cyber resilience level.<sup>6</sup> The results of the latest survey from 2020 showed that the infrastructure systems and solutions were at the top level among the survey participants. Given the key role of the systems for society, there is, however, also a clear expectation that resilience should remain at a persistently high level.

As described above, the cyber threat landscape is developing rapidly. In addition to external events, such as the covid-19 pandemic and the attack on Ukraine, affecting the general threat landscape, there is also a tendency towards the techniques and tactics used by 'ordinary' cyber criminals becoming increasingly specialised and sophisticated.

The development means that the risk that sophisticated hacker groups will penetrate external defences

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3 Nordic Financial CERT is a member-driven non-profit organisation, and its object is to strengthen the Nordic financial industry's resilience to cyber attacks and enable Nordic financial institutions to respond quickly and effectively to cyber security threats and online crime.

4 CPMI-IOSCO, Guidance on cyber resilience for financial market infrastructures, June 2016 ([link](#)).

5 A more detailed description can be found in the section on the individual systems/solutions in the report.

6 Danmarks Nationalbank conducted cyber surveys in 2016, 2018 and 2020. An analysis of the latest results can be found here ([link](#)).

cannot be eliminated. It is therefore completely essential that the infrastructure systems and solutions counter the development in the threat landscape with appropriate safeguards. This applies especially in relation to increasing the preparedness to respond to and deal with any cyber attacks that may succeed in penetrating the infrastructure.

### Special focus on data protection and recovery

The protection of critical data and the ability to ensure a quick and safe recovery are key elements in the work to limit the damage from an attack that may succeed in penetrating the external defence. Data protection and recovery are closely linked areas: if critical data are not available, this will substantially impact the systems' ability to restore operations.

Danmarks Nationalbank's oversight also focuses on the work with data protection and recovery in the infrastructure. This applies, for example, to the use of encryption and backup in the systems and solutions, both of which are key elements in effective data protection. When it comes to recovery, it is important that the systems have prepared a specific cyber contingency plan for targeted recovery of IT systems and continuation of critical business areas following a cyber incident. The contingency plan must be tested regularly using a risk-based approach based on extreme, but plausible, scenarios that a cyber attack may trigger.

In addition to the measures taken in the individual companies, the work with data protection and recovery also comprises special areas of action that authorities and key private players are jointly working to strengthen, see below.

### Consolidation may contribute to even higher resilience of individual systems

In the past two years, large international groups have acquired central systems and solutions or merged business areas in the Danish payments infrastructure:<sup>7</sup>

- In August 2019, the international payments company Mastercard entered into an agreement with Nets on the acquisition of Betalingsservice and clearing activities.

- In April 2020, the pan-European infrastructure group Euronext took over the ownership of the Danish central securities depository, which is now called Euronext Securities Copenhagen (formerly VP Securities A/S).
- In June 2021, the merger between Nets and the Italian payments company Nexi was finally completed.

One of the reasons for the increased degree of consolidation is sharper competition and economies of scale resulting from the large overheads connected with the operation of payments systems. In the large infrastructure groups, there will also be a number of security activities where synergies can create an even higher level of resilience, for example in relation to keeping up with the development in the cyber threat landscape.

In 2021, Danmarks Nationalbank has continued its work on preparing for the connection of the Danish krone settlement to the European payments and securities settlement platform Target Services, see box 2. The project also involves connection to TIPS, a platform for instant cross-border consumer-to-consumer and consumer-to-business payments in Europe. The connection to the European IT platform will provide advantages of scale that, other things being equal, will also mean increased resources for the work with cyber security, among other areas. The connection work is proceeding as planned and is expected to be completed in 2025.

### Collaboration boosts resilience at sector and societal levels

Part of the work to mitigate cyber risks and increase operational resilience takes place at sector level and through various sectoral collaborations. In the past six years, the Financial Sector Forum on Operational Resilience (FSOR) has brought together authorities and key private players in the financial sector in a joint collaboration forum that works to increase the operational resilience of the sector, including cyber resilience.<sup>8</sup>

Central to the work in FSOR is a risk analysis at sector level that contributes to identifying societal risks

<sup>7</sup> This is elaborated on in the sections of this report that deal with the infrastructure systems and solutions for which the development is relevant.

<sup>8</sup> Read more in FSOR's Annual Report for 2021 ([link](#)).

and thus provides a structured basis for prioritising measures to reduce risks. The risk analysis has, for example, identified several risks that involve data protection and recovery. In FSOR, initiatives have therefore been launched that focus on strengthening joint actions in these areas. This includes work initiated to identify the data which, from a societal perspective, must be particularly protected and where accessibility is critical in a recovery situation.

The work to identify socially critical data is handled in coordination with Risk Forum for Interdependencies (RGA), which is a collaboration forum with participation of the parties responsible for the central payments and settlement systems in the infrastructure.<sup>9</sup> The activities of RGA also include defining joint shutdown and reopening scenarios as well as roadmaps and tests for controlled shutdown of the critical infrastructure in the event of operational incidents such as a serious cyber attack.

In TIBER-DK, which is Danmarks Nationalbank's Threat Intelligence Based Ethical Red team test

programme, there is also focus on the ability of the systems to protect critical data. In a TIBER test, in which live systems are exposed to a simulated cyber attack, special attention is paid to testing scenarios that challenge the data security of the test participant. All the central systems in the infrastructure participate in TIBER-DK, and – together with Danmarks Nationalbank and the other participants – they were therefore involved in deciding in the spring of 2021 that the test programme was to continue.<sup>10</sup>

In addition to the initiatives launched in the financial sector under the auspices of Danmarks Nationalbank, for example FSOR and TIBER-DK, work is also being done to increase cyber resilience in society in general. Danmarks Nationalbank collaborates with and is represented in a number of collaboration forums in Denmark and also participates in Nordic and European collaborations. These collaborations include the exchange of information about incidents and threats, coordination of crisis management and sharing of best-practice.

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9 I.e. Danmarks Nationalbank (interbank payments), Euronext Securities Copenhagen (securities transactions), Finance Denmark (retail payments) and e-nettet (communications network).

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10 Read more about TIBER-DK here ([link](#)).

## Interbank payments

Interbank payments are payments between financial institutions. They are typically characterised by being time-critical, high-value payments. Interbank payments in Danish kroner are settled in Danmarks Nationalbank's Kronos2.

Kronos2 is a real-time gross settlement system, RTGS system, which settles payments individually and instantly. Kronos2 is the backbone of the Danish payments infrastructure, see box 1. In addition to interbank payments, Kronos2 also settles monetary policy operations and net positions from connected payments and settlement systems.

### Use

There are 80 Kronos2 participants, mainly Danish banks, mortgage credit institutions and branches of foreign banks.

In 2021, an average of just under 6,900 daily interbank payments with a total value of kr. 88.7 billion were settled in Kronos2 per banking day, see table 1.

The value of monetary policy operations decreased significantly from 2020 to 2021, see table 1. The reason for the decrease is that Danmarks Nationalbank introduced a technical adjustment of its monetary policy instruments on 19 March 2021 with the aim of ensuring more stable money market interest rates. With the adjustment, the ceiling on banks' deposits with Danmarks Nationalbank has been removed, which means that the banks can place their total deposits in their current accounts and no longer have to buy or sell certificates of deposit to adjust their liquidity on a daily basis.<sup>11</sup>

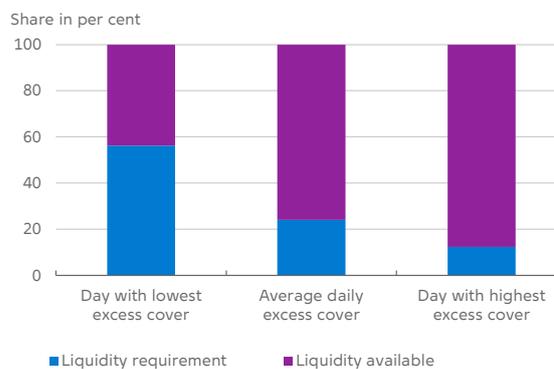
### Operational reliability

The operation of Kronos2 was affected by several incidents in 2021.

