Introduction to CISE

Architecture and standards

14 Oct 2021

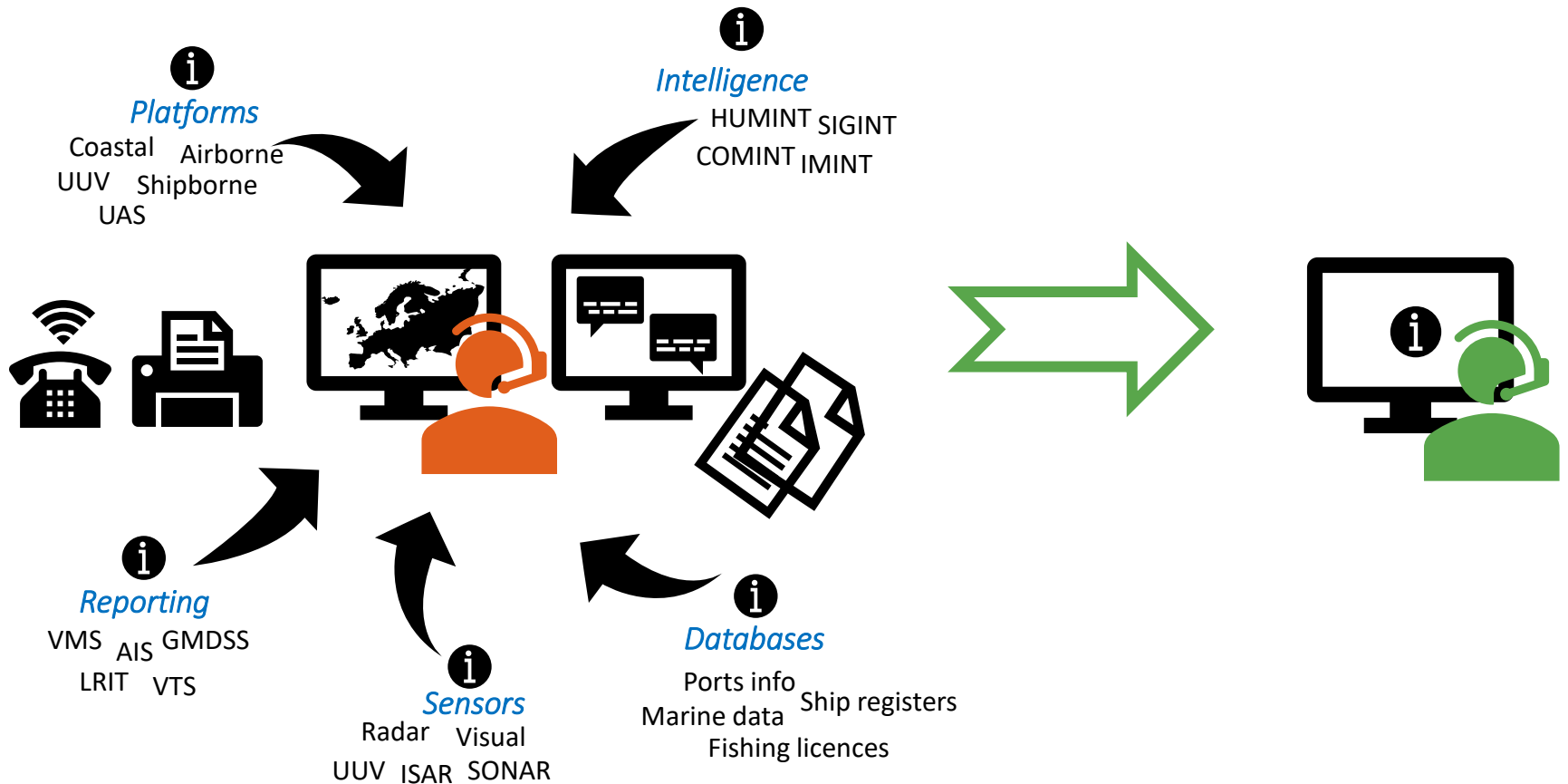EMSA
European Maritime Safety Agency

CISE

Project funded
by the European Union

Common **I**nformation **S**haring **E**nvironment
for the EU Maritime Domain

CISE aims at creating a *political*, *cultural*, *legal* and *technical* *environment*

to enable *information sharing* between existing and future surveillance systems and networks

Why CISE?

Platforms
Coastal Airborne
UUV Shipborne
UAS

Intelligence
HUMINT SIGINT
COMINT IMINT

Reporting
VMS AIS GMDSS
LRIT VTS

Sensors
Radar Visual
UUV ISAR SONAR

Databases
Ports info Ship registers
Marine data
Fishing licences
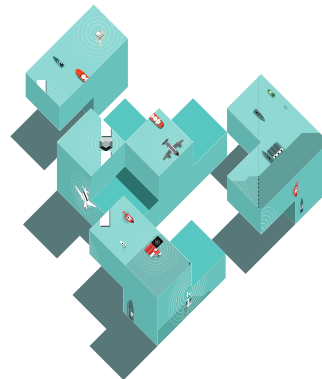
How CISE? The Hybrid Architecture

Explains

- how CISE should work
- how information is exchanged

Hybrid Vision

Defines

- Top-level requirements and principles
- Common building blocks
- Flexible organisational structure
  - each participant can choose how to share or have access to information

Project funded
by the European Union
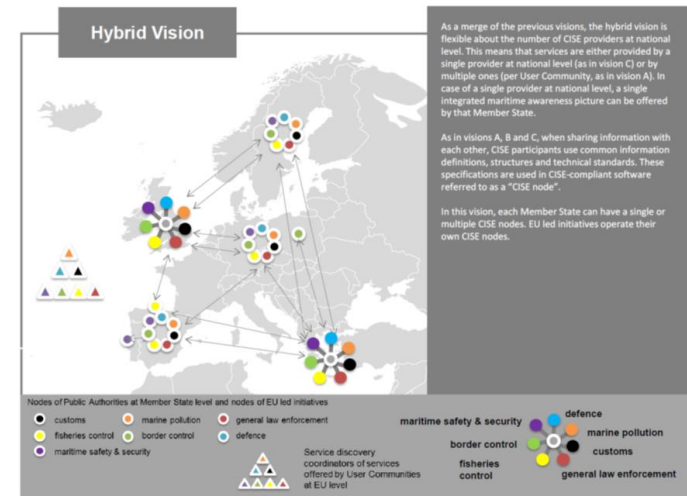
Connecting public authorities and their ICT systems

- **civil** and **military**
- regional/sectorial organisations, EU agencies

Connecting existing ICT systems

→ **not** a new surveillance system, **not** a new screen

Decentralised

→ **point-to-point** exchange of information

Sector-neutral solution

→ all sectors and systems are **important**

Voluntary

→ information exchange not enforced by legislation

Easy for information providers

→ ownership of the information, security, access rights

Information exchange in CISE

The CISE service and data models

twitter.com/emsa_lisbon
facebook.com/emsa.lisbon

Existing ICT systems can exchange information in CISE

- When their users (the operators) need it

Information goes from the provider to the consumer

- CISE is transparent to the users
- No central storage of information, no intermediate storage
- Information exchanged is reintegrated/ visualised in the ICT systems
- No new screens for operators

