Architectural Overview

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Executive summary

The Architecture Overview is meant to be a high-level presentation of the necessary architectural building blocks and enablers to support the Nordic Smart Government interoperable ecosystem. This overview is formulated to bind the more detailed architectural documents together and derived from identified architectural capabilities.

The overview focuses on the collection of application services that organizations share as a set of common goals and collaborate to provide specific services to customers regardless of the technology ownership or operational models and geographical distribution.

All the proposed architectures relies on well-known technologies (APIs, message exchange, addressing). This means that the NSG-vision can be implemented using these existing, well-known technologies. This does not, however, exclude that the future implementation-phase can take advantage of other technologies, for instance Distributed Ledger Technology (DLT).
The realization of Nordic Smart Government through an interoperable ecosystem of digital solutions will provide real-time financial data for business-to-business and business-to-government interactions. It will consist of public and private systems handling financial data used by the SMEs in various business systems. Business administration such as transaction processing and reporting to governmental authorities is supported by the ecosystem, as well as access to financial information for business counterparties.

**Recognized counterparties:**

**SME** is any entity that engages in business transactions and is required to report its financial data to Government agencies. (We use SME the entity as those are the main target group for NSG, although the architecture will be relevant for larger companies also.)

**Operators** deliver information between businesses or to Government agencies and are part of standardised data supply chain.

**Government agencies** analyse the business entities data and are responsible for the Economic and financial regulation fulfillment.

**Nordic Smart Government** is the Nordic Information and communication network of Government agencies.
Capability / reference architecture hierarchy

Vision

Expected outcomes

Capability map

Reference architecture: application & technical services
Hierarchical capabilities and services (partial example)

Illustrative example of architectural building block fulfilling the capabilities and expected outcomes of the NSG

Vision

The Nordic region shall become the most integrated in the world

Expected outcomes

Make life simpler for SMEs in the Nordic region

Make the Nordic region the most integrated in the world

Increased and more efficient use of financial data in public and private sectors

Capability map

eInvoice standard implemented in all business systems

Receipt of eReceipts possible in all business systems

eOrder and eCatalogs implemented in all business systems

VAT automation between businesses and business systems

Common representation of the base registry data on businesses

Reference architecture: Application & technical services map

Compliant with e-ordering and e-cataloging BIS format (semantic model EN-16931)

Detailed product information in catalogs through standardized product identifiers

Access to a service that checks for VAT registration
Architectural principles in a nutshell

These principles are meant to guide the effort of selecting and implementing the different technical mechanisms that will form the NSG solution. They may be used as guidelines before selection and/or implementation, or as a checklist after a choice has been made.

- Principle 1: Build on open existing standards
- Principle 2: Use clearly defined, global semantics
- Principle 3: Protect user data
- Principle 4: Built to evolve
- Principle 5: Use secure building blocks
- Principle 6: Enforce data portability
User Principles

The following user principles guide the architectural designing work:

1. I never manually enter information that is already maintained digitally by someone else, like the producers, vendors or the government.
2. When I buy and sell goods and services I don't need to make any special arrangements when my trade-partners are in another Nordic country.
3. I rarely perform manual steps related to inventory, book-keeping, bank-transactions, VAT- or other government reporting, unless I choose to verify or alter the proposals from my systems.
4. If someone offers me a better deal or improved service, migrating to new service providers for services like bookkeeping, inventory, reporting etc is just as easy as changing operator for my cell phone.
5. I get feedback during processes, and there is someone who can assure me -- as well as my existing and potential trade-partners -- that everything is OK with regards to my duties towards the Government, so I can sleep well at night and go for a holiday without worrying.
6. I am in control of all the transaction and financial data of my business, and empowered to re-use and share the data when I have the need, and I know who is accessing what information, on what legal basis (my consent or government legislation), when and for what purpose.
7. I can pick and choose among the best of breed, and use as many business systems by different providers simultaneously as I like, without having to pay for customized integrations.
8. When I pay for upgrades of my business systems, I expect improved functionality, not just a set of mandatory updates to stay compliant with new and complex requirements from the Government.
9. At any time I have an updated view of the financial situation of the company, including reliable forecasts for the coming weeks, so that I know whether I will be able to pay the salaries or the VAT next week.
The following diagram taken from the NSG Roadmap shows how actions are bundled into three different phases: short term 2020-2023, mid term 2024-2025 and long term 2026-2027. Short and mid term actions illustrated below:
Actors and infrastructure
Summary of the actors and the infrastructure

In this document we propose architectures for the different areas that represent a possible way of realising the necessary functionality. In most cases there are several ways of achieving the same functionality. The detailed architecture decisions must be taken as part of a future process where the relevant stakeholders are involved in the co-creation-process.