On 26 April 2021, Kronos2 was down between 15:30 and 20:00. During this period, no payments, clearings or exchanges of messages could be executed

**Ample liquidity among Kronos2 participants in 2021**

Chart 1



Source: Danmarks Nationalbank.

between Kronos2 and the pan-European securities settlement system Target2-Securities (T2S). The reason for the breakdown was a fault in a functionality that has rarely been used. It has subsequently been ensured that the same fault cannot happen again.

The ECB upgraded T2S in mid-June. However, the upgrade resulted in long response times to messages between T2S and Kronos2 on redemption of T2S auto-collateral<sup>12</sup>. The consequence was that the participants' securities, which were used by T2S auto-collateral, were retained as collateral, and that Danmarks Nationalbank had to release the papers manually. As a temporary measure, the participants in Kronos2 were asked manually to provide sufficient funds for T2S auto-collateral on a daily basis to address the problem. At the end of July, the ECB resolved the problems, which have also affected other central banks and participants in other countries.

### Liquidity

Overall, the participants have had ample liquidity for settlement of payments in Kronos2, see chart 1.

<sup>11</sup> Danmarks Nationalbank, Technical adjustment of monetary policy instruments, Press release, 19 March 2021 ([link](#)).

<sup>12</sup> T2S Auto-collateral: The account holder may raise intraday loans in Danish kroner to purchase securities and implement periodic payments on T2S against collateral in purchased or other eligible securities.

<b>Transactions in Kronos2</b>						Table 1
DKK billion, averages per banking day	2017	2018	2019	2020	2021	
<b>Interbank payments</b>	<b>74.0</b>	<b>83.0</b>	<b>87.4</b>	<b>87.6</b>	<b>88.7</b>	
- Of which customer payments	11.5	13.6	14.0	14.0	16.6	
<b>Monetary policy operations</b>	<b>39.9</b>	<b>36.9</b>	<b>48.4</b>	<b>34.5</b>	<b>6.1</b>	
- Of which sales of certificates of deposit	39.9	36.9	48.4	33.3	5.6	
- Of which monetary policy lending	0.0	0.0	0.0	1.3	0.5	
<b>Transfers to settlement systems</b>	<b>316.3</b>	<b>237.3</b>	<b>115.1</b>	<b>113.8</b>	<b>106.1</b>	
- Of which to Sumclearing, Intradagclearing and Straksclearing <sup>1</sup>	273.8	177.2	40.5	39.9	40.6	
- Of which to ES-CPH settlement (formerly VP settlement)	32.5	40.6	46.4	41.2	38.3	
- Of which to CLS	10.0	19.6	28.2	32.8	27.2	
<b>Net positions settled</b>	<b>24.8</b>	<b>24.1</b>	<b>16.3</b>	<b>16.6</b>	<b>17.0</b>	
- Of which Sumclearing, Intradagclearing and Straksclearing	8.0	8.1	8.3	8.3	9.3	
- Of which ES-CPH settlement <sup>2</sup>	10.1	9.1	1.0	0.9	0.8	
- Of which CLS	6.7	6.8	7.0	7.3	6.8	

1. The large decrease in transfers to Sumclearing, Intradagclearing and Straksclearing in 2018 and 2019 was due to Danmarks Nationalbank's replacement of Kronos with Kronos2 in August 2018. Previously, all of the participant's disposable current account liquidity was transferred to the night-time settlements using the 'Maximum liquidity' function in Kronos. Kronos2 automatically sources the necessary liquidity for the night-time settlements in the Sumclearing and Intradagclearing systems.

2. The migration of Danish kroner to TARGET2-Securities (T2S) in October 2018 has also had an impact on settlement in Kronos2. Following the migration, the professional players' settlement has been moved to T2S, while private investors' transactions continue to be settled on ES-CPH's, previously VP's, own platform. The settlement in net positions from the VP settlement decreased from kr. 9.1 billion in 2018 to kr. 1.0 billion in 2019.

Danmarks Nationalbank has also prepared a new stress test analysis of the liquidity in Kronos2. The stress test examines the resilience of the system to shocks to the participants' liquidity under extreme, but plausible, scenarios. This may, for example, be a large participant which cannot send payments for a whole day, a breakdown in a data centre, or that the participants' possibility of borrowing intraday amounts from Danmarks Nationalbank is reduced by a shock to the participants' collateral. The stress test scenarios were simulated for each banking day in the period September 2018 to December 2021. The test shows that the effects of the scenarios are generally

limited. However, there are a few days on which some of the scenarios have significant effects. Danmarks Nationalbank can counter these effects by making payments on behalf of the participants as an emergency procedure. The analysis shows that the value of non-settled payments can be halved by implementing a limited number of payments in an emergency procedure. This significantly reduces the undesirable effects of shocks to the participants' liquidity.

#### International standards

In 2021, Danmarks Nationalbank completed an assessment of Kronos2 according to the CPMI-IOS-

CO's Principles for Financial Market Infrastructures.<sup>13</sup> The assessment showed that Kronos2 has a high level of compliance with international requirements for organisation, risk management, security, efficiency and contingency planning. The assessment also identified a potential for improvements that can strengthen for example governance, risk management and contingency planning. Danmarks Nationalbank has implemented or initiated work in these areas.

Danmarks Nationalbank has, among other measures, strengthened its ongoing reporting to the management on risk management and countermeasures. Further formalisation and anchoring of the risk management responsibility with the system owner in the first line of defence have also been ensured. In specific terms, the system owner's involvement and follow-up have been extended in relation to compliance-related and operational risks. In addition, Danmarks Nationalbank has strengthened the participants' involvement in the risk management work, both through their participation in testing Danmarks Nationalbank's emergency solutions and knowledge sharing at regular meetings between Danmarks Nationalbank and the participants.

Danmarks Nationalbank is also working further to formalise the annual technical tests which are to be conducted.

In 2021, Danmarks Nationalbank analysed the risk of indirect participation in the settlement of payments in Kronos2. Indirect participants are participants which have entered into an agreement with a direct participant on execution of payments through the direct participant's account in Kronos2. The analysis shows that indirect participation is concentrated in the largest participants, and transaction data shows that indirect participation does not give rise to concern in relation to the settlement of payments in Kronos2. In addition, a framework has been established for regular revisits of risks connected with indirect participation.

In 2021, as described above, Danmarks Nationalbank prepared a new stress test analysis of liquidity in Kronos2, and a framework has been prepared for

regular stress testing and handling of the results. Through regular analyses of the risk of indirect participation and liquidity stress testing, Danmarks Nationalbank complies with the CPMI-IOSCO's principles.

### **Cyber resilience**

Danmarks Nationalbank is continuously working to strengthen the cyber resilience of the Kronos2 systems to prevent and counter cyber crime.

Danmarks Nationalbank has previously introduced requirements in its account rules that participants in Kronos2 which are connected via SWIFT must comply with SWIFT's Customer Security Programme (CSP). SWIFT's CSP are mandatory security checks aimed at preventing and detecting fraud. In 2021, Danmarks Nationalbank collected and followed up on the participants' CSP self-certifications, and work is being done to impose similar requirements on non-SWIFT participants. These requirements are expected to be based on Finance Denmark's cyber security handbook.