How information is exchanged in CISE

Voluntary exchange

- Information providers are not obliged to exchange any information
- Information providers remain owners of their data
- CISE paves the road for information exchange

Communication protocol – CISE Service Model

- 3$_{(x2)}$ patterns: pull, push, publish/subscribe (+ multicast)
- Information services

Communication needs and patterns

We need to send information to another partner
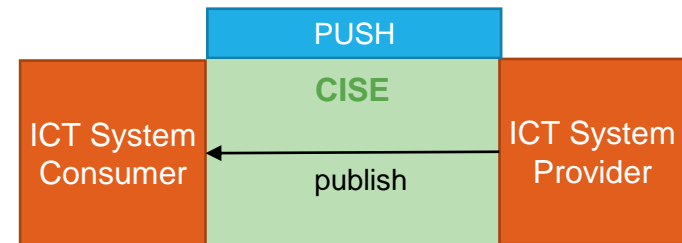
The partner did not request it

1. I know which partner can be interested → **Push**

2. I don't know the partners that may be interested → **Push unknown**

Communication needs and patterns
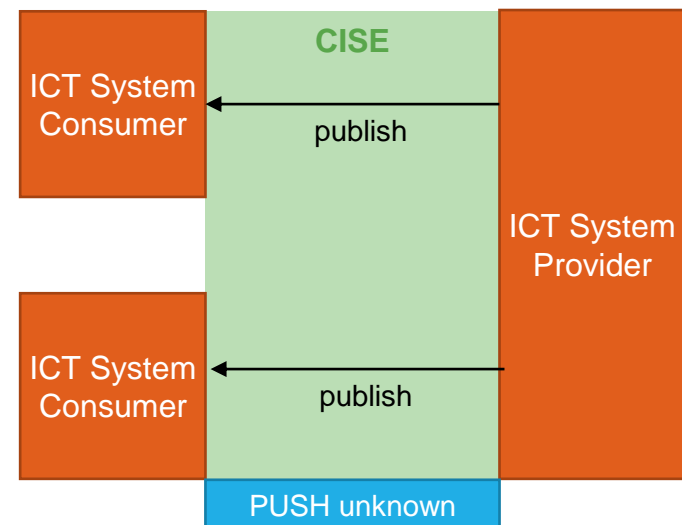
We need to request information to a partner

1. I know which partner may have the information → **Pull**

2. I don't know if a partner may have the information → **Pull unknown**

Communication needs and patterns
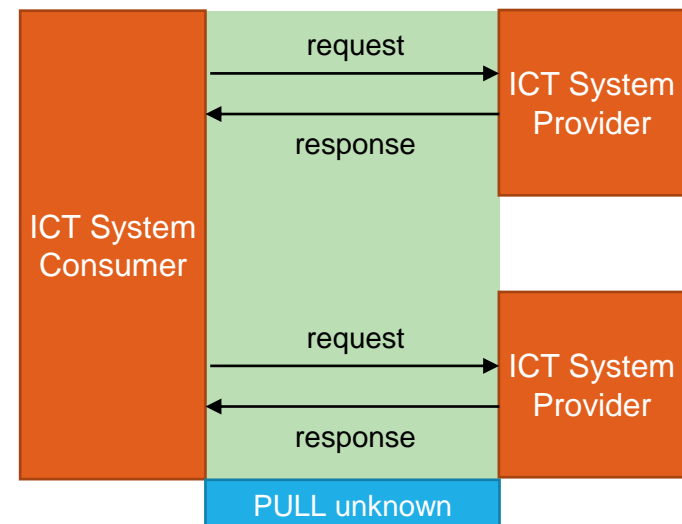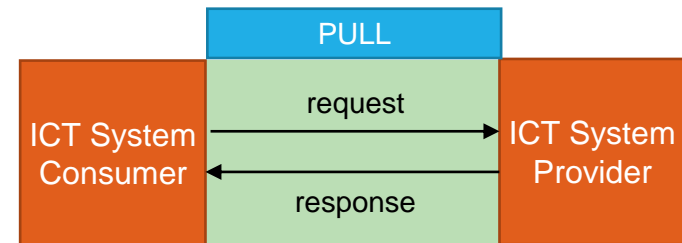
A partner is offering regular information on a subject (e.g., a vessel, an incident, etc.)

I want to receive the information

1. I know which partner is offering the information → **Publish/Subscribe**

2. I don't know if any partner is offering the information → **Publish/Subscribe unknown**
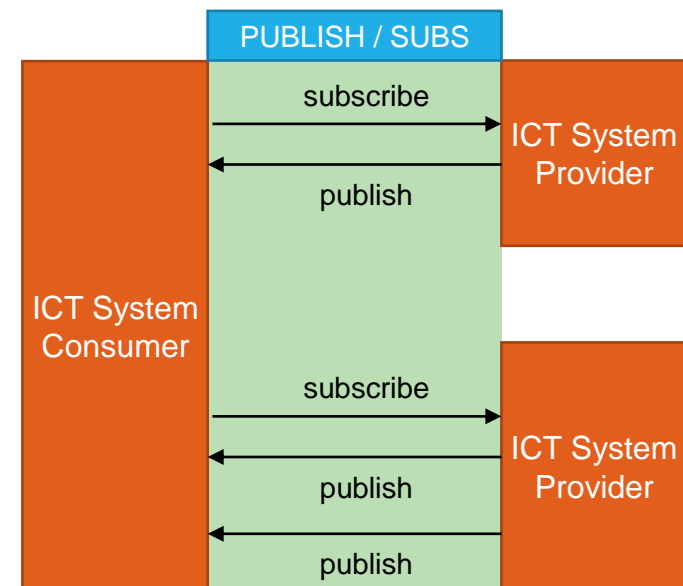
Make available consolidated or fused data

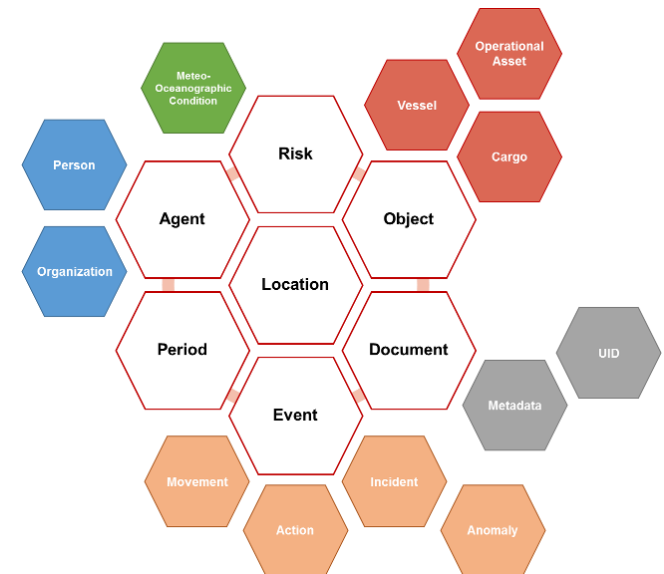- in one or several geographical areas
- for one or several CG functions

