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Modernized messaging using FHIR
&
EHMI, MedCom's new messaging infrastructure

Presentation for FHIR fagforum #31

Ole Vilstrup, MedCom

Who am I?

- Ole Vilstrup
- Senior Interoperability Consultant, MedCom
- 25+ years of experience with architecture, system design, development and integration within the healthcare domain with particular focus on message communication
- Consultant at MedCom since 2018, before that mainly developer, consultant or architect in private owned it-companies
- FHIR experience since 2019 on architecture and design

Agenda

- FHIR messaging in Denmark
- EHMI
  - Brief history from POC to Production Pilot
  - EHMI Core - Message delivery and document sharing
  - EHMI Addressing Service (EAS)
  - EHMI Delivery Status (EDS)
  - EHMI Endpoint Register (EER)
  - Flow of metadata
  - Open International Standards used in EHMI
- Where to find more…

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Modernized messaging using FHIR

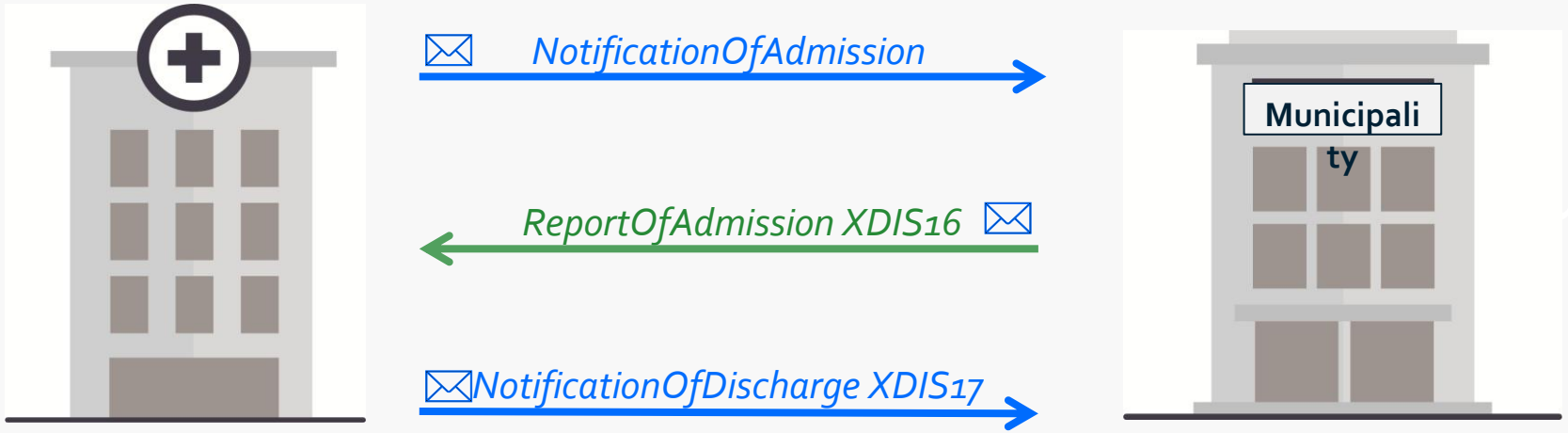
- The Danish health data sharing ecosystem was established 30+ years ago, and now it is time for transition to FHIR (each decade has a technology)
  - EDIFACT + XML + CDA + FHIR

- The Danish modernization strategy consists of FHIR based sharing formats and choice of data sharing paradigm:
  - Messaging + Document sharing + RESTful API services

- Our strategy is to use the proper data sharing paradigms offered by FHIR, depending on the use case, using FHIR building blocks across different infrastructures

HospitalNotification

- MedCom's (and Denmark's) first national FHIR messaging standard is a FHIR profile called HospitalNotification, which replaces two NotificationOfAdmission/-Discharge messages, revised and enhanced from 20+ years old Danish EDIFACT/XML message-types
- They were sent from regional hospitals to municipality care teams when patients are admitted or discharged. They were introduced around 2000 and due to new needs, they have been revised.
- Basically, the messages are notifying the Municipality Care teams about a citizen's hospitalization, so they know how to handle their services for the citizen



HospitalNotification – new needs for information + requirements

Due to new behaviors of patient's hospital encounters, patients do not longer stay at hospitals as long time as before.

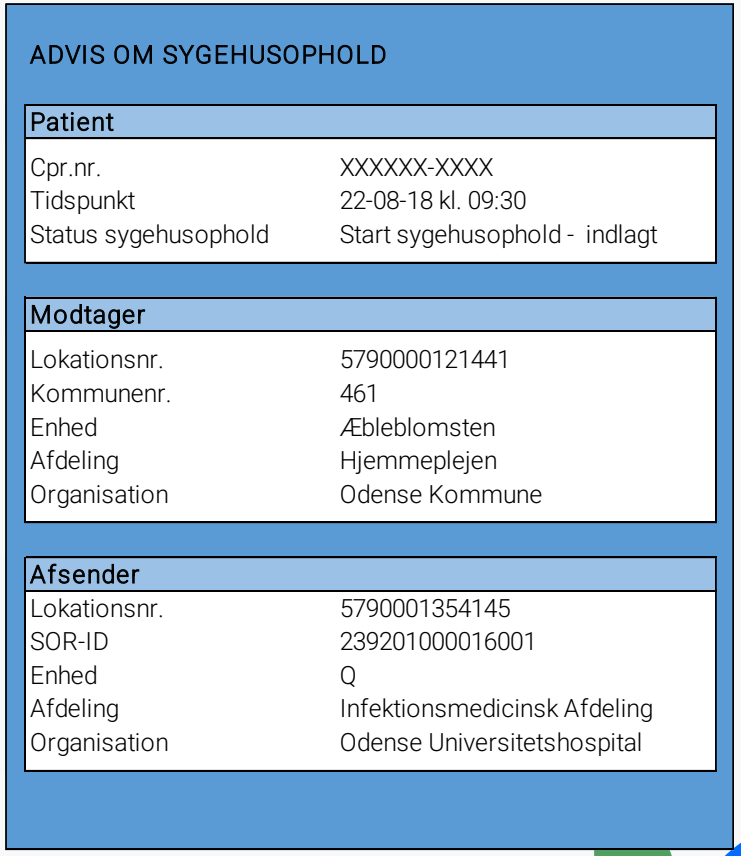
There has been an increased

- use of telemedicine for patients with chronic diseases causing fewer and shorter hospital stays
- effiency at the hospitals

So there is now a need of notification on:

- **Acute outpatient hospital stay (new)**
- **Leave during admission (new)**
- **and other patient ADT events (Admit, Discharge & Transfer)**

And certain national business rules for use has been updated



ADVIS OM SYGEHUSOPHOLD

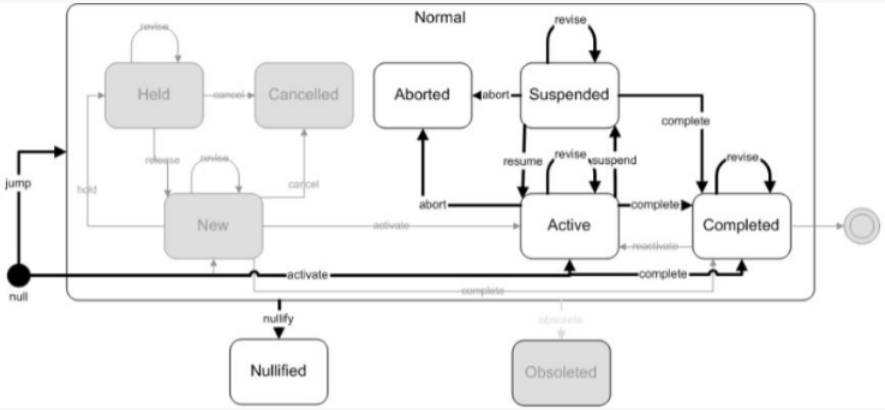
Patient	
Cpr.nr.	XXXXXX-XXXX
Tidspunkt	22-08-18 kl. 09:30
Status sygehusophold	Start sygehusophold - indlagt