An important element in the cyber resilience work is to ensure that the most critical business activities in Kronos2 can also be continued under extreme, but plausible, scenarios in which both Kronos2's operating centres are down, for example as a result of cyber attacks. In such cases, Danmarks Nationalbank has an isolated Extreme Contingency Facility (ECF), which is an emergency solution for the settlement of critical payments. In 2021, the ECF solution was tested with the participants and connected payments and settlement systems. In 2021, Danmarks Nationalbank and Finance Denmark also entered into an agreement that, in such extreme cases, Danmarks Nationalbank can encourage the participants to settle as many payments as possible via Intradag-clearing. Together with the ECF, this helps increase the certainty that the settlement of payments in Kronos2 can be handled in crisis situations, also over an extended period of time.

### **System updates**

In 2021, Danmarks Nationalbank's portfolio management system for collateral, Calypso, was upgraded and switched to a cloud-based solution at Adenza.

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<sup>13</sup> Danmarks Nationalbank, Assessment of Kronos2, *Danmarks Nationalbank Report*, no. 4, December 2021 ([link](#)).

The upgrade has strengthened the operational reliability of the system and provided several technical features that support the risk management in connection with Danmarks Nationalbank's intraday credit provision. The upgrade of Calypso was also done within the preparation for the planned migration of Danish kroner to the European payments and securities settlement platform Target Services, see box 2.

### Danish kroner on Target Services in 2025

Box 2

In 2020, based on a preliminary analysis and dialogue with the financial sector, Danmarks Nationalbank decided to migrate the settlement of Danish kroner to the new European consolidated payment and securities settlement platform Target Services. The migration is scheduled for Easter 2025.

Target Services currently consists of the Target2 RTGS system, the Target2-Securities (T2S) settlement system and the Target Instant Payment System (TIPS). Currently, Target2 only supports the settlement of euro payments, but as part of the European project to consolidate the three systems on a single platform from November 2022, Target2 will be modernised and renamed T2 and will be able to support multiple currencies, as is already the case for T2S.

A part of the Danish securities transactions has been settled in T2S since 2018. With the migration of the settlement of Danish kroner to T2 in 2025, Kronos2 will be replaced with T2, and, in addition, Danish kroner will be connected to TIPS. This gathers all settlement of Danish kroner in Target Services.

In continuation of the pre-analysis that resulted in the decision to migrate Danish kroner to Target Services, Danmarks Nationalbank initiated an implementation programme, Target DKK, at the beginning of 2021.

The programme is implemented in close collaboration and coordination with the ECB and the operator 4CB (the four central banks in Germany, France, Italy and Spain). In addition, Danmarks Nationalbank is working closely with the Danish financial sector and the other system owners in the payments infrastructure. The collaboration has been organised in a reference group and a sector group at senior

management level, both of which follow Target DKK closely. In addition, working groups have been established with the participation of experts from the sector who contribute to clarifying e.g. liquidity and technical aspects of the coming solution and to planning and coordinating testing and go-live activities in the sector.

The clarification phase of the programme was completed by the end of the 1st quarter of 2022. The solution has now been established, and work has been commenced on the design and development of the parts of the solution that are to be developed. This includes integrations to and from Target Services and support of the business areas that are not covered by Target Services – more specifically collateralisation and the Danish monetary policy instruments, which must be supported by systems in Danmarks Nationalbank.

In relation to Target Services, it has been clarified which adjustments are necessary to support special Danish needs, and the ECB is processing Danmarks Nationalbank's request for the necessary adjustments. The adjustments have been kept to a minimum, as Danmarks Nationalbank's strategy is to use Target Services as a standard solution to the greatest possible extent.

In addition, Danmarks Nationalbank is planning the details of the activities connected with solution design and development, testing and go-live as well as the transition to operation and management.

The overall plan is that Danmarks Nationalbank's testing of Target Services will begin during 2023 with ongoing sector tests towards go-live.

## Retail payments

Danish citizens and companies make most payments using electronic payment solutions such as Dankort, mobile payments, Betalingsservice or transfers via online banking. Transactions were executed using these payment solutions for kr.31.7 billion on average per day<sup>14</sup> in 2021.

Danmarks Nationalbank oversees the most important payment solutions in Denmark. At present, the oversight covers Dankort and Betalingsservice. In addition, credit transfers are overseen as part of Danmarks Nationalbank's retail payment system oversight.

Danmarks Nationalbank regularly considers whether targeted oversight of other payment solutions is needed if they have attained a more prominent role in the Danish market, see box 3.

### New system owner for Betalingsservice

Danmarks Nationalbank's oversight of Dankort and Betalingsservice has so far involved Nets, as the company has long been the system owner of both these payment solutions. In 2021, Mastercard completed an agreement with Nets which included the acquisition of Betalingsservice, for which Mastercard is thus the new system owner. After this, Dankort and Betalingsservice are subject to separate oversight, with Danmarks Nationalbank overseeing both Nets and Mastercard.

### Nets' services regarding Betalingsservice

In connection with Nets' sale of Betalingsservice to Mastercard, the companies have entered into a service agreement on IT infrastructure and security<sup>15</sup> under which Nets has an obligation to support the operation of Betalingsservice for a transitional period of up to three years. Mastercard is working with Nets towards taking over the operation of Betalingsservice from Nets via the implementation of a 'Separation Plan' for the relevant services. Regard-

### Growing payment solutions in Denmark

Box 3

Danmarks Nationalbank continuously monitors developments in the Danish payment market and oversees the payment solutions of greatest importance to Danish citizens and companies.

MobilePay and international payment cards such as Visa and Mastercard have acquired a greater role in the Danish payment market in recent years. One reason for the increased use of the international payment cards is that they are used in mobile payments with Apple Pay and Google Pay.

According to Danmarks Nationalbank's latest survey and analysis of Danish citizens' payment habits<sup>1</sup>, every fifth payment in stores was made by mobile phone in 2021 – more than a doubling since 2019. The study also shows that 42 per cent of mobile payments were made with Apple Pay, while MobilePay and Google Pay accounted for 22 per cent and 6 per cent, respectively. Payments with Apple Pay and Google Pay have so far been made via the international payment cards, which have thus grown in importance in Denmark.

In 2021, the average transaction volume was kr. 0.7 billion per day for the international payment cards<sup>2</sup> and kr. 0.4 billion per day for MobilePay.<sup>3</sup> In comparison, the value of Dankort payments, which are covered by Danmarks Nationalbank's oversight, averaged kr. 1.1 billion per day in 2021.<sup>4</sup>

1. Denmark is among the most digitalised countries when it comes to payments, *Danmarks Nationalbank Analysis*, No. 2, February 2022.
2. Danmarks Nationalbank's Statbank – the DNBSTS table (compared with information from Nets' statistics for Dankort)
3. MobilePay, ([link](#)).
4. Nets' statistics for Dankort.

14 The value of the transactions in the retail payment systems as calculated per calendar day, see the section *Clearing and settlement of retail payments*.

15 The Transitional Service Agreement (TSA) – Schedule 07, IT Infrastructure & Security: *Nets is to provide a reliable and secure service to Mastercard in order to run and operate the platforms.*

ing the critical services that Kyndryl (formerly IBM) provides to Betalingservice, the contracts must be replaced so that a contractual relationship is established between Mastercard and Kyndryl.

There is continuous oversight of Mastercard's supplier management and the work on the transfer of the services.

### **Nets merged with Nexi and SIA**

During the past two years, Nets has been involved in a merger with the Italian companies Nexi and SIA.

Following approval by the European Commission, the merger between Nets and Nexi was finally completed in July 2021. In October 2021, SIA was granted permission from the Danish Business Authority to acquire a qualified stake in Nets<sup>16</sup>, and the Italian competition authorities approved the merger between SIA and Nexi. The new overall company (Nets, Nexi and SIA) has been a reality since January 2022.<sup>17</sup>

The mergers are not expected to have any immediate impact on the Dankort solution and Danmarks Nationalbank's oversight thereof.

### **Operational reliability**

The overall Dankort operation was satisfactory in 2021. However, there were two major incidents during the year.