Information described using the CISE data model

- *Lingua franca* in the maritime domain

CISE Data Model

Design principles

- Oriented to cross-sector information exchange

- Independent from any business process

- Flexible

- Extensible

18 data entities with their attributes

Vessel, Operational assets, Cargo, Movement, Location, Action, Incident, Anomaly, Risk, Person, Organization, Document, METOC

CISE Data Model

Information that can be exchanged with the CISE Data Model (examples)

Vessel static info (including owners)

- EU merchant vessels registration files
- EU fishing vessels registration files
- EU leisure boats registration files
- Non-EU vessels registries

Vessel tracks

- Coastal radar
- Coastal AIS
- Satellite AIS, satellite radar, LRIT
- VMS
- Satellite imagery

About persons (e.g., masters and crew on EU registered vessels)

- for merchant vessels
- for fishing vessels
- for leisure boats (boating licenses)

Alerts and risks

- Port state control records
- Recorded accidents/incidents involving a ship
- Transmission of alerts on ships/zones among all national CG authorities in Europe

CISE Data Model

Information that can be exchanged with the CISE Data Model (examples)

Reporting formalities (merchant vessels)

- Notification of arrival/departure
- Goods, dangerous goods
- Crew and passengers lists
- Other reporting formalities

Assets at sea

- Real-time positions of surveillance and intervention assets

Vessels of interest

- IUU vessel list
- Vessel of interest list

CISE

Project funded
by the European Union

Information Services – Definition

|	
Service ID	Unique identifier (URN) of a service in CISE: **rc.simlsa2-noderc.vessel.pull.consumer**
Service Type	Data type exchanged using this service. For instance, a service of type **VesselService** exchanges vessel data.
Service Operation	Supported communication pattern: ***Pull, Push, Subscribe, Feedback***
Service Role	Role of the service in the communication pattern: **Provider, Consumer**
Service Status	**Draft, online, test, maintenance, deprecated**
Participant ID	Legacy system owning the service (URN) **rc.simlsa2-noderc**

One information type per service → Service type

- Main data entity (vessel) + related entities (location, incident, etc.)
- Vessel information → VesselService

Several services can carry information of the same type

- from different sources
- for different purposes
- Vessel → AIS fused data, verified VMS positions, …

Information services – Service type
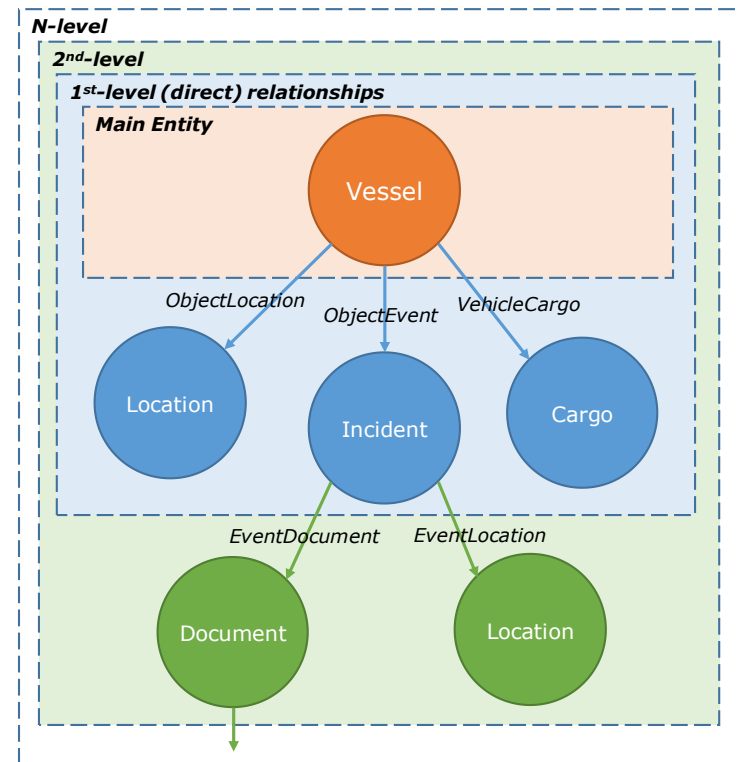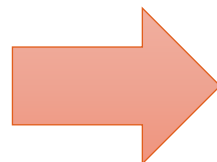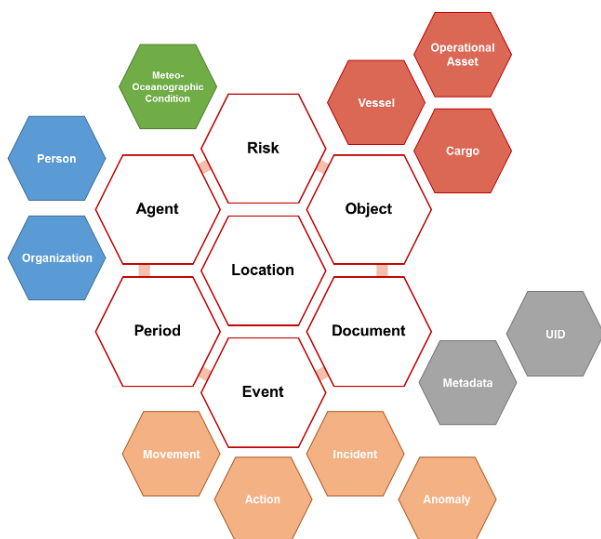
ActionService	LocationDocumentService
AgentService	MaritimeSafetyIncidentService
AnomalyService	MovementService
CargoDocumentService	OperationalAssetService
CertificateDocumentService	OrganizationService
CrisisIncidentService	OrganizationDocumentService
DocumentService	RiskService
IncidentService	VesselService