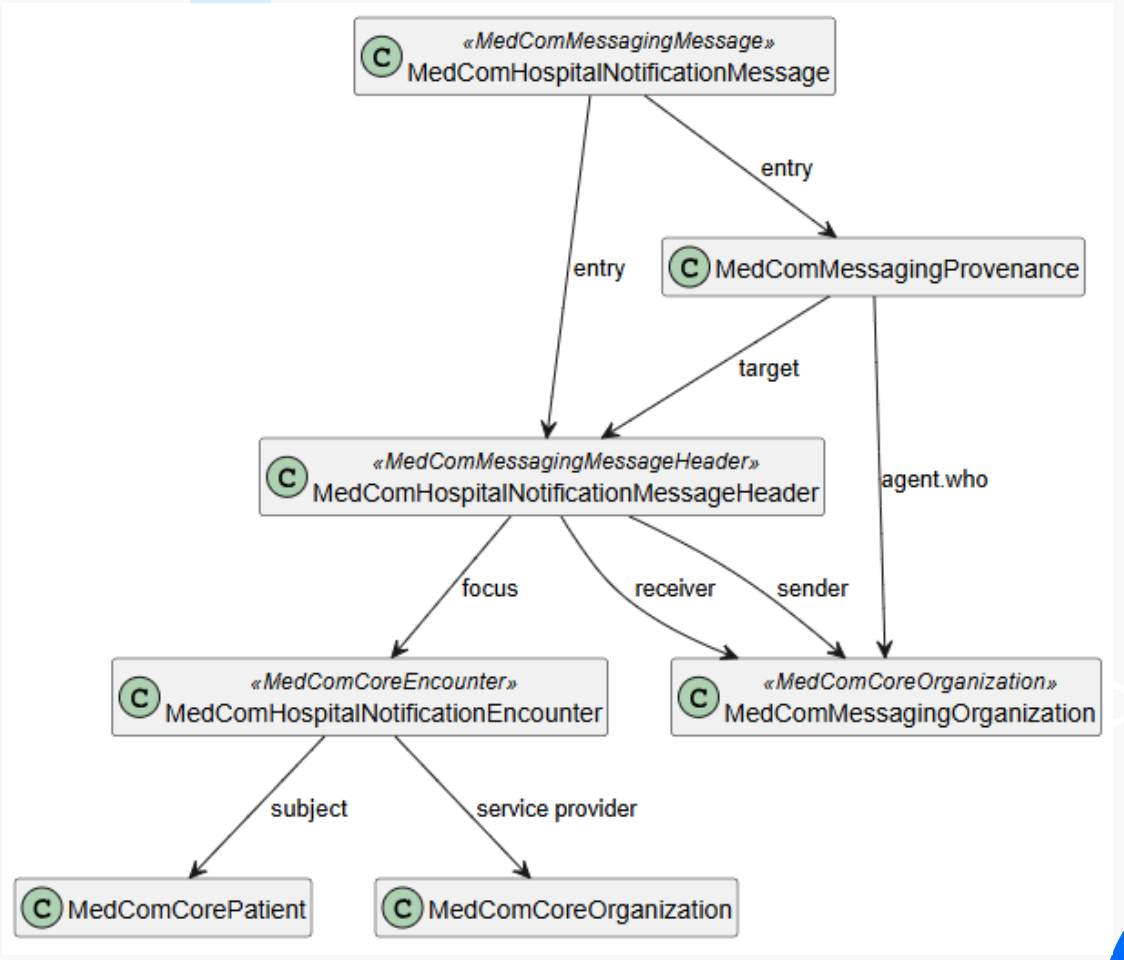
Modtager	
Lokationsnr.	5790000121441
Kommunenr.	461
Enhed	Æbleblomsten
Afdeling	Hjemmeplejen
Organisation	Odense Kommune

Afsender	
Lokationsnr.	5790001354145
SOR-ID	239201000016001
Enhed	Q
Afdeling	Infektionsmedicinsk Afdeling
Organisation	Odense Universitetshospital

HospitalNotification Information structure

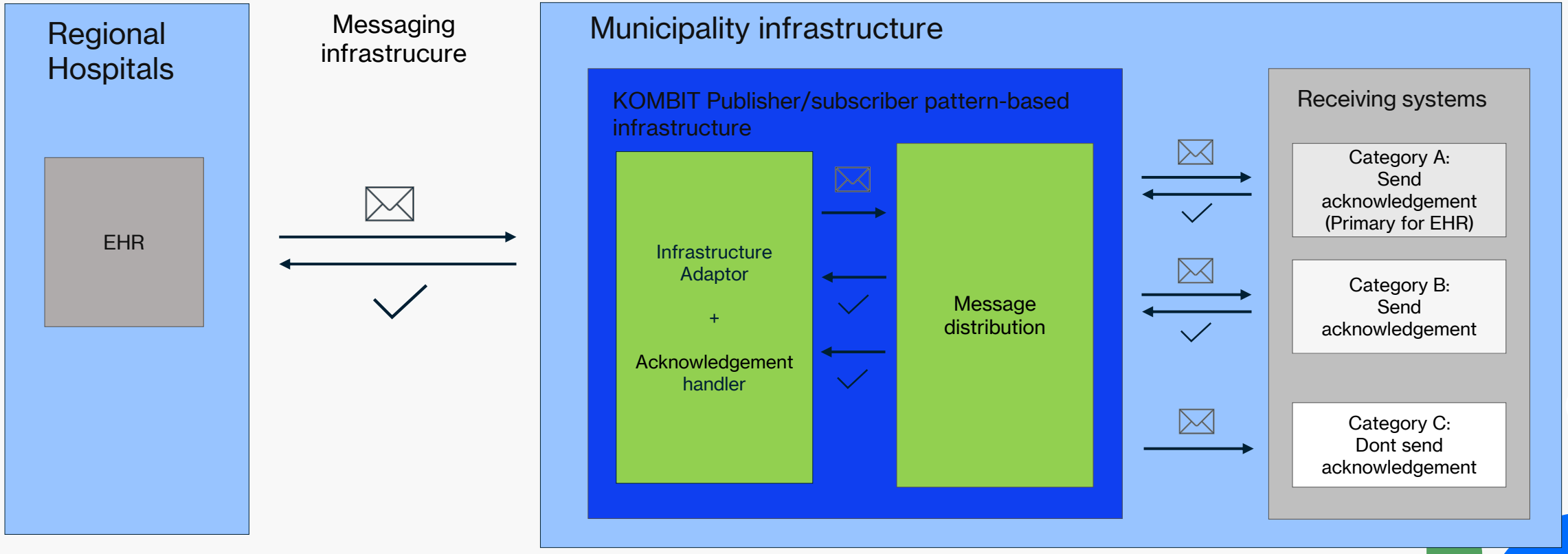
- FHIR version R4 message-bundle
- Build upon long time experiences from HL7v2 ADT-messages on logistics around a patient
- Inspired from HL7 state machine for encounters





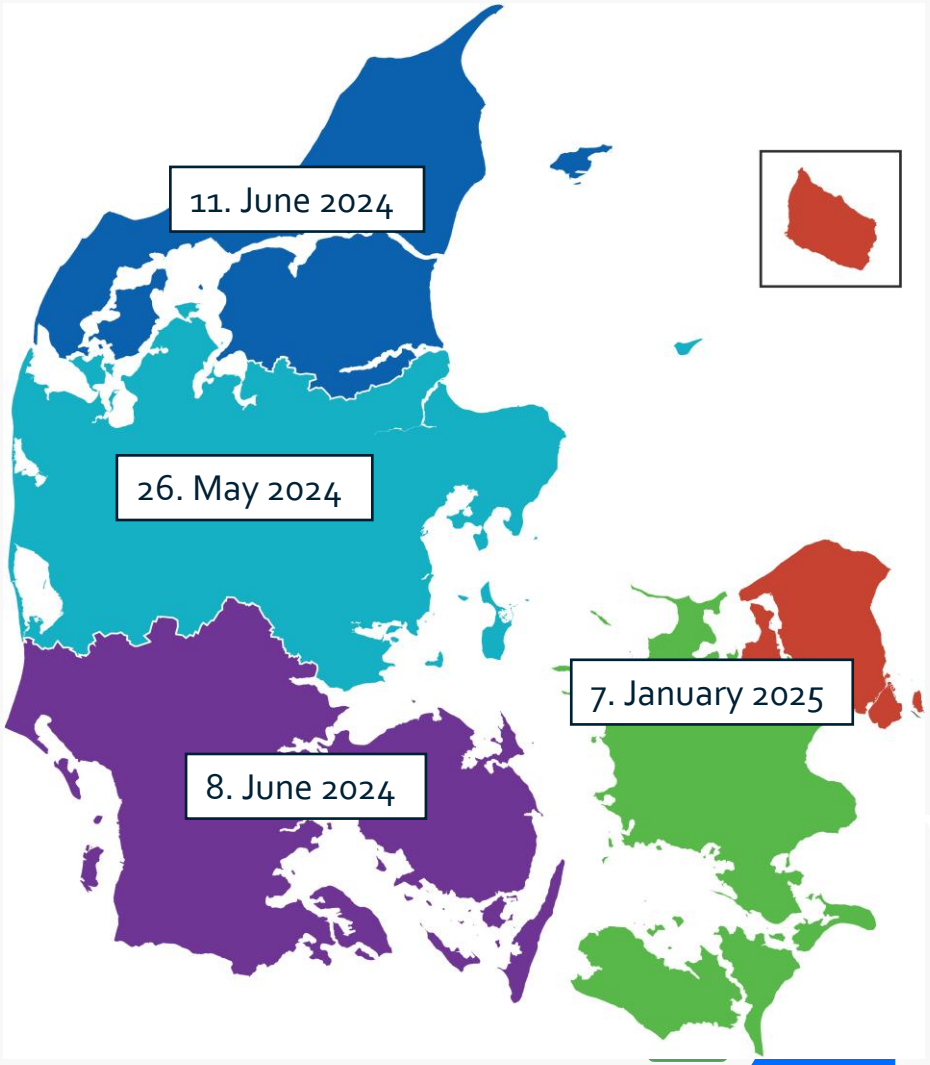
Distribution of HospitalNotification

The requirement for notifications now also support multiple recipients, since there can be multiple EHR's in the municipality