On 10 June 2021, around 100,000 Dankort transactions were not processed correctly in Nets' systems. Therefore, these transactions were not booked in the accounts of merchants and cardholders. Nets subsequently reentered the transactions and the merchants received the money on Tuesday, 22 June.

On 11 June 2021, the central system for processing Dankort transactions crashed due to an overload. According to Nets, the overload was due to an extraordinarily large number of transactions resulting from the lifting of covid-19 restrictions and good weather. A large number of transactions were rejected

from 15:30 in the afternoon and for about an hour and a half onwards. In many stores, however, the problem was solved by switching to completing transactions in the terminals offline. The incident was finally resolved by adding more capacity and processing power to the system. Nets has also implemented measures to avoid similar incidents in the future by securing operations with an adequate capacity plan.

Danmarks Nationalbank assesses that Nets' handling of and follow-up on the incidents have been satisfactory.

For Betalingservice, operational reliability was high in 2021 and there have been no significant incidents.

### **Dankort fraud unchanged**

In 2021, Dankort fraud amounted to kr. 17.8 million and was thus approximately on a par with 2020. Relative to the total Dankort-based consumption, fraud still constitutes 0.05 per mille.<sup>18</sup>

Most cases of Dankort fraud occur in stores and ATMs due to theft or loss of cards. This type of fraud increased by 58 per cent in 2021 to kr. 12.8 million<sup>19</sup>. According to Nets, the increase is due to the reopening of society, and especially nightlife, after an extended period with covid-19 restrictions. In addition, elderly cardholders have been among the victims of recent types of trick theft.

In turn, Dankort fraud in connection with online shopping dropped by 49 per cent in 2021 relative to the previous year.<sup>20</sup> To a great extent, this development can be attributed to the requirements under the Revised Payment Service Directive 2 (PSD2) in force from January 2021 for use of two-factor authentication for card payments on the Internet, implemented in Dankort Secured by Nets. PSD2 has also resulted in a reduction in the limit for when Dankort Secured by Nets must be used from kr. 450 to kr. 225 in January 2021.

Online Dankort fraud as a share of the total online use of Dankort has now decreased every year since 2016, see chart 2.

16 The Transitional Service Agreement (TSA) – Schedule 07, IT Infrastructure & Security: Nets is to provide a reliable and secure service to Mastercard in order to run and operate the platforms.

17 In accordance with the new Danish Investment Screening Act (*Investeringsscreeningsloven*).

18 Nets, Nexi, Nets and SIA becomes Nexi Group, (*link*).

19 Nets' statistics on Dankort fraud.

20 Nets' statistics on Dankort fraud.

### Betalingservice fraud

There was no Betalingservice fraud in 2021.

### International standards

-During 2021 and the beginning of 2022, Mastercard continued its follow-up on Danmarks Nationalbank's assessment of Betalingsservice's compliance with the ECB's standards<sup>21</sup>. Mastercard has now met the final outstanding recommendations and remarks regarding the work to strengthen the handling of critical suppliers, IT risk management and network monitoring.

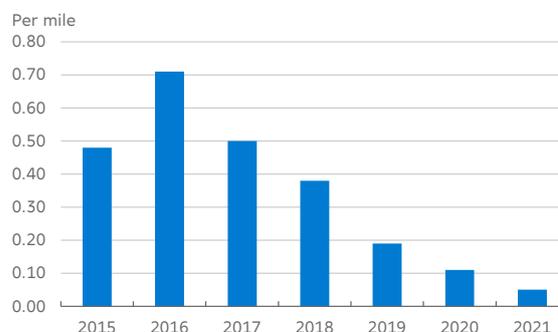
The ECB has updated the standards for payment solutions such as Dankort and Betalingservice. The new framework is called 'PISA', which stands for Payment Instruments, Schemes & Arrangements (Eurosystem oversight framework). To harmonise the payments area, PISA builds on the requirements of the oversight standards applicable to central payment systems – see box 4.

To a great extent, PISA constitutes a continuation of the current requirements in the ECB standards – especially in relation to the key requirements. PISA was published in November 2021.<sup>22</sup>

Danmarks Nationalbank has notified Nets and Mastercard of the change with a view to entering into a dialogue on the significance of the updated standards to Dankort and Betalingservice. In the Eurosystem, the transition to PISA is scheduled for 15 November 2022.

### Dankort fraud on the Internet (as part of the total use of Dankort on the Internet)

Chart 2



Source: Nets.

### PISA – updated standards for payment solutions

Box 4

Together with the central banks in the euro area, the ECB has updated the requirements for electronic payment solutions and the oversight framework for these solutions. With PISA, the ECB's current assessment guides have been gathered in a single framework based on and harmonised with the CPMI-IOSCO's Principles for Financial Market Infrastructures (PFMI). The focus remains on the security and efficiency of the payment solutions.

In addition to a consideration of harmonisation in the payments area, the PISA requirements reflect the latest technological and regulatory development, including the emergence of crypto-assets, electronic wallets, PSD2 and Electronic Money Directive 2 (EMD2). The oversight framework has thus been extended to cover these solutions.

Overall, PISA largely continues the current requirements of the ECB's assessment guides – especially with regard to the key requirements in the main areas, including legal basis, governance, access, comprehensive risk management and efficiency. The main difference between the existing.

21 Danmarks Nationalbank, Betalingservice Assessment, Danmarks Nationalbank Report, no. 4, October 2019 ([link](#)).

22 Eurosystem publishes new framework for overseeing electronic payments, November 2021, ([link](#)).

## Clearing and settlement of retail payments

Sumclearing, Intradagclearing and Straksclearing are the financial sector's systems for clearing and settlement of Danish retail payments. The systems are owned by Finance Denmark, managed by e-nettet and operated by Mastercard.

The Sumclearing system is used for clearing of, for example, card and Betalingservice payments once a day on banking days. The Intradagclearing system is used for clearing of credit transfers such as online banking transfers, payroll transactions and public sector payments. The banks' net positions – corresponding to the sum of payments to and from the banks' customers – are calculated in the systems at fixed times. The net positions are sent to Kronos2, which exchanges the amounts between the banks.

In the Straksclearing system, credit transfers are executed in a matter of seconds 24/7. This is possible because the banks reserve liquidity in Kronos2 for the transfers in advance. The actual interbank exchange of liquidity takes place six times a day on banking days. The Straksclearing system is used primarily for online banking transfers and payments via MobilePay.

### Use

There are 50 direct participants in the retail payment system and 24 indirect participants, which settle via direct participants. The value of the transactions in the systems amounted to an average of kr. 46.1 billion per banking day in 2021, which is a significant increase relative to previous years, cf. table 2. The number of transactions in Straksclearing increased in 2021 after an unchanged level from 2019 to 2020, see chart 3.

### Operational reliability

Retail payment system operations were satisfactory in 2021 without any incidents necessitating follow-up by Danmarks Nationalbank.

However, an incident in another part of the payments infrastructure resulted in an activation of the retail payment system's contingency plans as there was concern that the incident would have an impact on the settlement of retail payments. However, the incident was handled without giving rise to delays in settlement of transactions in the retail payment system.

**Value of transactions in Sumclearing, Intradagclearing and Straksclearing**

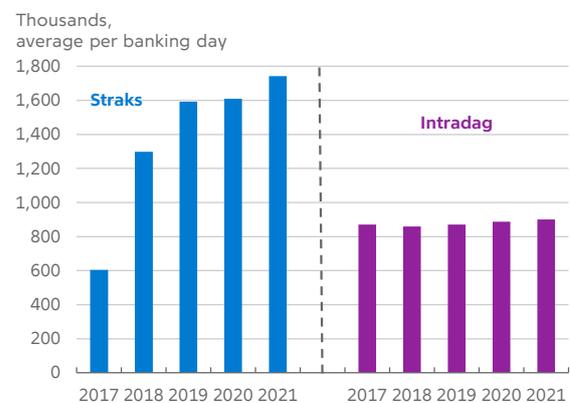
Table 2

System	2017	2018	2019	2020	2021
Sumclearing					
Intradagclearing	17.8	18.3	19.2	18.7	20.5
Straksclearing	19.7	20.1	20.8	21.9	23.9
Total	0.9	1.2	1.4	1.6	1.7
Total	38.4	39.6	41.4	42.2	46.1

Source: Mastercard.