1 data entity → 1 service type

A service can carry information from different sources

How to use information services

Communication patterns use 2+ information services
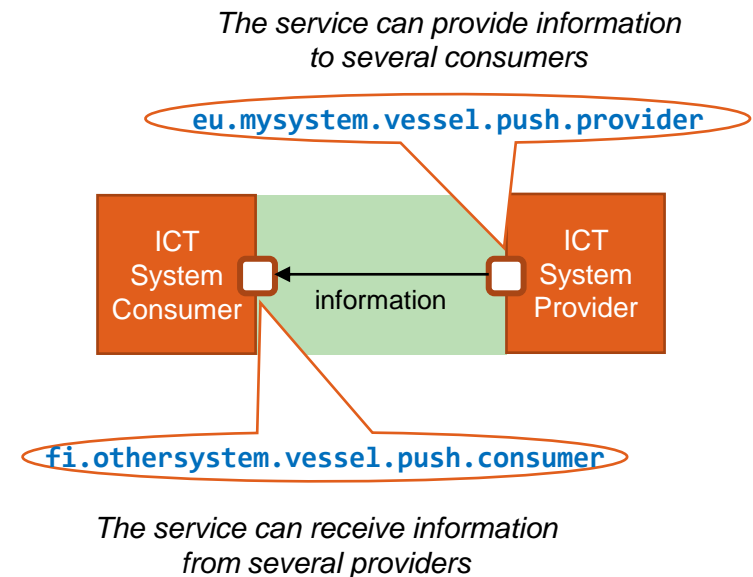
How to use information services
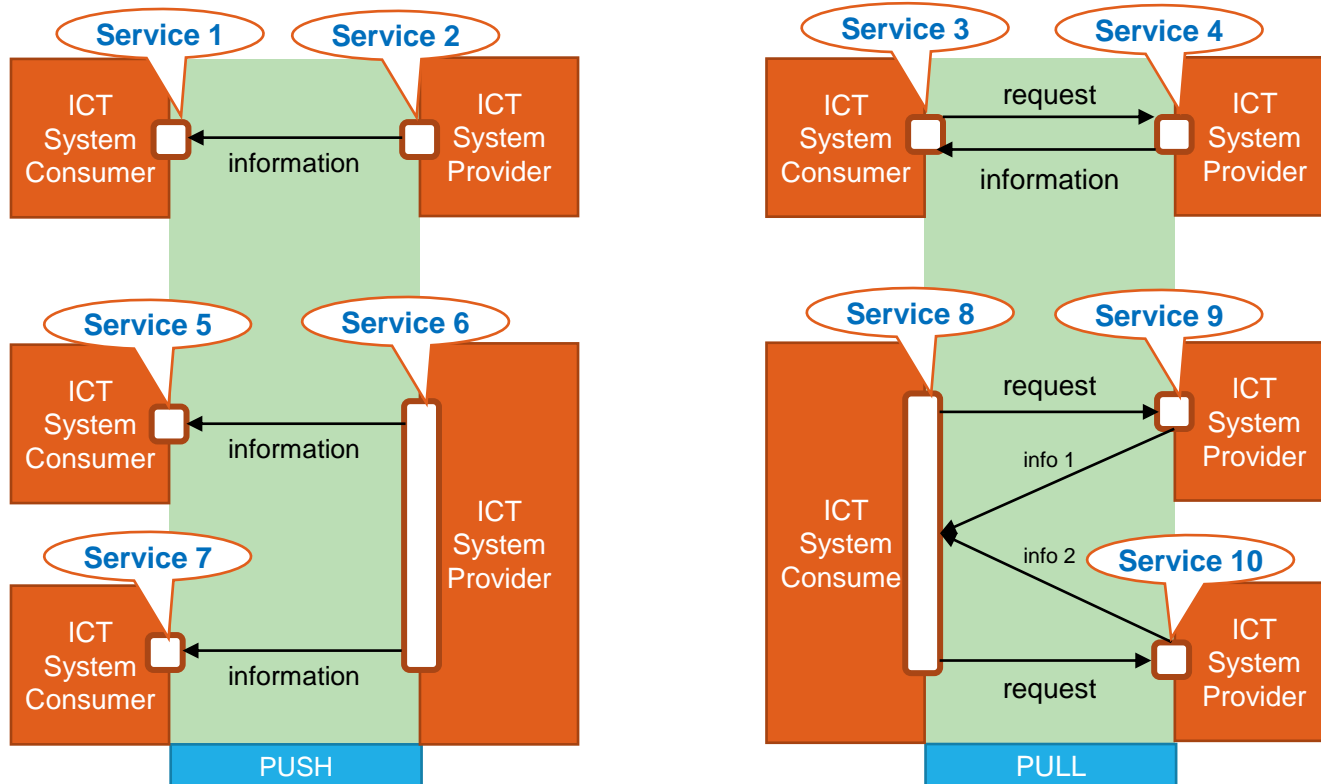
1. I want to send vessel information to another partner

- I need a push provider vessel* service
- Example:
  `eu.mysystem.vessel.push.provider`

2. I want to receive vessel information from other partners

- I need a push consumer vessel service
- Example:
  `fi.othersystem.vessel.push.consumer`

The service can provide information to several consumers

`eu.mysystem.vessel.push.provider`

| ICT System Consumer | information | ICT System Provider |

`fi.othersystem.vessel.push.consumer`

The service can receive information from several providers

* service type: VesselService

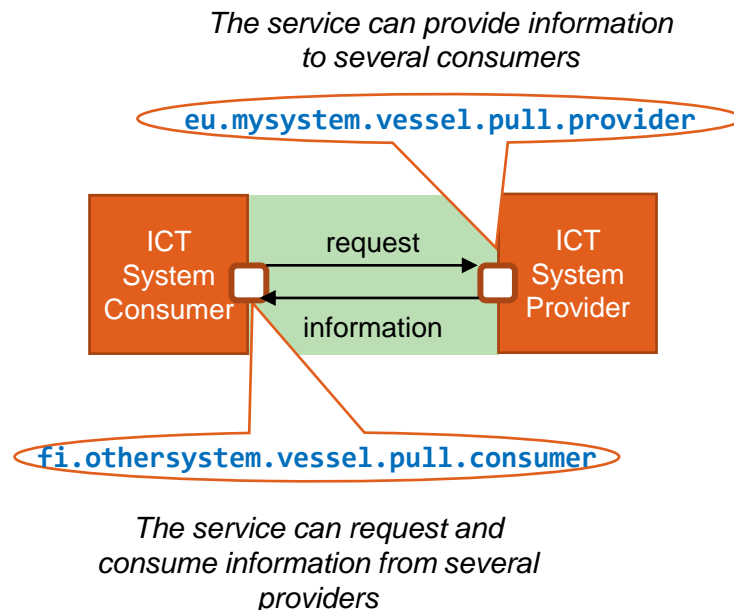CISE — Project funded by the European Union