- The following slides illustrate the logical application services and standards for the actors and infrastructure within the NSG ecosystem.

- These illustrations are not meant to be comprehensive blueprints for implementations and there can be other possible solutions for the same needs. The proposed architectures might also co-exist with other architectures within the same domain, for instance Peppol and other implementations of EDI. See also slide [Peppol and EDI](#).

- All the proposed architectures relies on well-known technologies (APIs, message exchange, addressing). This means that the NSG-vision can be implemented using these existing, well-known technologies. This does not, however, exclude that the future implementation-phase can take advantage of other technologies, for instance Distributed Ledger Technology (DLT).

- The application services will be realised by concrete physical services. These may be provided by private operators, government agencies and/or be mapped to existing solutions.

- Actors and infrastructures have goals and steps that correspond to the actions numbered in the headline. These numbered actions may be found in the [Capabilities and business processes of the NSG ecosystem document](#).

- The terms may vary depending on the concept so treat ‘operator’, ‘data provider’, ‘access point’ and ‘vendor’ as synonyms as they share similar functionalities.

- Readiness for adoption indicated on a scale of low-medium-high:
  - **High** means that standards and technology exist today, but that implementation is not yet completed
  - **Medium** means at least one necessary component is missing, but there is a path to implementation
  - **Low** means that the prerequisites to implementation are ill-defined or difficult to meet
Readiness of eInvoices

Goal
Actions are needed for all business systems to comply with the standards. Suggested specification is Peppol BIS Billing 3.0.

Steps
- Compliance with eInvoice BIS format
- Complete the implementation of the OpenPeppol BIS standard
- Market the eInvoice feature to their business system clients
- Promote and communicate the benefits to SME's
- Extend the regulation from public procurement to demand sending of invoices from public sector
- Create incentives in public procurement
- Require that when the customer supports eInvoices, suppliers must send invoices in that format
- Enhance the OpenPeppol BIS Billing specification to improve support of cross-border VAT

Readiness for adoption: High
- Existing technical services for invoicing in general are widely spread
- Common standard EN 16931-1 already decided by EU

Possible Applications or technical services required
- eInvoice creation service
- B2B interface for invoice delivery
- eInvoice format translation service
- Company ID verification service
- eInvoice archiving service
- eInvoice routing service
- Metadata provider service
- OpenPeppol BIS Billing 3.0 specification

Services for SME's
- Existing fit or partial fit solutions
- Further development needed

Government agency services
Readiness of eInvoices (continued): Fully developed eInvoice infrastructure – actions 1.1.1 - 1.1.3, 1.1.9

OpenPEPPOL network

Business system - invoice creation service

Encrypting - PKI
ASIC-E (Associated Signature Containers – Extended)

eInvoice Archiving

Public key services

Service Metadata Locator

Service Metadata Provider

Access Point

EN-16931 eInvoice

Sign evidence
Registered Electronic Mail
PKI-Peppol
MDN with timestamp

Implement support for PEPPOL BIS specification

Access Point

EN-16931 eInvoice

Sign evidence
Registered Electronic Mail
PKI-Peppol
MDN with timestamp

Access Point

EN-16931 eInvoice

Decrypting - PKI
ASIC-E

Business system

eInvoice Archiving

Seller

Buyer

Nordic Smart Government
Readiness of eReceipt

Goal
A standardized, cross-border network for sending and receiving eReceipts for bookkeeping and auditing purposes.

Steps
• Standardize the content of eReceipt
• Implement eReceipt in OpenPeppol network, connecting to the PoS
• Implement eReceipts in Business systems
• Implement mapping and routing from national eReceipts systems to the OpenPeppol network
• Mobile payment services send eReceipts

Readiness for adoption: Medium
• Several networks exist but interoperability and portability needs to be improved (4-corner model)
• eReceipt standardization is ongoing

Possible Application or technical services required
- eReceipt creation service
- Interface for payment verification
- Interface for receipt delivery
- eReceipt translation service
- eReceipt archiving service
- OpenPeppol Network
- eReceipt routing register
- Company ID verification service
- eReceipt standard

Services for SME’s

Government agency services

Existing fit or partial fit solutions
Further development needed
Readiness of eReceipt (continued): Mapping and routing of eReceipts – action 1.1.15, 1.1.16