**Number of transactions in Intradagclearing and Straksclearing, 2017-2021**

Chart 3



Source: Mastercard.

### Liquidity

The banks reserve liquidity in accounts with Danmarks Nationalbank for settlement of their net positions. If a participant does not reserve sufficient liquidity, the participant's settlement will be postponed, and new net positions are calculated for the other participants, who risk not receiving the expected liquidity.

Most of the banks use the automated liquidity management tools of the systems, and there have not been any incidents in 2021 in which participants' settlements were postponed due to a lack of liquidity.

### Cyber resilience

Finance Denmark is working continuously to strengthen the cyber resilience of the retail payments infrastructure. Most recently, a cyber security handbook has been introduced describing IT security requirements to be implemented by the banks and Mastercard and on which they must submit compliance reports.

At the end of 2021, Mastercard conducted a self-assessment showing that they comply with the requirements in the cyber security handbook. The banks have also reported their compliance with the requirements to Finance Denmark.

Danmarks Nationalbank is in the process of assessing the retail payment system's observance of the CPMI-IOSCO's cyber security guidance. The assessment is expected to be completed in mid-2022.

### System updates

Finance Denmark is working to increase the threshold in Straksclearing, which is currently kr. 500,000. According to Finance Denmark, the banks are experiencing an increasing need to execute large payments in real time. This is especially the case in connection with corporate payments, change of banks etc. Finance Denmark also sees an increase in the threshold as a natural step towards the take-up and usage of instant payments.

Finance Denmark has prepared a number of requirements for the banks' use of Straksclearing which must be complied with in connection with any increase in the threshold. These include requirements for monitoring of payments to detect suspicious transfers, differentiated thresholds for sending instant payments, including via customer segmen-

tation, and the possibility of quick revocation of transactions.

### Retail payment system operations taken over by Mastercard

In 2021, Mastercard acquired and took over the areas of Nets' infrastructure that cover retail payment system operations. In connection with the acquisition, the parties entered into an agreement that Nets will continue to operate the retail payment system as Mastercard's supplier during a transitional period.

Mastercard has now requested Finance Denmark's consent to move the operation of Intradagclearing and Straksclearing from Nets' existing data centres in Norway to Mastercard's own data centres in Norway and Sweden, respectively. The data centres are the same as those used to operate P27. Sumclearing will still be operated by Kyndryl (formerly IBM).

As part of the migration, changes must be made to the existing setup, tests and the like. The relocation to the new data centres, including the time for this, is awaiting further analysis and coordination before final approval. The migration will be coordinated with the Target DKK project and the sector's programme for the future payments infrastructure in Denmark.

Net's Security Policy and the underlying standards, known as Nets Security Framework, have been continued as Mastercard Security Framework. The framework reflects regulatory, customer-related and industry-dictated security requirements for companies operating critical infrastructure. Mastercard has also retained Nets' risk framework for the retail payment system and is working to align this with Mastercard's existing standards and practices.

Danmarks Nationalbank and the system owner, Finance Denmark, as well as Nets and Mastercard all focus on ensuring secure operation of the retail payment system after the transfer to Mastercard.

### P27 – common retail payment system for Denmark, Sweden and Finland

The banks behind P27 have established the company P27 Nordic Payments in Sweden and have chosen Mastercard as IT supplier.

Being a foreign company, P27 will not automatically be subject to Danish law and Danmarks Nationalbank's powers of supervision and oversight<sup>23</sup>. Danmarks Nationalbank and P27 have therefore agreed a model in which P27 will voluntarily incorporate a provision into its contractual basis, stipulating that the clearing and settlement of Danish kroner in P27's Swedish system will be governed by Danish law. P27 will thus be covered by Danish law and Danmarks Nationalbank's powers.

At the same time, the Danish Parliament (Folketinget) has passed a new act to ensure appropriate supervision and oversight of the players, including foreign companies, which handle clearing and settlement of Danish retail payments. The Act entered into force in January 2022 and allows Danish authorities to require that systemically important payment systems and their IT supplier establish themselves in Denmark and thus be covered by Danish law.

P27's Nordic retail payment system is also being discussed by the Nordic central banks and financial supervisory authorities. The ambition is to establish Nordic cooperation related to supervision and oversight.

### **Sectoral decision on the future payments infrastructure**

In 2021, the overall Danish sector decided to work towards replacing the existing retail payments systems (Sumclearing, Intradagclearing and Straksclearing) with P27's Nordic retail payments system<sup>24</sup>. P27 is scheduled to go live with Danish kroner in Easter 2025 concurrently with the system joining Target DKK.

The work is anchored in a sector programme for the future payments infrastructure under Finance Denmark's Board of Directors, and a steering committee has been set up with broad sector representation, including by P27.

The programme is run by e-nettet in close collaboration with Finance Denmark.

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23 Under the Danish Capital Markets Act (*Kapitalmarkedsløven*), the duty of supervision of the retail payments system rests with Danmarks Nationalbank. The Danish Capital Markets Act stipulates that Danmarks Nationalbank oversees payment systems of major significance to the settlement of payments.

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24 P27 has been established by Danske Bank, Nordea, Handelsbanken, SEB, Swedbank and OP Financial Group. DNB was part of the initiative, but withdrew from the project together with the Norwegian sector in March 2019.

## Securities settlement

Securities transactions can be concluded in different ways: on the stock exchange, through a multilateral trading facility or bilaterally between the parties through a bank or a broker. The final settlement of the transactions, i.e. where money and securities are exchanged in the participants' accounts, takes place in two central systems in the Danish and European financial infrastructure:

*Euronext Securities Copenhagen (ES-CPH)*, which, until November 2021, was called VP Securities<sup>25</sup>, operates the Danish system for settlement of securities transactions. ES-CPH is also responsible for handling periodic payments, issues, redemptions etc. and is the only company in Denmark with permission to issue securities and hold securities in custody.

ES-CPH forms part of the pan-European stock exchange and the market infrastructure group Euronext Group. Euronext's acquisition of the Danish central securities depository was finally approved by the Danish Financial Supervisory Authority in June 2020, and, since then, there has been a major integration process in ES-CPH. The purpose of the process is to enhance the efficiency of ES-CPH's organisation through synergies across the Group and concurrently streamline the business and products in the four central securities depositories in Italy, Norway, Portugal and Denmark, respectively, which all form part of Euronext.

Target2-Securities (T2S) is a pan-European platform on which cross-border securities transactions are settled just as efficiently as national transactions. Since October 2018, a large share of the settlement of securities transactions in Danish kroner has been settled on T2S. T2S is owned by the Eurosystem and

operated by the four central banks of the largest euro area countries, with the ECB as coordinator.

Under the Danish model for settlement of securities transactions, the professional participants'<sup>26</sup> mutual securities transactions are settled on T2S, while private investors' transactions are settled through ES-CPH's own settlement system. Danish kroner for the money leg in the settlement of the transactions is debited or credited to the participants' accounts in Danmarks Nationalbank's RTGS system, Kronos2.<sup>27</sup> Registrations of the changes in the holdings of securities are made in securities accounts with ES-CPH.

### Use

ES-CPH's settlement system has 86 participants, 45 of which are foreign market participants, including four CCPs<sup>28</sup>. Out of ES-CPH's participants, 48 have a dedicated money account with Danmarks Nationalbank which can be used for the settlement in kroner in T2S.