How to use information services

1. I want to request cargo information to other partners

- I need a pull consumer cargo* service

- Example:
  `eu.mysystem.cargo.pull.consumer`

2. I want to receive requests from other partners

- I need a pull provider cargo* service

- Example:
  `gr.othersystem.cargo.pull.provider`

The service can provide information to several consumers

`eu.mysystem.vessel.pull.provider`

| ICT System Consumer | request → ← information | ICT System Provider |

`fi.othersystem.vessel.pull.consumer`

The service can request and consume information from several providers

*** service type: CargoService**

How to use information services

1. I want to offer regular information on maritime incidents

- I need a subscribe provider incident* service

- Example:
  `eu.mysystem.incident.subscribe.provider`

2. I want to subscribe to the information on maritime incidents

- I need a subscribe consumer incident* service

- Example:
  `it.system.incident.subscribe.consumer`

`eu.mysystem.incident.subscribe.provider`

`it.system.incident.subscribe.consumer`

* service type: IncidentService

23
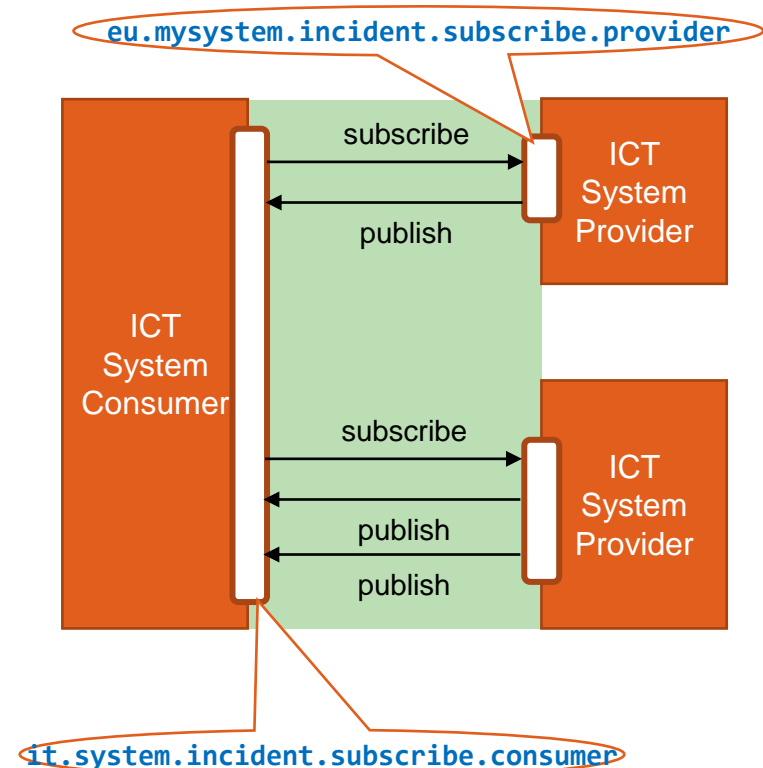
How many information services per ICT system?

As many as we need

Can I have two services: subscribe provider incident?

Yes, with different Service ID. They may use different information sources.

How to limit the access to my information?

With access rights rules

Information services – Access Rules

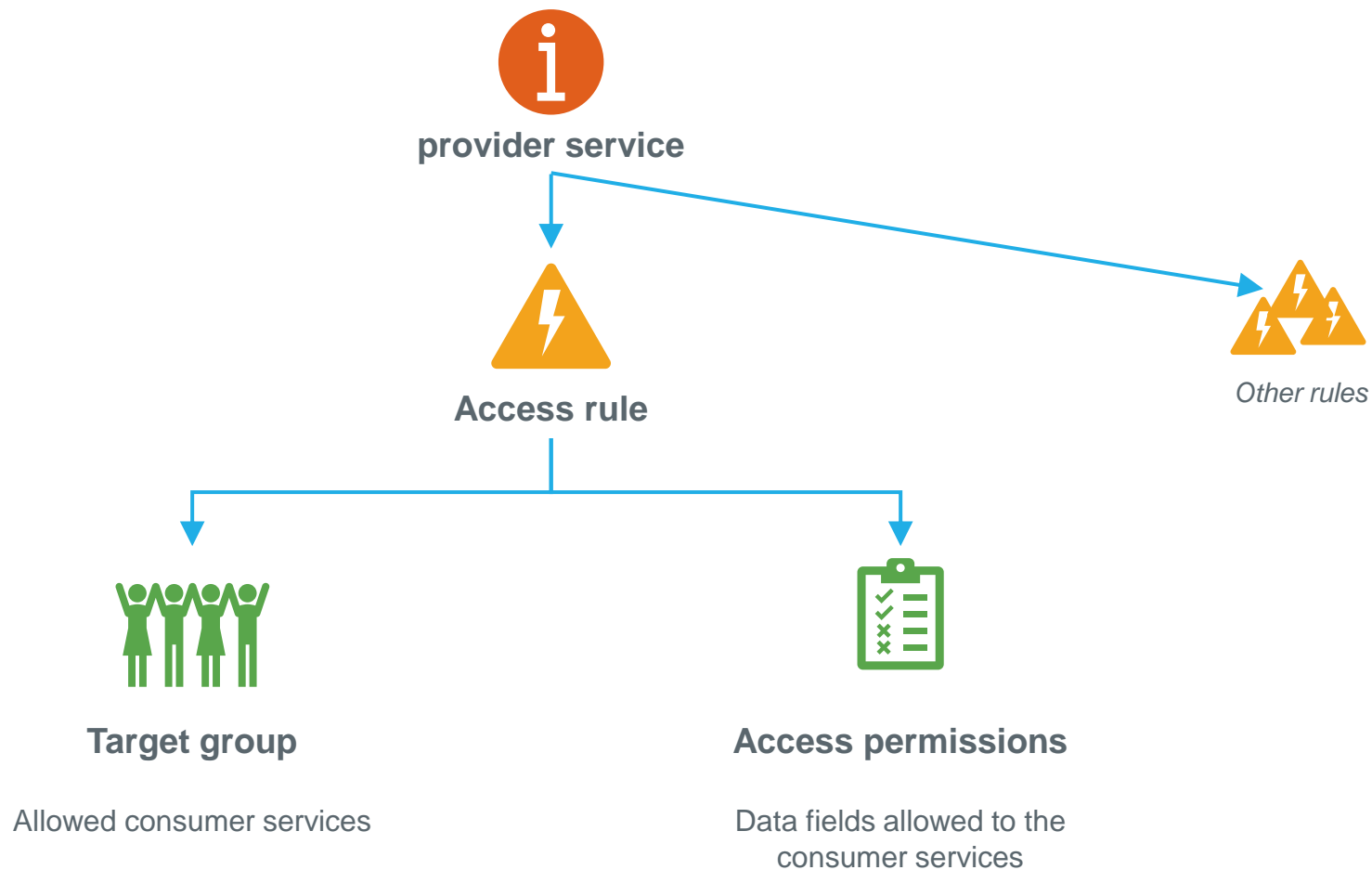**Rules are defined on provider services**
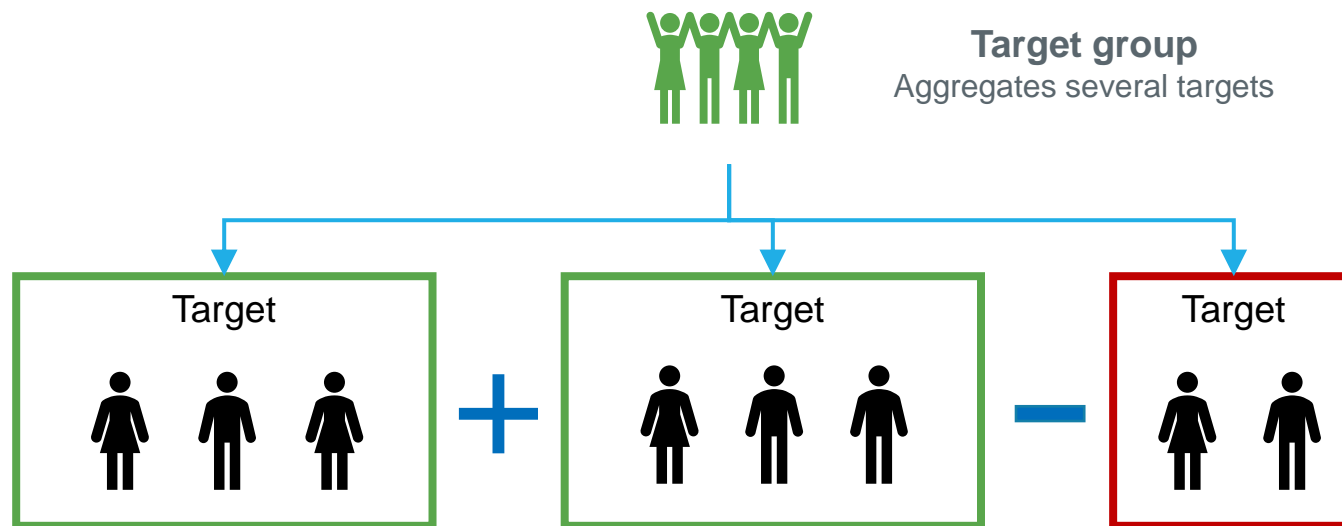
- Enforced by the CISE Node