Implementation method

- Successive transition where receiver applications in the municipalities were ready before the sender applications



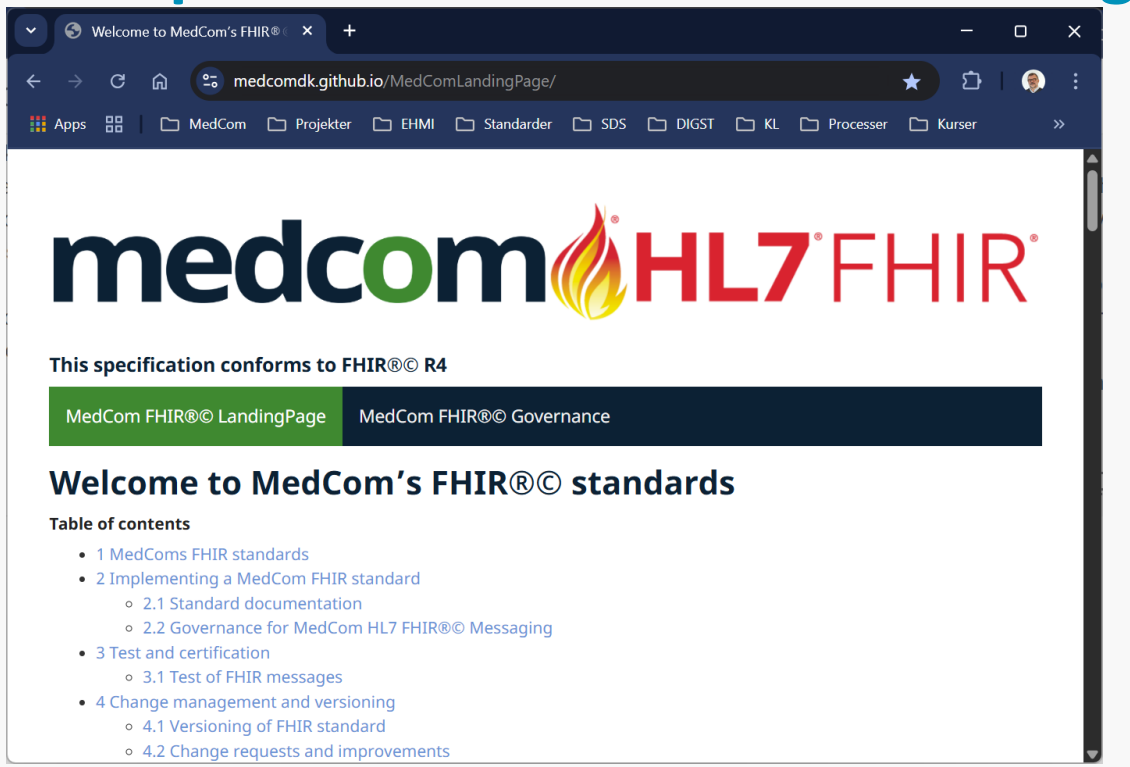
Statistics

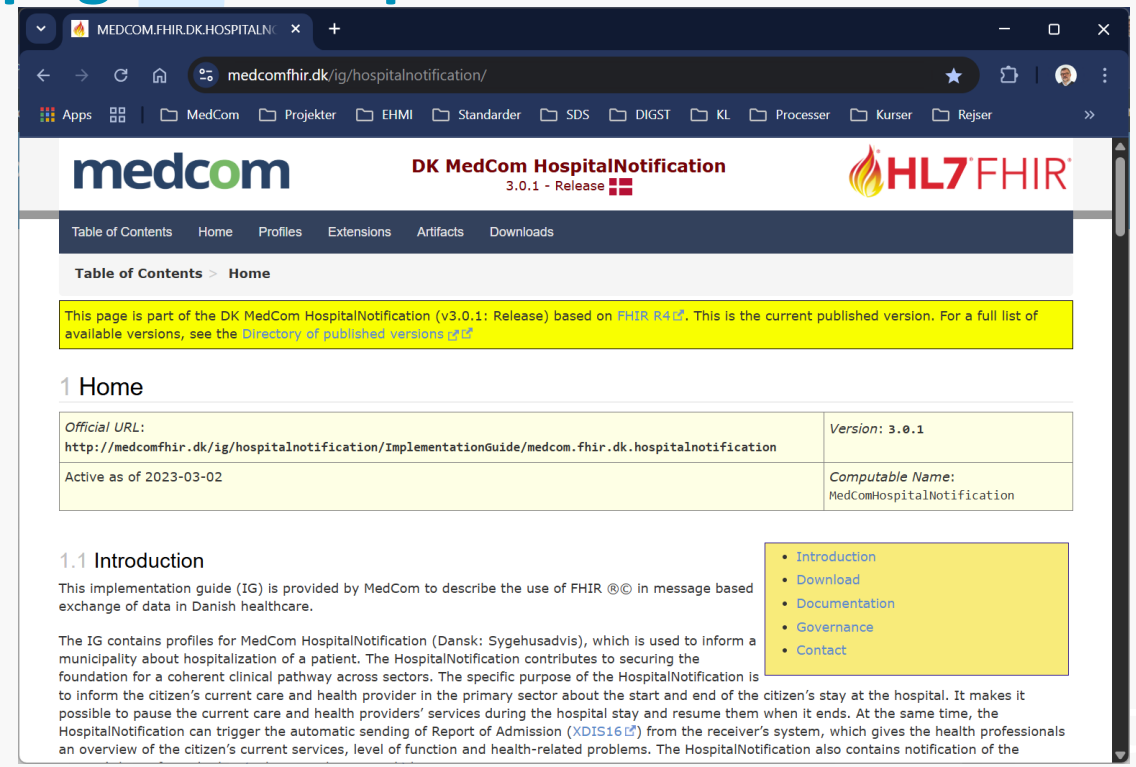
- April 2025 compared to April 2024

Notification type	Number
Acute outpatient	124.352
Admission	86.440
Start leave	9.749
End leave	9.301
End hospitalstay	174.393
Cancellations or revisions	6.547
Total	**410.782**

Notification type	Number
Admission (XDIS17)	95.625
Discharge (XDIS20)	85.244
Total	**180.869**

HospitalNotification – FHIR landingpage and ImplementationGuide





https://medcomdk.github.io/MedComLandingPage/

https://medcomfhir.dk/ig/hospitalnotification/

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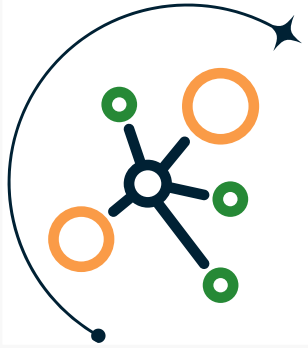

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EHMI

Enhanced Healthcare Messaging Infrastructure

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EHMI in brief

EHMI (Enhanced Healthcare Messaging Infrastructure) is replacing and enhancing an old messaging framework from the 90’s

EHMI is built on the Eu technology, eDelivery, which is the core of future national message communication in Denmark (and EU)

EHMI involves several additional elements and services compared to eDelivery, such as

- support of national message sharing through national IHE XDS infrastructure
- improved handling of addressing via the health addressing service, EHMI Addressing Service (EAS) and the EHMI Endpoint Register, (EER)
- delivery status also called Track’n’Trace via EHMI Delivery Status, (EDS)

EHMI is guided by a national architectural vision (DA: Målbilledet for meddelelseskommunikation på sundhedsområdet) which forms the framework and guideline for developing and testing EHMI.