A new record was set for ES-CPH in 2021, with more than 100,000 transactions settled on average per banking day, see table 3. The high level was especially driven by an increase of 29 per cent in the number of trades in investment fund shares. The activity was particularly high at the beginning of 2021, see chart 4, which shows the development in the number and value of transactions in Danish-issued securities settled in T2S and ES-CPH's own settlement system, respectively. In terms of value, a total of kr. 226.4 billion was settled on average per banking day, which was slightly below the level of the previous year. 2020 thus remains the year with the highest settled value in ES-CPH ever.

25 The change of name is only commercial, and the Danish company is still registered as VP Securities A/S in the CVR register.

26 For example banks, institutional investors and stockbrokers.

27 In T2S, liquidity is transferred from Kronos2 to the T2S platform, while the settlement of the money leg in ES-CPH takes place directly in accounts with Danmarks Nationalbank.

28 The four foreign CCPs in ES-CPH are EuroCCP, LCH Clearnet and Six X-clear, which clear equities transactions, while Nasdaq Clearing clears repo transactions. The regulatory control of the CCPs is conducted in so-called supervisory colleges, where the Danish Financial Supervisory Authority participates in the supervision of EuroCCP and Nasdaq Clearing AB.

Equities, investment fund shares and bonds settled in ES-CPH, averages per banking day

Table 3

Year, average per day	Total		Obligationer		Aktier		Investeringsforeningsbeviser	
	Number of transactions, thousand	Value, kr. billion	Number of transactions, thousand	Value, kr. billion	Number of transactions, thousand	Value, kr. billion	Number of transactions, thousand	Value, kr. billion
2017	66.9	162.7	2.7	118.4	32.4	36.6	31.8	7.7
2018	65.5	168.5	2.6	119.0	29.4	40.8	33.5	8.8
2019	67.0	223.1	4.2	180.7	33.0	34.8	29.8	7.6
2020	90.5	231.5	3.8	178.1	49.0	43.5	37.7	9.9
2021	101.7	226.4	3.9	163.6	49.1	51.0	48.7	11.8

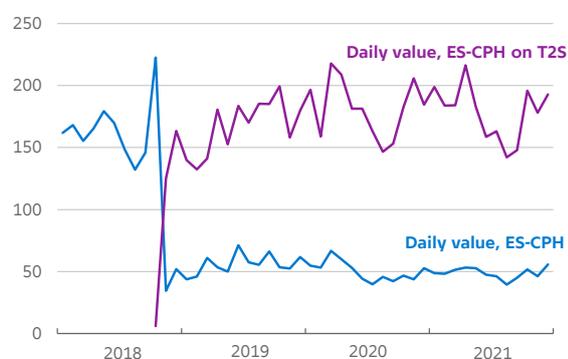
Note: The number and value of transactions have been calculated collectively for ES-CPH and ES-CPH on T2S. Values have been calculated on the basis of the securities leg of a transaction, i.e. the market value of the securities transferred from the seller to the buyer.

Source: ES-CPH

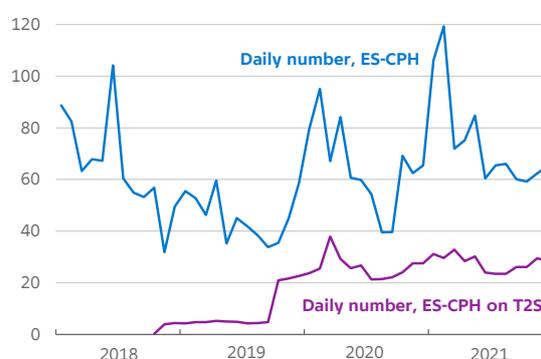
Number and value of securities transactions

Chart 4

Kr. billion, monthly average



1,000 units, monthly average



Note: The left-hand chart shows the number of transactions settled, while the right-hand chart shows the value of transactions, calculated based on the market value of the securities transferred from the seller to the buyer.

Source: ES-CPH.

As mentioned, ES-CPH is also responsible for holding all Danish-issued securities in custody. At the end of 2021, the market value of securities held in ES-CPH was kr. 12,200 billion, see chart 5, which is an increase of 46 per cent relative to January 2018. The primary reason for the increase is that the value of

Danish-issued shares held in ES-CPH nearly doubled in the period 2018-2021.

### Operational reliability

Operational reliability in the settlement of Danish securities was satisfactory in 2021. During the year, there were a number of minor incidents that have only had a limited impact on the operation of ES-CPH's and T2S' systems. However, a single incident had a significant impact on settlement stability:

In November 2021, a technical fault occurred in ES-CPH which resulted in delays in the settlement of transactions and a number of related inconveniences for the participants in ES-CPH. The problems arose after system updates in T2S, SWIFT<sup>29</sup> and ES-CPH's own systems, respectively. The incident lasted for two days, after which ES-CPH succeeded in identifying and remedying the main problems, thereby stabilising the settlement. There were a number of minor derived effects on the operation for a subsequent period of two weeks.

ES-CPH has prepared a detailed report describing the initiatives taken to reduce the risk of similar future incidents. Danmarks Nationalbank follows up on the initiatives as part of its ongoing oversight.

### Settlement ratio

The settlement ratio indicates the percentage of the transactions settled in a timely manner. According to Article 5 of the Central Securities Depositories Regulation (CSDR),<sup>30</sup> securities transactions must be settled two days after the transactions have been concluded unless otherwise agreed between the parties to the transaction.

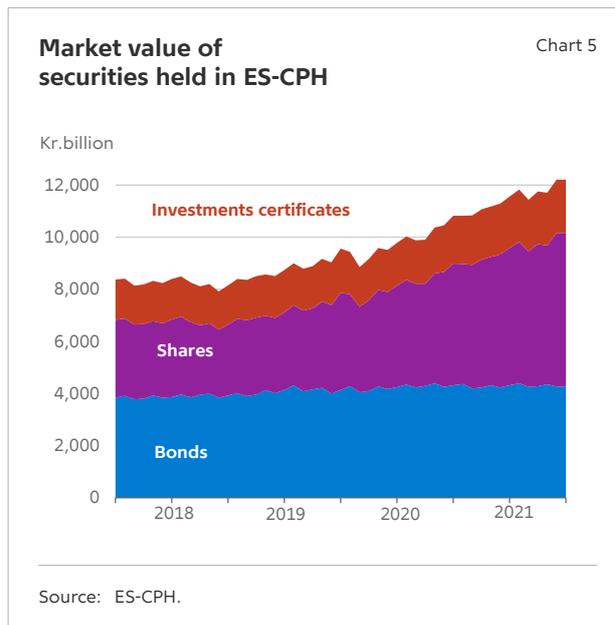


Chart 6 shows the settlement ratio for ES-CPH's own system and for ES-CPH's settlement in T2S, respectively. The settlement ratio in ES-CPH's own system dipped in the last two months of 2021 after having been at a stable level for most of the year. The dip was due to the problems surrounding the incident in ES-CPH in November 2021.

### Sanctions

If the transactions of a participant are not settled in a timely manner, this may cause problems for that participant's counterparties, which may not be able to meet their obligations as a result. In February 2022, a new pan-European sanctions system was taken into use. The system, which has been introduced as part of the CSDR, is designed to sanction participants whose transactions cannot be settled in a timely manner due to a lack of securities or liquidity. The sanctions system is described in further detail in box 5.

<sup>29</sup> The Society for Worldwide Interbank Financial Telecommunications (SWIFT) is a society that ensures standardised message format for financial telecommunications.

<sup>30</sup> Regulation (EU) No 909/2014 of the European Parliament and of the Council of 23 July 2014 on improving securities settlement in the European Union etc., abbreviated CSDR (link), aims to harmonise times and behaviour in connection with securities settlement as well as the rules applicable to the central securities depositories (CSDs) that operate the settlement infrastructure.