Default rule: deny access to information

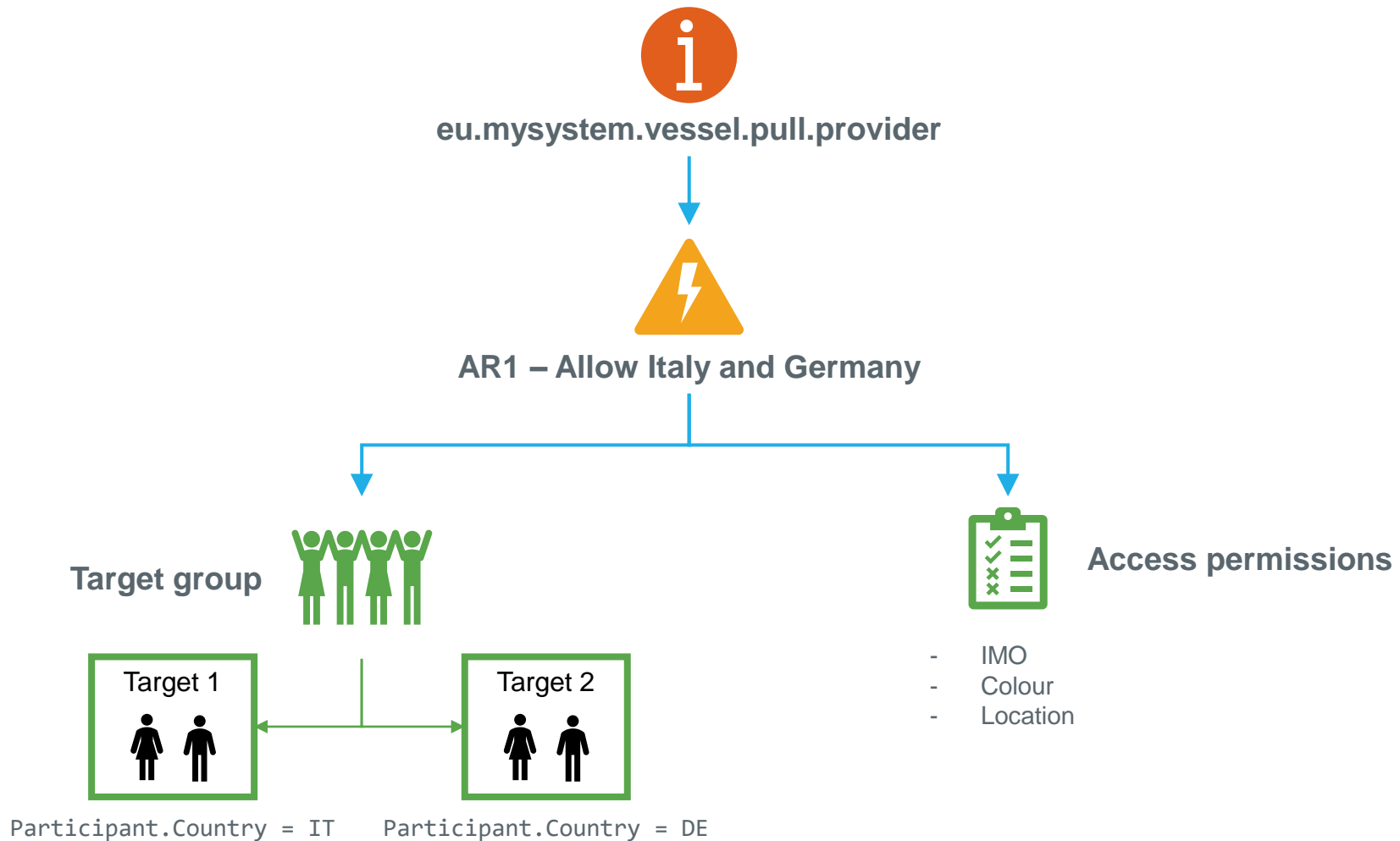**Information owners can define several rules over a service:**

- To grant access (requests, pushed information)
- To filter the information exchanged (data fields)

Information services – Access Rules

provider service

Access rule

Other rules

Target group

Allowed consumer services

Access permissions

Data fields allowed to the consumer services

Information services – Access Rules

Target group
Aggregates several targets

Target **+** Target **–** Target

A **target** is a set of consumer services defined by:
- All consumer services
- Service ID
- Participant ID
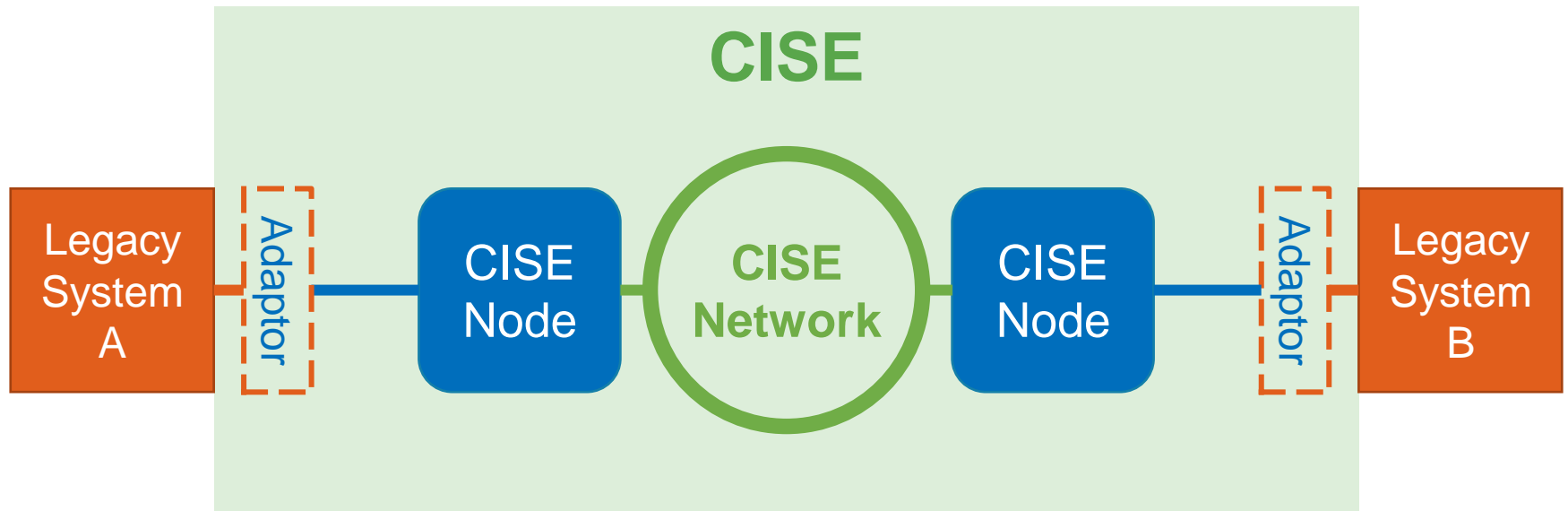- Participant metadata (member state, etc.)