**Point of Sales system**

- Cash register
- Mobile payment system

**eReceipt archiving service**

- eReceipt (in format produced by vendor)
- Marked as business expense account? <forward>

**eReceipt routing service**

- Routing service selected by operator or vendor (there may be many)
- Address lookup

**Business system**

- Endpoint address for this card/mobile payment id

**Common routing register**

- Registered as customer
- Registered as endpoint for this customer

**Mobile payment system**

- Card
- Mobile pay

**Buyer**

- Buy
- Fetch eReceipt

**PEPPOL network**

- CEN/PEPPOL BIS eReceipt
- eReceipt standard

**Automatic bookkeeping**

- Format?
- ARTS-DR or other
Nordic Smart Government

Readiness of Digital Product Information

Goal
• Enable detailed, structured, digital product information available to buyers, through support of identifiers as references in the digital business documents, and ways of accessing the detailed information
• Examples of detailed product information are information about carbon footprint, material composition for circular economy or certification of organic production methods
• There are various identifiers that can be used, e.g. EAN code, EU Harmonized System codes, or other standard product and service category codes (UNSPC for example)

Steps
• Include and process product identifiers, as part of the business documents
• Discover digital product information and access services providing additional information about the product.
• Ordering systems must provide product identifiers
• Enforce the use of product identifiers in the supply chain
• Enforce a best practice for use of product identifiers in eInvoicing

Readiness for adoption: Low
• There is a plethora of product identifier standards and registries, with different uses and scope
• Harmonization requires a lot of work

Possible Application or technical services required

- eInvoice creation service
- Interface for payment verification
- GS1 product registry
- eReceipt creation service
- Customs product code registry
- Statistic categories registry
- Product registry lookup
- Standardized API product access

Services for SME's

Government agency services

Existing fit or partial fit solutions
Further development needed
Readiness of Digital Product Information (continued): Product information lookup – action 1.2.5

Specific product data needed, eg. fire safety classification.

1. Find endpoint of registry from central lookup
2. Get data using standardized API
Readiness of Business Document immutability

Goal
- Ensure integrity for business documents and prevent tampering
- Prevent illicit double use of business documents

Steps
- Provide access to digital business documents validation services that check that necessary contents are present and used codes etc. are correct
- Provide services that register usage of business documents (e.g. eReceipts) in order to make sure that a document is only used once. This enables automated checks (based on hash calculations)

Ready for adoption: medium
- Existing solution for signing and validation exist and emerging technologies are maturing
- Common services and interoperability is missing

Possible Application or technical services required

- Product code validation service
- Hash verification service
- Automated document check engine
- Business document validation service
- Document signing service
- Peppol document validation service
- Hash Database
- Hash calculation service

Services for SME’s
Government agency services

Existing fit or partial fit solutions
Further development needed
Readiness of Business Document immutability (continued): Business document immutability – action 1.3.2

- Business system
- Seller
- Buyer
- Auditor
- Tax agency
- Business document immutability service
- Hash database
- eInvoice
- eInvoice hash
- PEPPOL network
- (Alternative transport methods)
- Is this eInvoice unchanged?
- Has this eInvoice been claimed as expense more than once?

Common API specification
Readiness of Store references to documents

Goal
- Using digital proofs of transaction instead of current process of storing paper vouchers for a number of years as a copy for both parties of the business transaction

Steps
- Enforce a system where sales documents are not sent at all, but stored in one place and being referenced. Eliminates the challenges of having different copies at each end.
- Legal changes to remove the need to store and archive copies of business documents

Ready for adoption: low
- The Nordic countries have different legal requirements in this area and some allow changing of documents after transmission
- There are technical solutions for secure off-site storage, eg. in distributed networks, but standards are lacking

Possible Application or technical services required
- Document storage
- Digital transaction validation
- Document store API
- Document standard
- Common API specification

Services for SME's
- Government agency services

Existing fit or partial fit solutions
Further development needed
Readiness of Store references to documents (continued): action 1.3.3

- Seller
- Business system
- eInvoice
- PEPPOL network
- Store with third party
- Retrieve
- Business system
- Buyer
- (Alternative transport method)
- Invoice reference + address
- Document archiving service
  - Invoice
- Auditor
- Common API specification

Retrieve for audit
Trusted government services for secure business

Goal

- Doing business cross-border increases the need for services that enable the necessary trust between trade-partners. Nordic Governments are key actors in establishing the necessary level of trust, through authoritative information about businesses.
- The Nordic Governments need to make the relevant information easy accessible in a standardised way across the Nordic countries.
- Examples of relevant information include confirmation that the trading partner exists, is registered for VAT and has paid taxes, as well as ownership (“beneficial owners”).