EHMI - Timeline

2018

- **Analyze and Proof of Concept**
  - Participation in an analyze project on eDelivery by Agency of Digital Government, DIGST, 2018
  - MedCom led POC with participation from VANS operators, regions and GP systems in DK, DIGST and Healthcare DK (sundhed.dk)
  - **Connectathon** primo December 2018
  - **Operational outcome:** Architecture vision for message communication in healthcare in DK led by DHDA

2019-2022

- **MedCom led Pilot project**
  - Foundation by DIGST, DHDA and MedCom with participation from a lot of public and private organizations and companies
  - **Connectathon** primo March 2022
  - **Operational outcome:** Revised architecture vision for message communication in healthcare in DK led by DHDA
  - Decision of a Production Pilot guided by the Architectural Vision led by MedCom 2023/2026

2023-2026

- **MedCom led Production Pilot of EHMI**
- Foundation by ERST, DHDA and MedCom with participation from a lot of public and private organizations and companies
  - Message: New FHIR message focusing on exchange of clinical measurements between municipality nurses and GPs
  - **Live Production September to November 2026**

2027-?

- **Operational outcome:**
  - Full initial operational Governance for EHMI, onboarding processes for EHMI on all levels
  - Further adjustments of Architecture vision for message communication in healthcare in DK
  - Fully functioning components on EHMI Addressing Service, EHMI Endpoint Register and EHMI delivery Status all in version 1.0

Architecture vision and goals

Extensive report based upon workshops with parties involved in healthcare message communication

Vision:

"***Effective digital message communication in the Danish healthcare domain to the benefit of citizens and healthcare professionals via a secure robust scalable general infrastructure based on mature open international standards***"

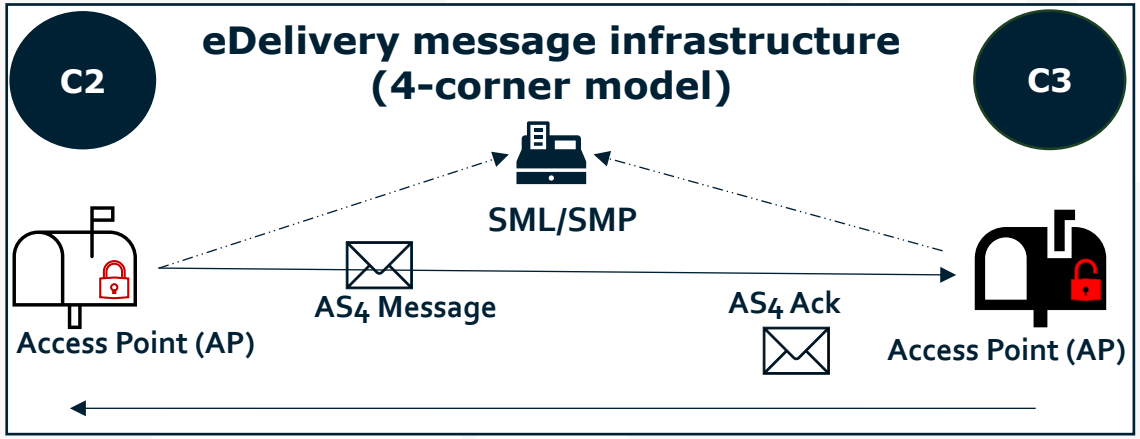
Selected goals:

- Effective and robust:
  - Few errors, and few and small delays
  - High availability
- Secure:
  - Build-in high security, not optional
  - Protection against threats
- Common national and European foundation:
  - Cross domain national message communication
  - Cross border healthcare services
- Sharing of sent messages benefitting health care professionals and citizens
- Near real time delivery status of messages:
  - Benefits both healthcare professionals and citizens
  - Operational problems are detected fast
- Common governance model for all parts and parties involved reducing blaim games

EHMI Core - Message delivery

Sender Organization

1. A clinician creates a message regarding a patient.
2. The message is delivered to the Message Service Handler (MSH)
3. The message is placed in a SBDH envelope.
4. The enveloped message is delivered to Sender's Access Punkt (AP).
5. The Sender's AP sends the message to Receiver's AP



Receiver Organization

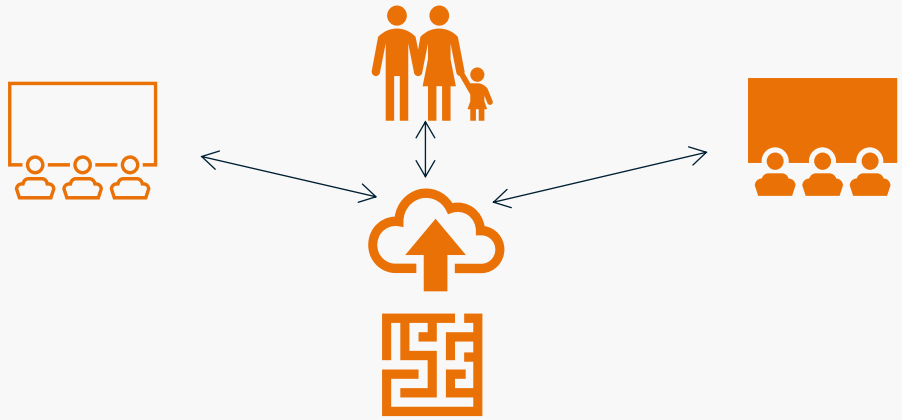
1. Receiver AP receives the AS4 message and decr ypts the eDelivery envelope
2. Receiver AP sends an AS4 ACK to Receiver AP
3. The envelope is forwarded to the MSH
4. The message is unpack ed from the envelope and placed in the receiver's inbox
5. The clinician reads the message regarding the patient.

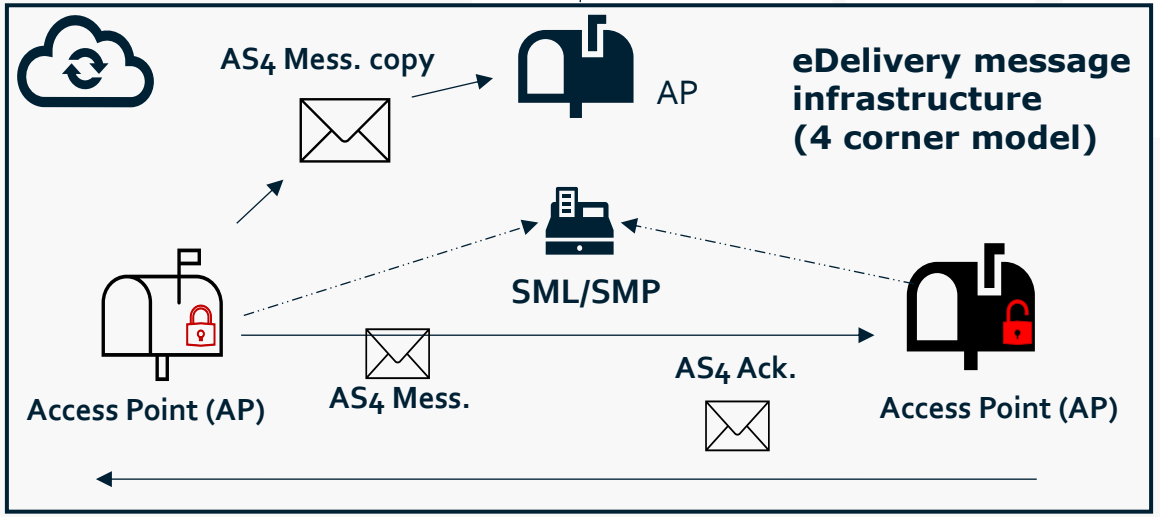
EHMI Core - Message delivery and document sharing

Sender Organization

1. A clinician creates a message regarding a patient.
2. The message is delivered to the Message Service Handler (MSH)
3. The message is placed in an eDelivery envelope. A copy is made and a FHIR DocumentReference is added to the envelope
4. Both enveloped messages are delivered to Sender's Access Punkt (AP).
5. The Sender's AP sends the message to both:
   - Receiver's AP
   - XDS's AP

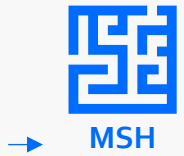
Document sharing - Infrastructure (IHE XDS)