The implementation of the sanctions system has required a number of technical adjustments in both ES-CPH's and T2S' systems. Especially in relation to the latter's system, this has led to a number of challenges and incidents. The operational reliability of the pan-European platform was therefore lower in February and March 2022 relative to the otherwise stable operational level throughout 2021.

### International standards

Danmarks Nationalbank oversees that the settlement of Danish securities transactions in ES-CPH and T2S meets international standards for securities settlement systems.

For T2S, the oversight is performed in collaboration with all the central banks connected to the platform, with the ECB as the main overseer and coordinator, see the section on payments and securities settlement in euro.

At the same time, the securities settlement is, as mentioned, also regulated by common legislation in the EU, including the CSDR. The Danish Financial Supervisory Authority supervises compliance with the statutory requirements. To the extent that there is an overlap between standards and statutory requirements, documentation from the Danish Financial Supervisory Authority on compliance with statutory requirements is included in Danmarks Nationalbank's oversight.<sup>31</sup>

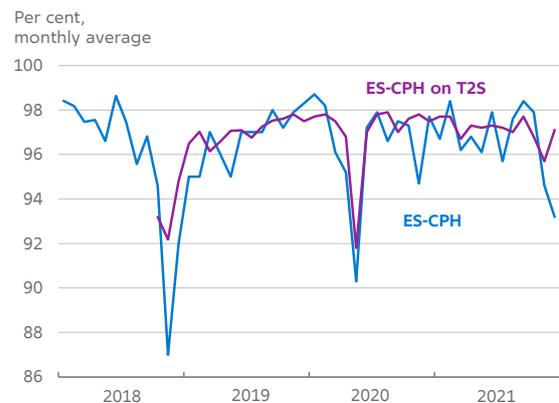
Danmarks Nationalbank's latest assessment of ES-CPH's settlement system according to CPMI-IOSCO's Principles for Financial Market Infrastructures (PFMI) was performed in 2016. ES-CPH has complied with all the recommendations made in the assessment.

### Cyber resilience

In 2020, Danmarks Nationalbank completed an assessment of ES-CPH's compliance with the CPMI-IOSCO's cyber guidance. This assessment shows that ES-CPH has a high level of maturity and complies with the cyber guidance in most areas. However, there are also a few, but key, areas in which

### Settlement ratio

Chart 6



Note: In the chart, the settlement ratio is based on the number of transactions (trading volume). The low level at the end of 2018 was due to a number of incidents occurring in the weeks following ES-CPH's connection to T2S. The dip in the settlement rate in May 2020 is due to a major incident in T2S, which also affected ES-CPH.

Source: ES-CPH.

### CSDR Settlement Discipline Regime

Box 5

The sanctions system specified in the regulatory technical standards (RTS) of the CSDR aims to harmonise securities settlement within the EU. This is done by ensuring that buyers and sellers receive their securities and money on time and without risks. To achieve this objective, the RTSs contain a number of measures to prevent and remedy faults in the settlement of securities transactions.

As a central securities depository operating under a CSDR licence, ES-CPH is obliged to implement the new sanctions system. This has an impact on both ES-CPH's customers and ES-CPH's own systems, as the new functionalities will be introduced to support penalty mechanisms, mandatory partial settlement and suspension of a participant.

Source: Danmarks Nationalbank

<sup>31</sup> Danmarks Nationalbank is the relevant authority for ES-CPH, see Article 12 of the CSDR, and must therefore be notified of matters relating to the central securities depository's compliance with the requirements in the Regulation.

ES-CPH does not fully comply with international standards. Danmarks Nationalbank has therefore given ES-CPH a number of recommendations, of which 6 out of 16 are still open, while the rest have been complied with. Danmarks Nationalbank follows up on the open recommendations as part of its ongoing oversight.

#### **System updates**

As mentioned, ES-CPH is in the process of adapting its organisation, processes and products to those of Euronext. Work is also being done on a future consolidation of selected services on a common cloud-based platform to be shared by the four central securities depositories in the Group. For the time being, however, all of ES-CPH's critical business areas are operated in their own separate and local systems.

## Payments and securities settlement in euro

Target2 and Target2-Securities (T2S) are used by Danish banks to settle payments and securities transactions in euro. The systems are owned and operated by the Eurosystem.

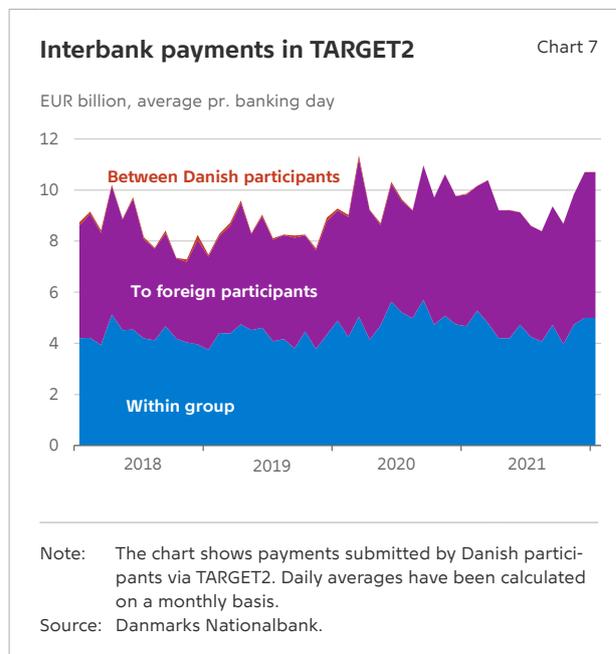
The trans-European RTGS system, Target2, is used for settlement of large time-critical payments in euro. In Target2, liquidity is also transferred for settlement in other euro systems, including T2S. T2S is the trans-European system for settlement of securities transactions in euro and in Danish kroner.<sup>32</sup>

### Use

There are 21 Danish participants, which executed interbank payments averaging 9.5 billion euro a day in 2021. Danish participants use Target2 mainly for intergroup payments and payments to non-resident participants, see chart 7. Exchange of euro mostly takes place with participants in Germany, Finland, France and Belgium.

A total of 21 central securities depositories from 20 European countries are connected to T2S, including ES-CPH. A bank may settle payments via T2S as either a direct participant, if the bank has a so-called Dedicated Cash Account, or as an indirect participant via a direct participant's access.

A Dedicated Cash Account is set up through one of the central banks in the EU. 15 Danish participants hold a Dedicated Cash Account in euro at Danmarks Nationalbank for payment in or receipt of euro in connection with T2S settlement. Other Danish participants may have set up a Dedicated Cash Account through other EU central banks.<sup>33</sup>



### Operational reliability

The operational reliability of the local Target2 components for which Danmarks Nationalbank is responsible was satisfactory in 2021.

An upgrade of T2S in June 2021 affected Danmarks Nationalbank's Kronos2 and the Kronos2 participants. The incident and incident follow-up are described in more detail in the section on interbank payments.

Back in 2020, there were five major IT-related incidents (not cyber incidents) which affected the

<sup>32</sup> T2S can handle multiple currencies. Besides the euro, Danish kroner is the only other currency connected to T2S. Read about the settlement of Danish kroner in the section Securities settlement.

<sup>33</sup> As euro cannot be deposited permanently in Dedicated Cash Accounts, banks must also have access to a Target2 account to which euro can be transferred at the end of the settlement day. Most of the Danish banks have concluded agreements with correspondent banks, while some of the largest banks have established a Target2 account, through their branch, with a central bank in the euro area.

settlement of payments and securities in Target2 and T2S. As a follow-up to the incidents, the ECB commissioned an external investigation into the causes and into the more general procedures and processes in selected areas. The external investigation was conducted by Deloitte. The investigation was concluded with a report containing recommendations on how the ECB can strengthen its risk management work in several areas, including change management, business continuity, governance etc <sup>34</sup>. The ECB has accepted all recommendations and has prepared an overall action plan addressing the recommendations from Deloitte, the oversight and the ECB's internal audit. In 2021, the ECB implemented and initiated measures aimed at addressing most of the recommendations. The ECB expects the main part of the measures in the action plan to have been completed by the end of 2022. Danmarks Nationalbank participates in the ECB's follow-up on the action plan under the auspices of the joint oversight of Target2 and T2S, see below.