eu.mysystem.vessel.pull.provider

AR1 – Allow Italy and Germany

Target group

Access permissions

- IMO
- Colour
- Location

Target 1

Target 2

`Participant.Country = IT`   `Participant.Country = DE`

Building blocks

twitter.com/emsa_lisbon
facebook.com/emsa.lisbon

Building Blocks
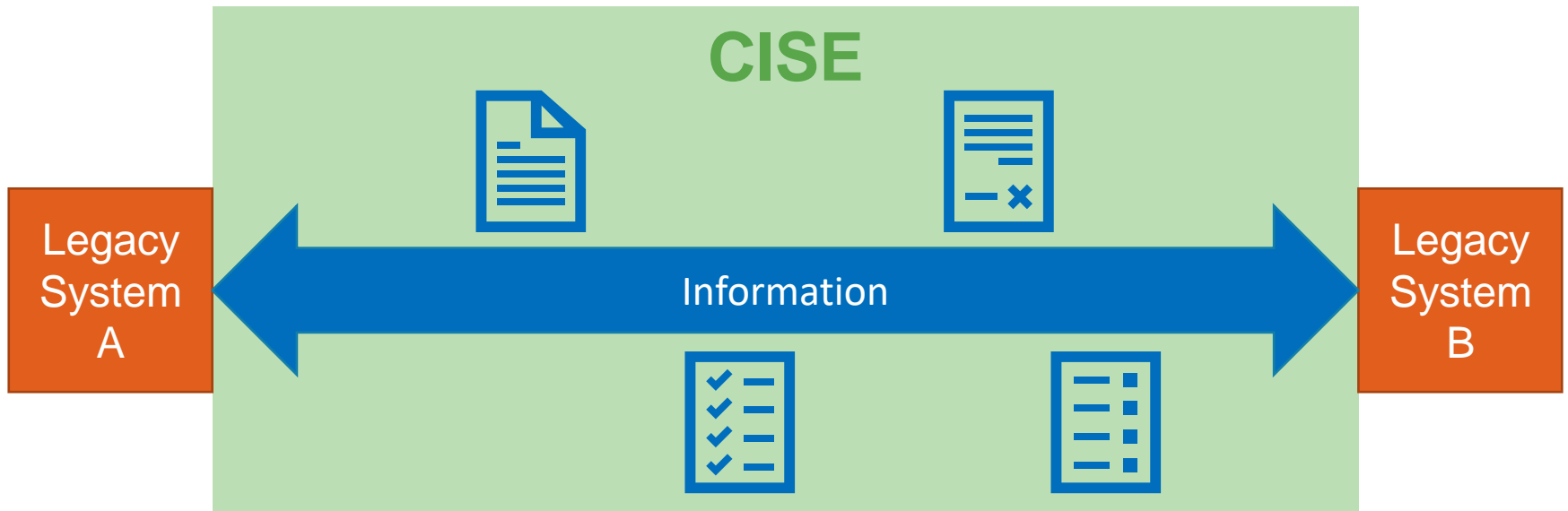
- **Existing** ICT system
- Can provide/consume information
- Used for maritime surveillance

- **Same** software for all the partners
- Communication, security, access rights
- Can handle **several** legacy systems

Legacy System — Adaptor — CISE Node — **CISE Network**

- **Optional**
- Translates information CISE - Legacy System
- **Specific** for each Legacy System

Building Blocks (CISE Node)
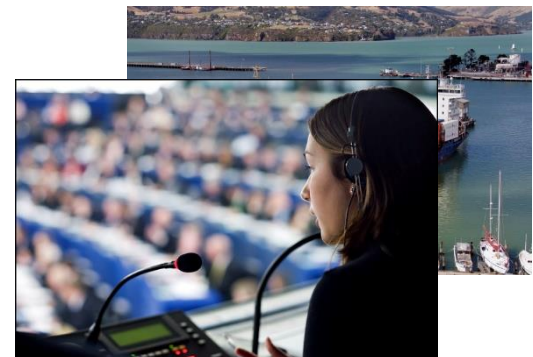
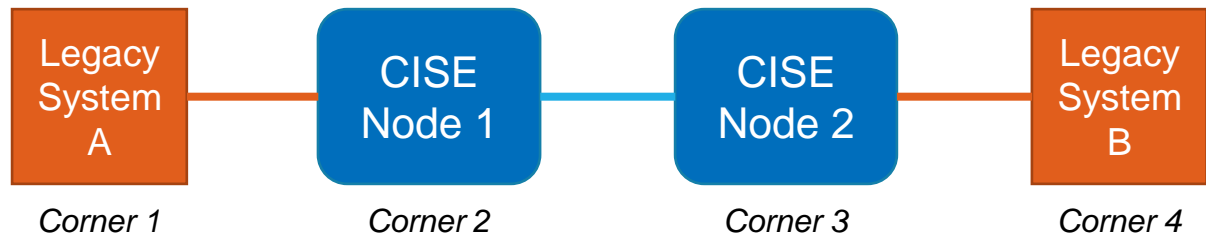|	
Service Registry	Distributed directory in the CISE network
Subscription Registry	Local directory of subscriptions
Access Rights Registry	Local directory of access rules
Accounting Service	Local registry of events
Monitoring Service	Monitoring node status (and neighbourhood)

Communication Protocol

CISE Service Model

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Common Communication Protocol