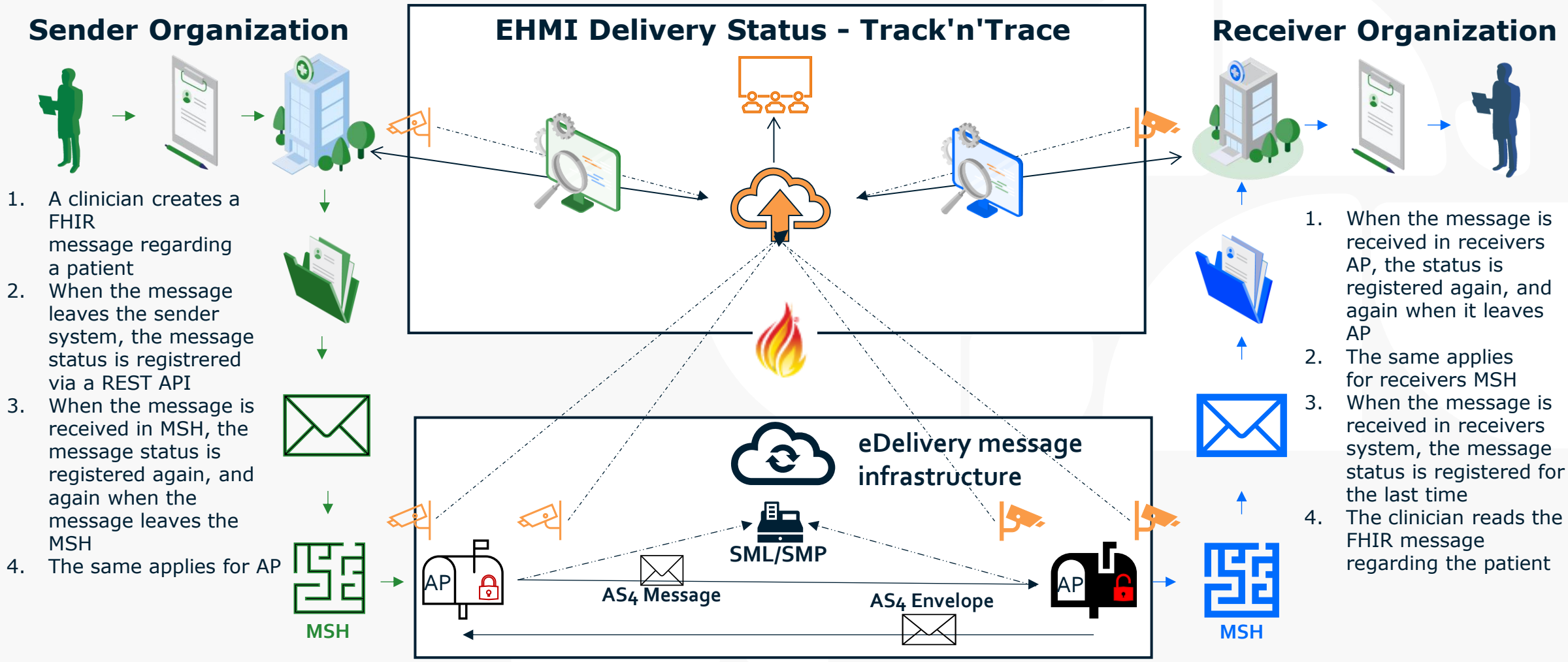


Receiver Organization

1. Receiver AP receives the AS4 message and decrypts the eDelivery envelope
2. Receiver AP sends an AS4 ACK to Receiver AP
3. The envelope is forwarded to the MSH
4. The message is unpacked from the envelope and placed in the receiver's inbox
5. The clinician reads the message regarding the patient.

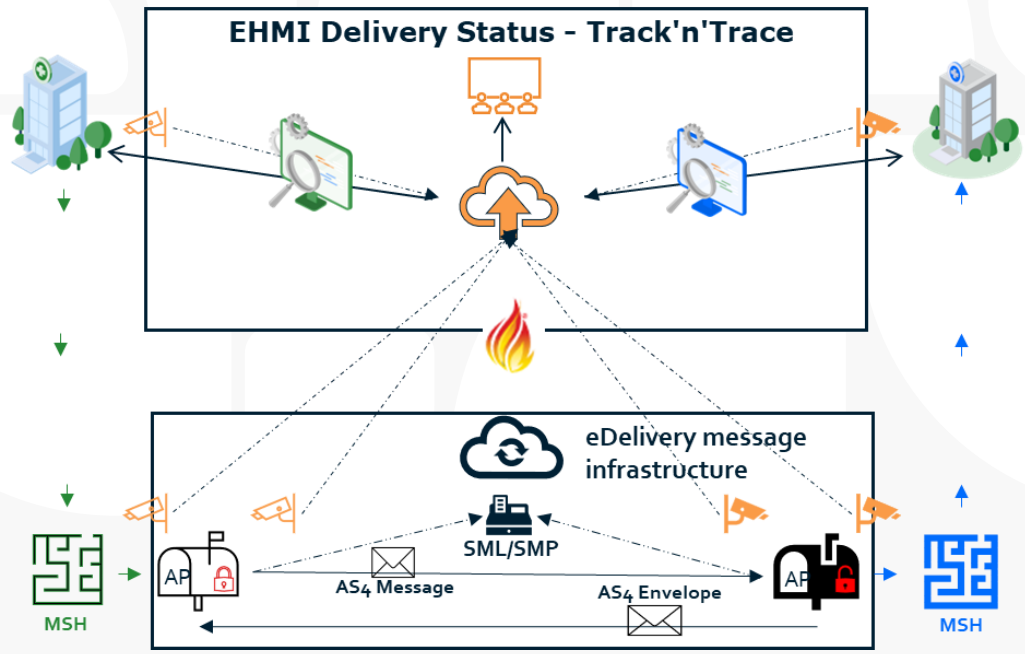


EHMI Delivery Status (EDS)

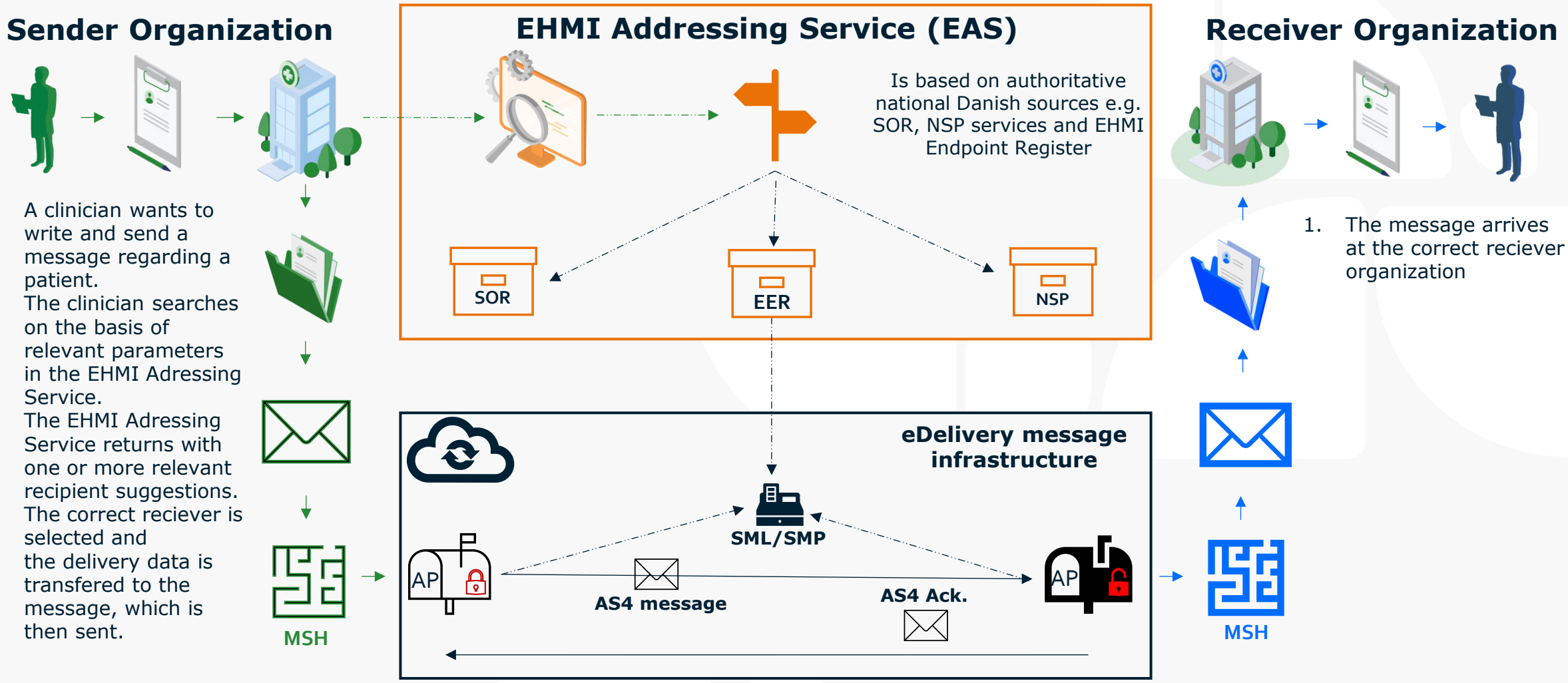


EHMI Delivery Service (EDS)