Steps

- Access to a service that checks the validity of a bank account number against the company number.
- Access to a service that checks for VAT-registration.
- Access to a service that checks the “seriousness” and compliance of a company (taxes paid, VAT paid, annual accounts delivered).
- Access to a service that checks that trading partners really exist before sending documents (is registered in business registries).
- Implement warning services for factual events about a company (gov. data: forced proceedings, persons not allowed to do business).

Ready for adoption: high

- Common Nordic business registry lookups and API’s are missing which are technically quick to implement.
- The Single Digital Gateway Regulation (SDGR) and accompanying Once Only Principle-Architecture have relevant requirements, services and standards.
- Connecting the data points with validation and lookup services can be used to provide legitimacy checks.

Possible Application or technical services required

- Business registry API
- VAT-registration confirmation
- Compliance Services
- Bank account validation service
- Company rating service
- Government API lookup service
- Common Business registry lookup

Services for SME’s

Government agency services

- Existing fit or partial fit solutions
- Further development needed
Trusted government services for secure business (continued) – action 1.3.6 – 1.3.8

- Has buyer paid taxes?
- Is buyer undergoing reconstruction?
- Is seller registered for VAT?

Government API lookup service

Common lookup service

Single Digital Gateway

Common specifications

Address lookup

Address lookup

Business system

Business system

Seller

Buyer

Tax agency

Business registry

Tax agency

Business registry
Nordic Smart Government

Readiness for Business system API and eAddressing

**Goal**
Enable standardized ways for integration while supporting portability of business data without customization

**Steps**
- a standardized service, API, for accessing transactional data from a business
- a (standardized) role based authorization service for the businesses to grant access to different parties to read/write data
- implement a standardized format for transferring detailed bookkeeping data between systems (portability)

**Ready for adoption: low**
- Bookkeeping standards are implemented by the business systems, but implementation is nation-specific and not Nordic.
- Lack of a common chart of accounts hampers portability
- Common business services are not fully interoperable and need further development in services supporting portability

**Possible Application or technical services required**

- Common Business API lookup
- eAddress registry
- Transaction API
- Authorization service
- Bookkeeping standards
- Common CoA
- Business Transactions API

**Services for SME's**
- Government agency services

**Existing fit or partial fit solutions**

**Further development needed**
Business system API and eAddressing (continued) – action 2.1.1, 2.2.2

Business system API lookup service

Common lookup service

Common specification

Get transactions for audit

Access granted by business owner

Get aggregate information for due diligence purposes

Business system

Bank

Tax agency

Business

Business API address lookup

Business API

Action 2.1.1, 2.2.2
Goal

Authentication of an information consumer in a business system is necessary to make sure that only an intended consumer gets access to the system and information within.

Steps

• Provide authorization by power of mandates
• Provide authorization through user's consent in B2B
• Provide authentication of a company (eID for businesses)

Ready for adoption: medium

• Multiple different national registries exist but they are not consolidated on a Nordic level
• Further development of common services is needed for seamless verification of powers and mandates in the Nordics - lookup and verification services

Possible Application or technical services required

- User consent service
- P&M registry lookup
- Role & rights mgmt service
- Mandate verification API
- P&M registry
- eID registry

Services for SME's

Government agency services

Existing fit or partial fit solutions

Further development needed
Powers and mandates – action 2.1.2

1. Give mandate to bank

2. Get address to P&M registry

3. Get mandate

4. Request information

5. Confirm mandate to release information

Common specification

Business system

Powers and Mandates registry

Powers and mandates registry lookup service

Bank officer

Bank

Identified by

Identified by

Common specification and infrastructure

eIDAS Infrastructure
Operator (service provider) mapping to assessments

**Standardized eReceipts**
- StoreBox
- ReceiptHero
- Kuittilompakko
- eTasku
- Findity
- Kwick

**Sharing detailed Business transaction data**
- SAF-T (audit)
- XBRL-GL
- XBRL
- SIE 1 to 5
- BAS (CoA)
- UNCEFACT (data model)
- ISO21378 Audit Data Collection

**Identification & Authorization**
- BankID
- Commfides
- Buypass
- MnID
- D-porten
- Altinn Auth.
- Suomi.fi (eDas)
- Incomes Register’s certificate service
- SisuID
- Freja ID
- BankID
- DIGG (eIDAS)
- NemID
- MitID
- IceKey (islykill)
- Auðkenni