#### **International standards**

Oversight of Target2 and T2S takes place in collaboration with the EU central banks. Danmarks Nationalbank participates in the joint oversight headed by the ECB which takes place in working groups with the participation of the national central banks.

In 2021, under the auspices of the ECB, Danmarks Nationalbank participated in the follow-up on an assessment of T2S against the CPMI-IOSCO principles from 2019.

In 2021, Danmarks Nationalbank also contributed to the efforts of assessing T2S according to the Cyber Resilience Oversight Expectations (CROE), the ECB's implementation of the CPMI-IOSCO cyber guidance.

#### **System updates**

In 2016, the ECB initiated a major project aimed at modernising the European payments infrastructure and has, since then, been working to consolidate Target2, T2S and the Target Instant Payment System (TIPS) on a single IT platform. The aim is to meet new market requirements and optimise participants' liquidity management across all TARGET Services.

The consolidation will be launched on 21 November 2022. On this date, all connected central banks and participants from Target2's Single Shared Platform will migrate to the consolidated platform, T2 Service, concurrently in a so-called big bang.

In preparation for the migration, the central banks began their testing phase in June 2021 and the market participants commenced their testing phase in December 2021. The purpose of the testing phases is to make the central banks and market participants familiar with the system and its structure, but they are also aimed at finding any faults.

Several migration tests are conducted, so that the central banks and participants have tried and tested the migration plan several times before the final go-live in November 2022.

<sup>34</sup> European Central Bank, ECB publishes an independent review of Target incidents in 2020, Press release, 28 July 2021 (*link*).

## Settlement of foreign exchange transactions

In a foreign exchange transaction, two opposite payments are made in two different currencies. Foreign exchange transactions can either be settled through correspondent banks or through the international settlement system for foreign exchange transactions, CLS, which settles transactions in 18 participating currencies. Most foreign exchange transactions in Danish kroner are settled in CLS.

CLS Bank International (CLS) handles the CLS settlement and is owned by large international banks. In the CLS settlement, the participants report their payments to CLS, after which the payments are matched by CLS, and the two payments in the foreign exchange transaction are settled concurrently (Payment-versus-Payment, PVP), which eliminates the risk between the parties to the transaction.

Danmarks Nationalbank collaborates with other central banks on the oversight of CLS, see box 6.

### Use

Both Danish banks and firms can settle foreign exchange transactions via CLS. One Danish bank participates directly in CLS settlement. Those who are not direct participants can settle foreign exchange transactions in CLS via one of the nine participants who offer indirect participation to the Danish market.

More than 95 per cent of all foreign exchange transactions in Danish kroner are settled via CLS.<sup>35</sup> The average daily value of transactions in Danish kroner was kr. 280 billion in 2021, which was on a par with 2020, see chart 8.

In 2020, CLS entered into a collaboration with several participants to address the risk of foreign exchange transactions settled without PVP<sup>36</sup>. When the two payments in a foreign exchange transaction are not

### Oversight of CLS

Box 6

Oversight of CLS is based on the CPMI-IOSCO principles for safe and efficient payment systems. Every second year, CLS publishes an updated disclosure of the system's observance of the principles.<sup>1</sup>

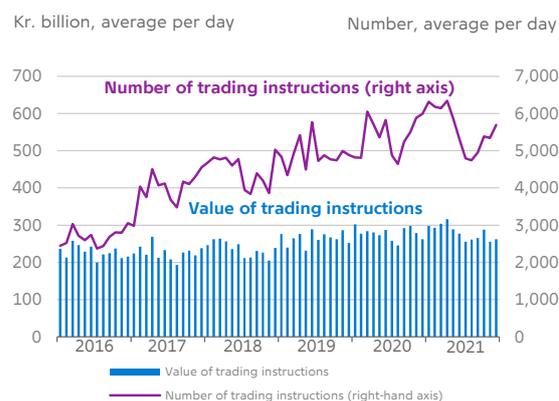
Oversight of CLS is carried out by a joint CLS Oversight Committee<sup>2</sup>, which is a collaboration between the central banks of the participating currencies, through which they can carry out their national oversight responsibilities. Danmarks Nationalbank participates in this work, which is managed and coordinated by the Federal Reserve, which is also the supervisory authority for CLS.

Danmarks Nationalbank's oversight of CLS is particularly focused on matters of importance to the settlement of transactions in Danish kroner.

1. CLS, Principles for Financial Market Infrastructures Disclosure, 2019 ([link](#)).
2. Federal Reserve System, Protocol for the Cooperative Oversight Arrangement of CLS ([link](#)).

### Trading instructions in CLS

Chart 8



Source: CLS Bank.

<sup>35</sup> Estimate based on BIS, Triennial Central Bank Survey, Foreign exchange turnover in April 2019, Bank for International Settlements, September 2019 ([link](#)) and data from CLS Bank.

<sup>36</sup> CLS, CLS announces collaboration with 12 global banks to pilot PVP solution for a wider range of currencies and market participants, September 2021 ([link](#)).

executed concurrently, the parties are exposed to a settlement risk, i.e. a risk that the counterparty does not pay its share of the transaction. In June 2021, CLS and the participants commenced a pilot project to examine different solutions and find the optimal design for a PvP solution for currencies that do not currently form part of the CLS settlement.

#### **Operational reliability and liquidity**

CLS settlement takes place during a relatively short defined window when all RTGS systems of the participating central banks – across time zones – are open. Pay-ins and pay-outs related to CLS are made using RTGS systems, as far as Danish kroner are concerned through Kronos2. The operational reliability of CLS is therefore dependent on the reliability of the connected RTGS systems in relation to conclusion of the settlement within critical time limits.

In 2021, there were no incidents in Kronos2 affecting the CLS settlement.

The Danish participants reserve sufficient liquidity for CLS settlement.

#### **System updates**

In 2021, CLS completed a migration of all of its settlement services, including the CLS settlement, to a new shared technology platform called Unified Services Platform, USP. In addition to an optimised, flexible and more robust technological platform, the migration has also led to improved monitoring and alerts as well as more automation for the benefit of the CLS ecosystem.<sup>37</sup>

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<sup>37</sup> CLS, CLS completes migration of its settlement service to new state-of-the-art technology platform, July 2021 ([link](#)).

## PUBLICATIONS



### NEWS

News offers quick and accessible insight into an Analysis, an Economic Memo, a Working Paper or a Report from Danmarks Nationalbank. News is published continuously.



### ANALYSIS

Analyses from Danmarks Nationalbank focus on economic and financial matters. Some Analyses are published at regular intervals, e.g. *Outlook for the Danish economy* and *Financial stability*. Other Analyses are published continuously.



### REPORT

Reports comprise recurring reports and reviews of the functioning of Danmarks Nationalbank and include, for instance, the *Annual report* and the annual publication *Danish government borrowing and debt*.



### ECONOMIC MEMO

An Economic Memo is a cross between an Analysis and a Working Paper and often shows the ongoing study of the authors. The publication series is primarily aimed at professionals. Economic Memos are published continuously.



### WORKING PAPER

Working Papers present research projects by economists in Danmarks Nationalbank and their associates. The series is primarily targeted at professionals and people with an interest in academia. Working Papers are published continuously.

The report consists of a Danish and an English version. In case of doubt regarding the correctness of the translation the Danish version is considered to be binding.

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