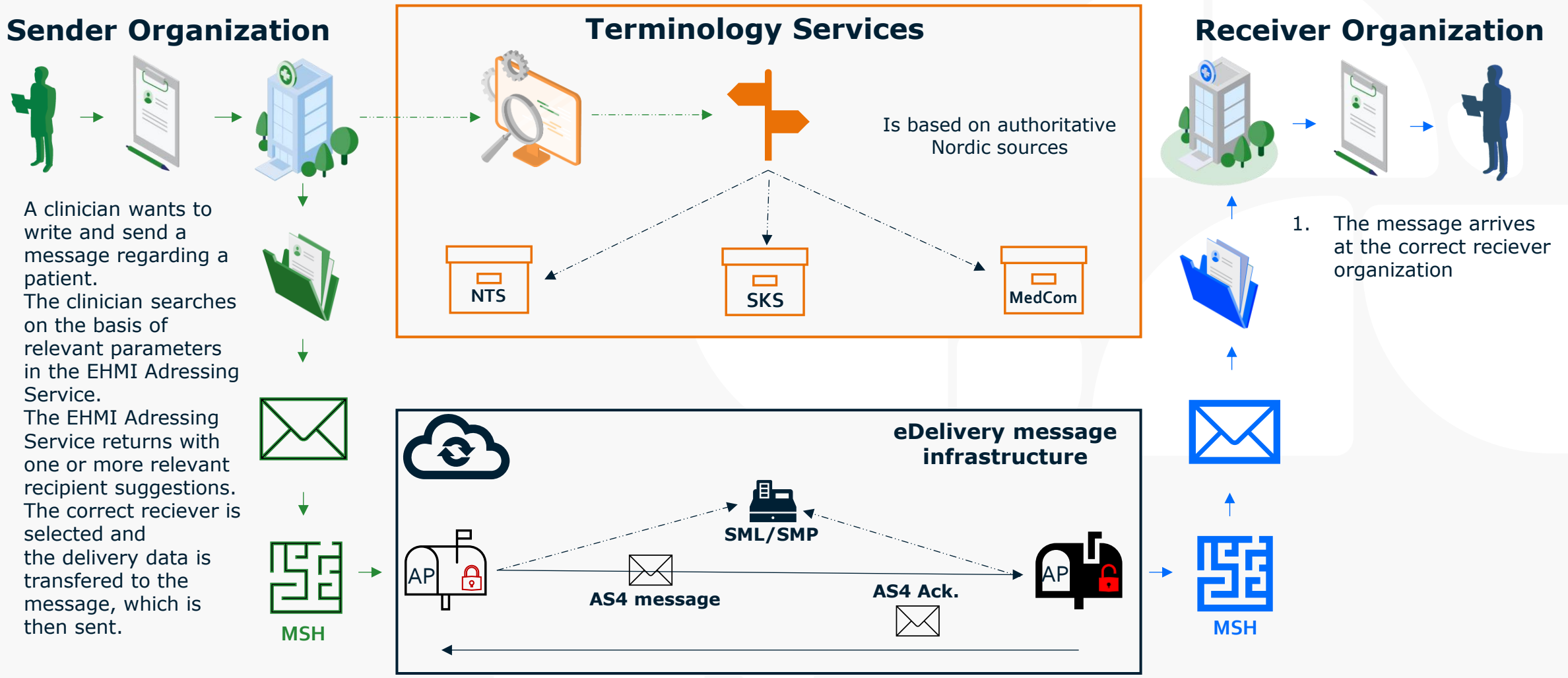
EDS is a Danish profile on the FHIR AuditEvent ressource. The stations on the message flow use basically organizational information, station information, message, envelope and person information to deliver track and trace information to a central server. Certain user profiles will have partially access their own part of the exchanges made in order to monitor the network of sent messages. Some have organizational access, some station access, some personal access.



EHMI Addressing Service (EAS)



Terminology Services (not supported yet)



EHMI Addressing Service (EAS)

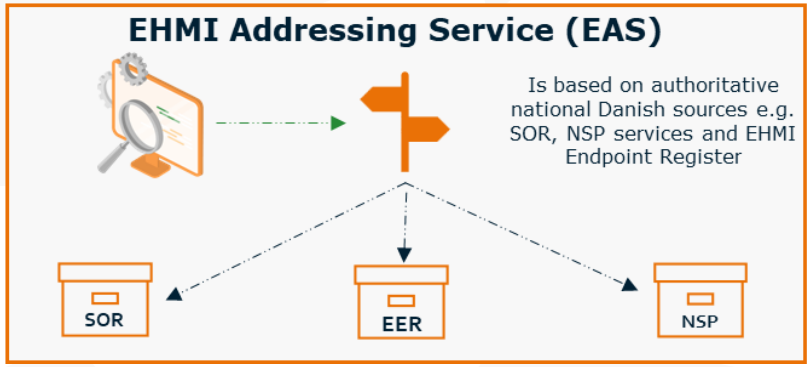
EAS is an EHMI FHIR façade on several Danish national services hosted on the National Service Platform for Healthcare (NSP). NSP is managed and hosted by the Danish Health Data Agency under the Ministry of Health.

NSP is exposing services for many different services. Among those

- Personal information
- Personal public health insurance information
- Healthcare addressing information through SOR

In EHMI we will not expose the national services on Personal information and Personal public health insurance information, as the outcomes of these requests will feed into different requests against SOR.

SOR, however, will be exposed through the EAS façade together with its messaging endpoint information due to the use cases around EHMI v1. SOR could though easily be exposed through EAS without the EER Endpoints.



EHMI Endpoint Register (EER)

The purpose of buiding EER

EER is supposed to replace part of our old SOR Register, a part called SOR-EDI

SOR is a centralized and authoritative registry used in the Danish healthcare system to maintain up-to-date information about healthcare organizations, units, departments, and healthcare professionals. The SOR is published through the National Service Platform (NSP), making the data accessible to various healthcare IT systems.

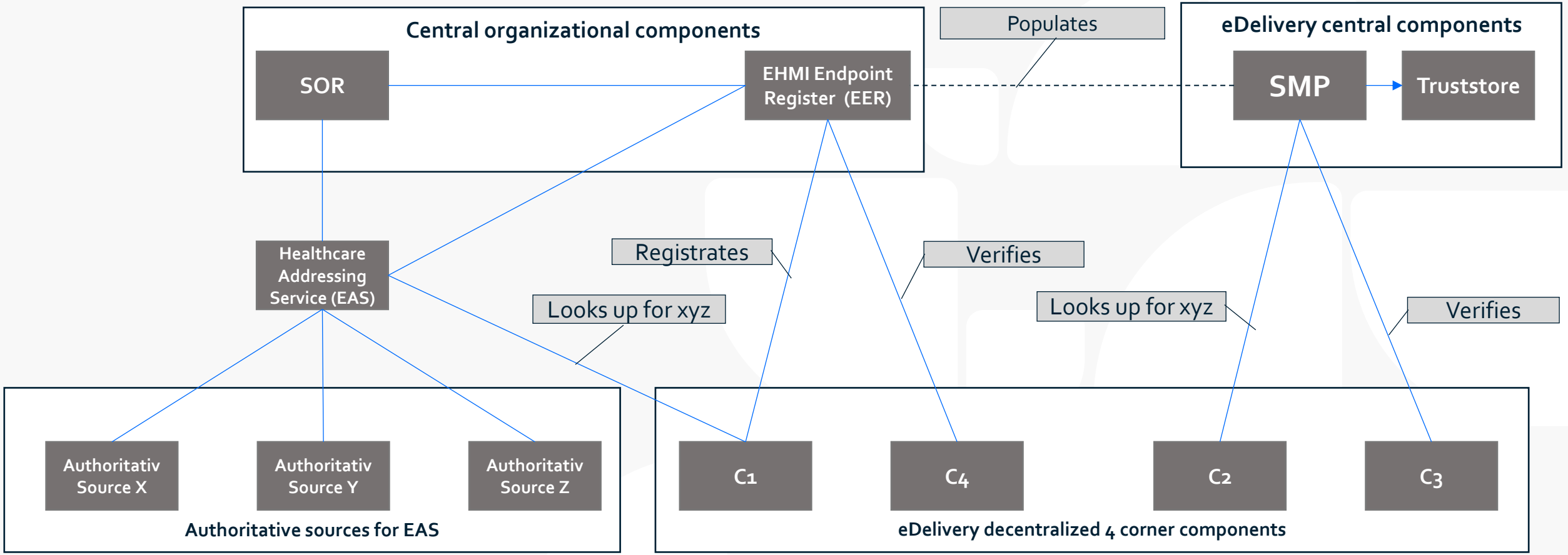
The purpose of SOR is to support interoperability, secure communication, and efficient coordination across the healthcare sector. It ensures that all actors in the system refer to the same standardized and validated addressing data when exchanging digital messages.