**Common set of Nordic government open and free API’s**
- Felles datakatalog
- data.brreg.no
- lityntakatalogi
- Suomi.fi (X-Road)
- Vero-API
- Avoindata.prh.fi
- Dataportal.se (DIGG)
- EU Fiscalis (Bilsp的服务)
- datahub.virk.dk
- CVR at Virk (business reg.)
- CVR at Virk (annual account)
- Basic Data register
- SMAT (income & annual tax)

**Powers & Mandates**
- Register of legal entities
- Altinn Auth.
- Maskinporten
- Suomi.fi (eAuthorizations)
- Suomi.fi (eIdentification)
- SisuID
- Findy
- Nationell behörighetslösning
- NemLogin
- MitID

**Mechanisms for enforcing user consent before delivery of protected data**
- Altinn Consent
- MyData
- Suomi.fi (eIDas)

**eInvoice**
- OpenPeppol BS Billing 3.0
- Finvoice
- Teapps
- Nemhandel (UBL)
- CENBII

**Nordic Smart Government**

*These are the so far identified service providers*
Mechanisms for enforcing user consent before delivery of protected data: Provide authorization through user’s consent in B2B – action 6.1.1

Authorization

Consent registry operator

Data source API

Business

Data Owner

Identified by eID

Register source and give or withdraw consent

Consent control

Get mandate

Data Sink

Consent control

Request information

Request data from Data API

Logging service

Consent control
Identification & Authorization: service for the businesses to grant access to different parties to read/write data (B2B...)

- eIDAS Infrastructure
- Connect to routing service
- Routing layer
- Service X
- Service Y
- Service Z
- Authentication service

Common specification and infrastructure
Common specification
Common specification
Service call to authentication endpoint

Nordic Smart Government
Example of national readiness heatmap: Finland

**Nordic Smart Government**

### Standardized eReceipts
- eReceipt creation service
- Interface for payment verification
- Interface for receipt delivery
- eReceipt translation service
- eReceipt archiving service
- OpenPeppol Network

### Sharing detailed Business transaction data
- Common Business API lookup
- Transaction API
- Bookkeeping standards
- Common CoA

### Identification & Authorization
- Authentication service
- Routing service

### Common set of Nordic government open and free API's
- eAddress registry
- Nordic API catalog
- API catalogs

### Powers & Mandates
- User consent service
- P&M registry lookup
- Role & rights management service
- Mandate verification API
- P&M registry
- eID registry

### elInvoice
- elInvoice creation service
- B2B interface for invoice delivery
- elInvoice format translation service
- Company ID verification service
- elInvoice archiving service
- elInvoice routing service
- Metadata provider service

### Mechanisms for enforcing user consent before delivery of protected data
- Authorization service
- Logging service
- Consent registry service

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Legends:
- National services development required
- National services exist
- Existing fit solutions NSG-level
- Further development needed (NSG-level)
Peppol and EDI

● EDI and Peppol are expected to co-exist in the foreseeable future

● Typically Use Cases:
  ○ EDI: Tight integrations of actors in a value chain, due to rich set of document types and information elements, which enable tailoring to specific industries, and were actors are known in advance. The higher level of integration enables higher levels of automation, but requires more resources
  ○ Peppol: “One-off”-integrations, where actors can exchange single document types (typically invoices) with no prior knowledge of each-other. Document types are fewer and more restricted, reducing functionality relatively to EDI, but adoption requires less resources

● Service Providers can perform transformation between different EDI-networks and Peppol for their customers

● EDI as the specific, Peppol as the default
  ○ A company that uses EDI with partners in a value chain, will still benefit of Peppol for sales and purchases with actors outside the value chain, for example their phone bill, insurance costs, a one-time consultancy contract or course etc

● Government requires Peppol
  ○ As a result of EU-regulation, it is mandatory for all Nordic Governments to require Peppol BIS Billing as part of Public Procurement
  ○ All governmental bodies and all companies selling to public sector are thus likely to have Peppol-support as a requirement for its business systems
  ○ Experience from Norway where the same requirement has been in force since 2012, shows that such requirement has resulted in nearly 100% of the business systems supports Peppol BIS Billing (sending and receiving)

● To enable exchange of electronic business transaction documents for SMEs in the Nordic Countries, NSG recommends support for Peppol as a minimum requirement for the parties in the ecosystem