SOR basically consists of two parts:

SOR, the hierarchy, contains the full, structured registry of healthcare organizations, units, and professionals, including detailed relationships and metadata, and is used broadly across healthcare IT systems via the National Service Platform (NSP).

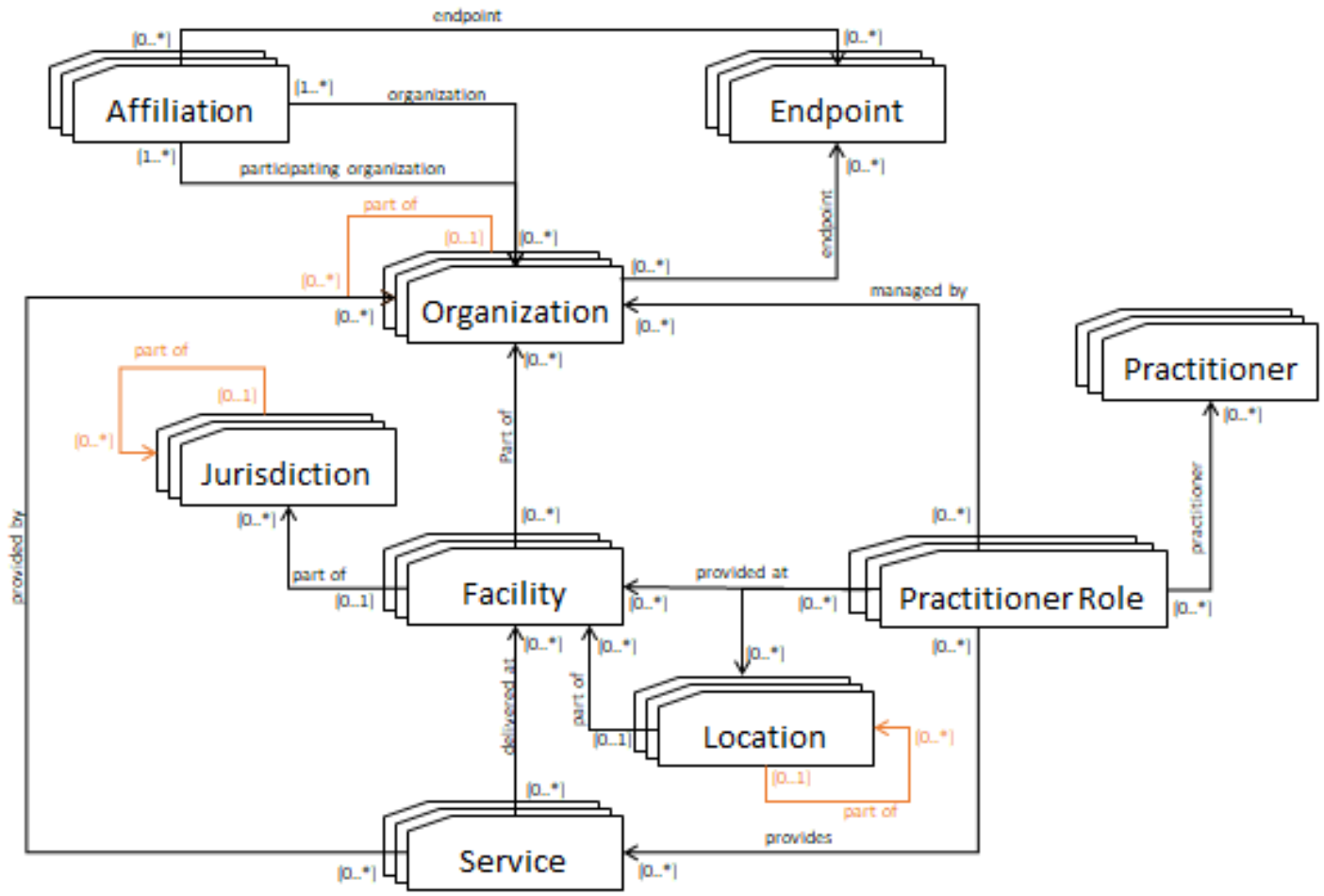
SOR-EDI, on the other hand, is a simplified subset of SOR data, tailored specifically for use in EDI (Electronic Data Interchange) messaging. It includes only the essential address and routing information needed for message delivery, particularly for legacy systems.

EHMI Endpoint Register (EER) and its surroundings



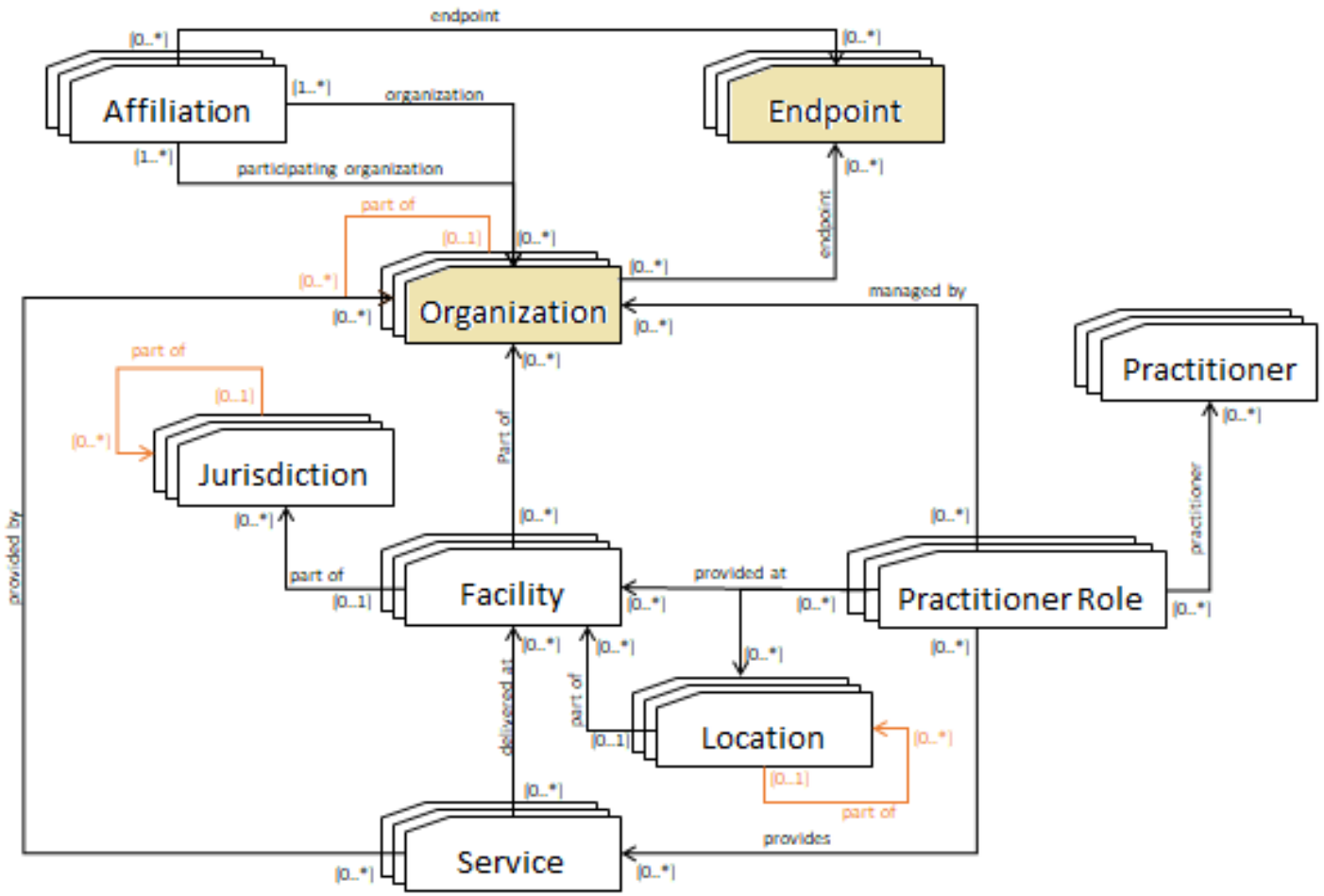
EHMI Endpoint Register (EER)

EER is a Danish profile on IHE mCSD



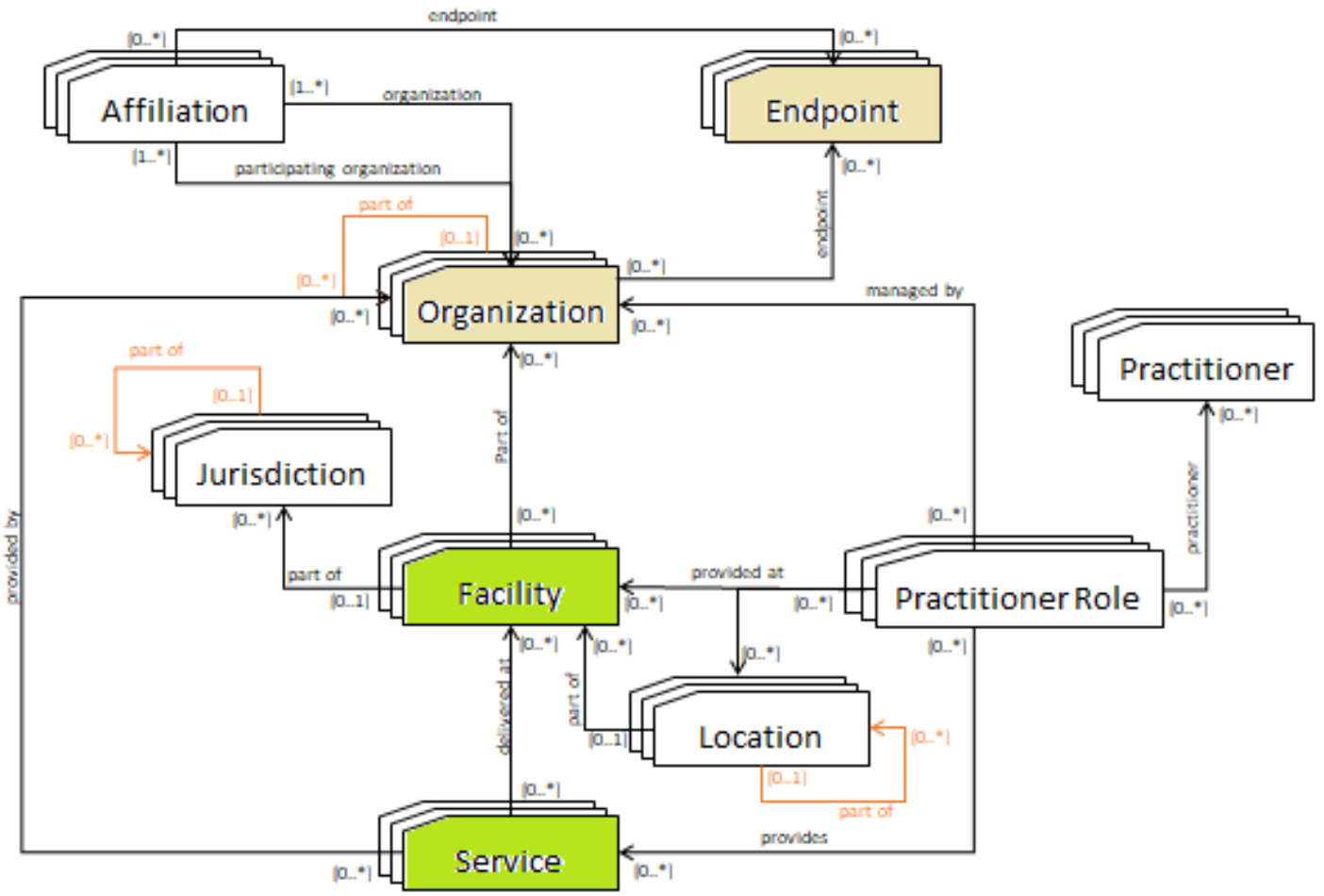
EHMI Endpoint Register (EER)

In version 1 EER is just focusing on mCSDs Organization and Endpoint ressources in order to meet the basic needs and mapping of SOR-EDI to EER

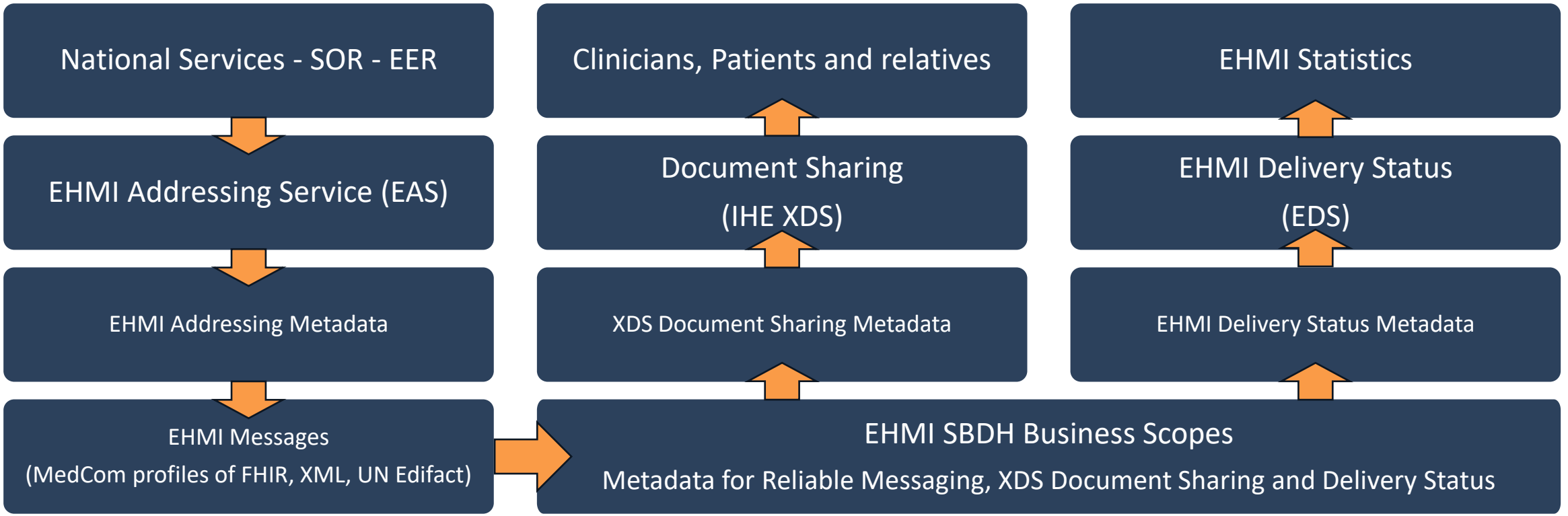


EHMI Endpoint Register (EER)

In version 2 EER will be covering more of mCSD by adding Facility And Service to the mix in order to meet the demands from our Referral Package Solution (Henvisningstabellen) handling the most commor severe illnesses like cancer and heart issues.



EHMI – flow of metadata



Open international standards used in EHMI

- Messaging
  - Messages (HL7 FHIR Messages, UN EDIFACT Messages)
  - Network Envelope (GS1: SBDH, PEPPOL: SBDH)
  - eDelivery (OASIS: SMP/SML/AS4(ebXML v3))
  - Reliable Messaging (OASIS: ebXML v3 Signal Messages)
- Document sharing
  - IHE XDS (OASIS: ebXML RegRep v3 and ebXML v3 User Messages)
  - IHE MHD (HL7 FHIR)
- EAS, EER, EDS
  - EER/EAS (IHE mCSD (HL7 FHIR)
  - EDS (HL7 FHIR, inspired by IHE BALP)
- Security
  - RESTful APIs (OpenId: Oauth 2.0 and FAPI 2.0)

EHMI's use of FHIR – in short

- eDelivery messaging handling legacy messages and FHIR messages
- FHIR (and legacy) messages are shared in the national Danish XDS infrastructure, growing the Danish XDS infrastructure towards MHD with the use of the FHIR DocumentReference ressource
- Track'n'trace is built upon the FHIR AuditEvent ressource
- Healthcare addressing is a FHIR facade on some services on the National Service Platform for healthcare
- The Endpoint Register is a Danish profile on IHE mCSD and will be build incrementally over the years covering more and more of mCSD hopefully replacing SOR (our legacy register) with mCSD.

EHMI – where to find more

- EHMI Project: (in Danish)
  - https://medcom.dk/projekter/kommunale-proevesvar-paa-ny-infrastruktur/
- EHMI Landingpage (in English)
  - http://ehmi.dk
- EHMI FHIR IGs (in English)
  - https://medcomehmi.dk/ig/
- Architectural Vision (in Danish: ”Målbilledet for meddelelseskommunikation på sundhedsområdet”)
  - https://sundhedsdatastyrelsen.dk/media/15283/Maalbillede%20for%20meddelelseskommunikation.pdf

Video on EHMI

If you want to see a short video on EHMI, you will find our bright new video in English here

Other MedCom initiatives on FHIR: IHE XDS/MHD Documents

The IHE XDS/MHD paradigm is changing from CDA to FHIR starting with a Conditionlist Document this year,

- supported by the use of DocumentReference resource in the future.

Step by step approaching a MHD based repository in the future

Q&A

Contact

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  - https://www.linkedin.com/in/olevilstrup/

Thank you!