4 corners

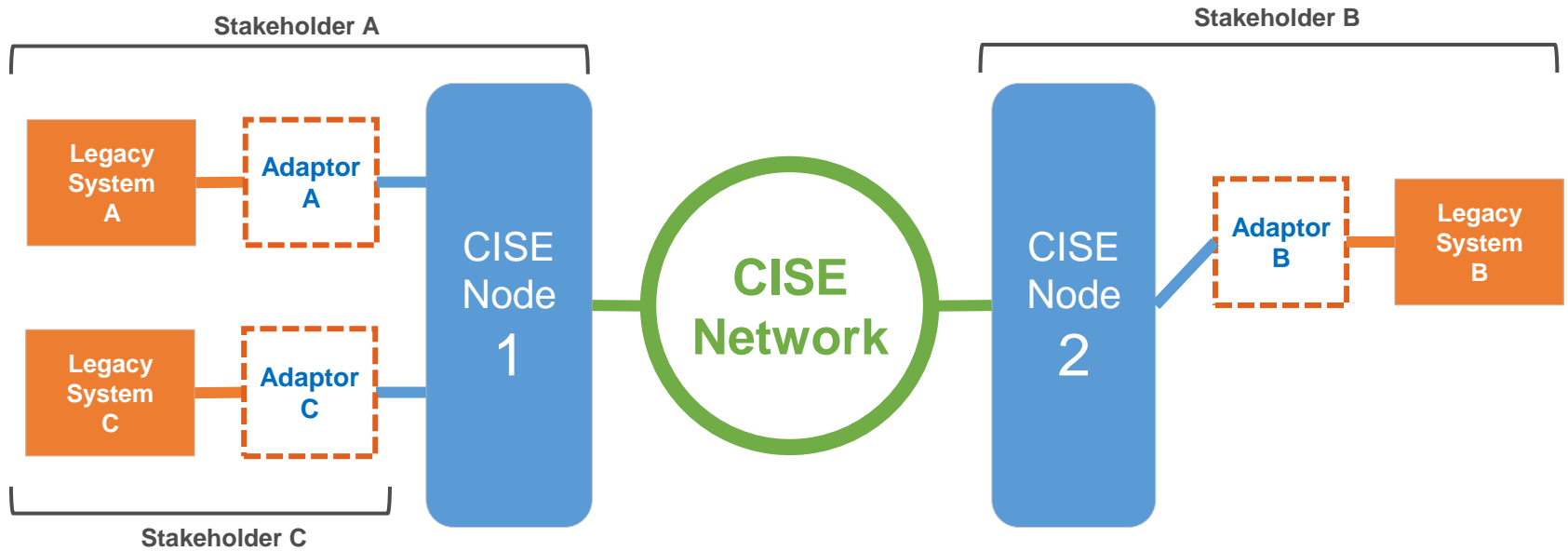| Legacy System A	—	CISE Node 1	—	CISE Node 2	—	Legacy System B
Corner 1		*Corner 2*		*Corner 3*		*Corner 4*

Service-oriented

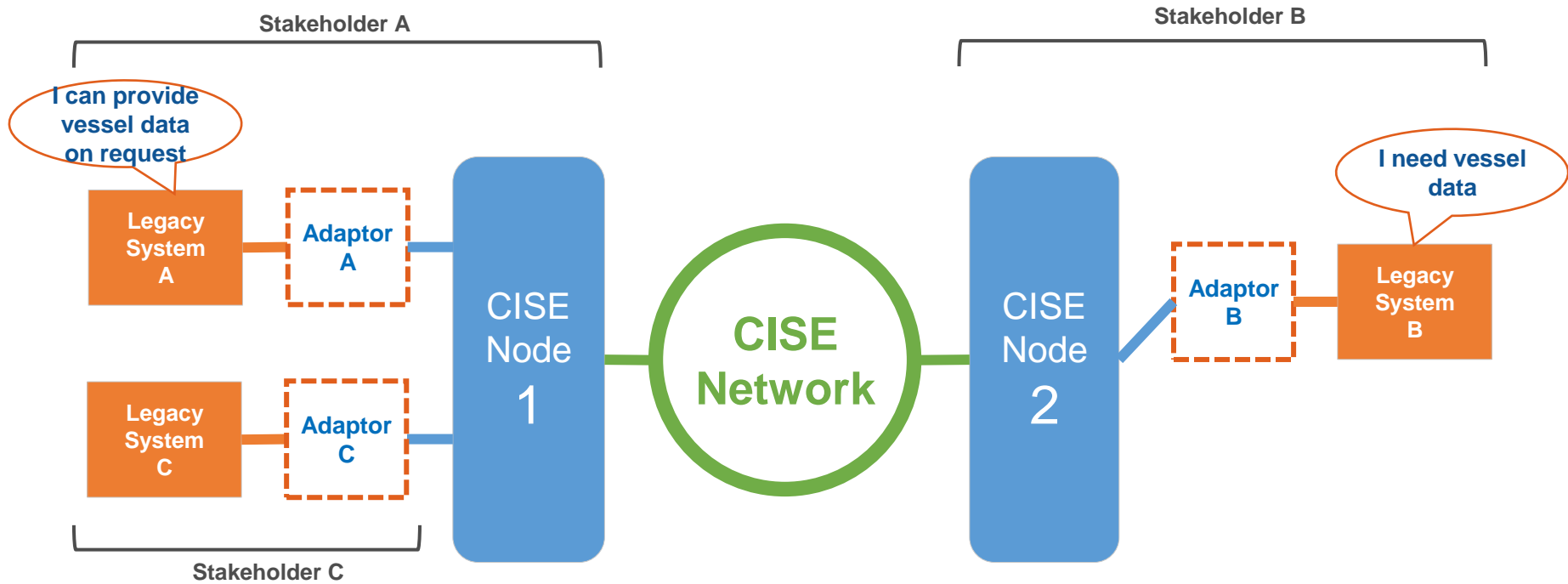- information exchange using information services

Message-driven ✉

- information services use messages
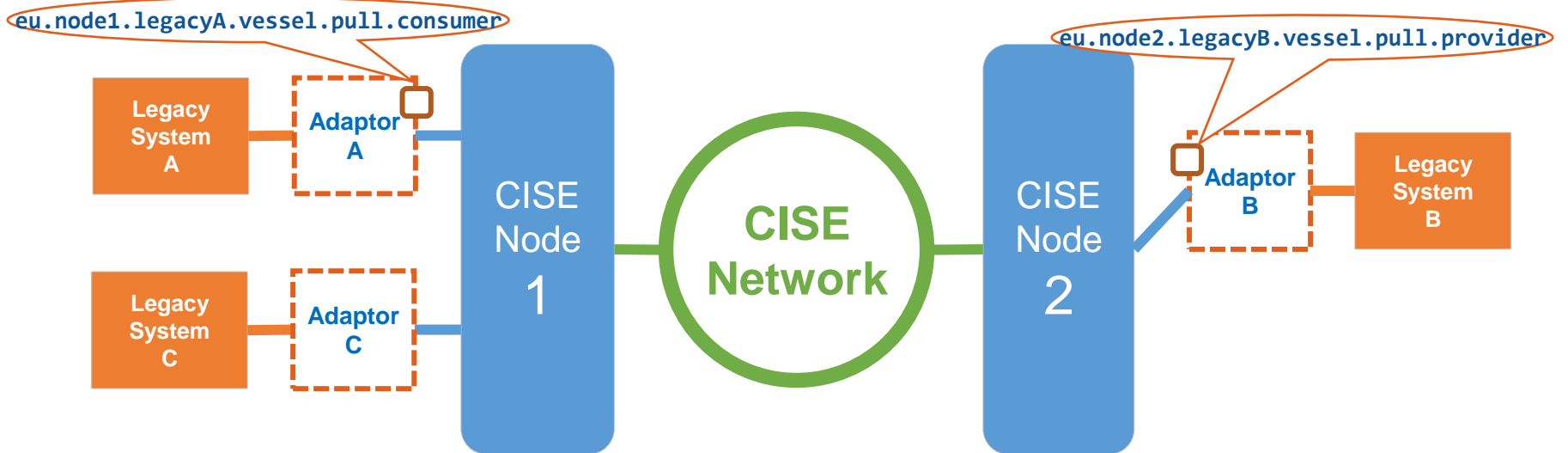- Basic piece of data exchanged between corners

How information exchange works

Initial organisation
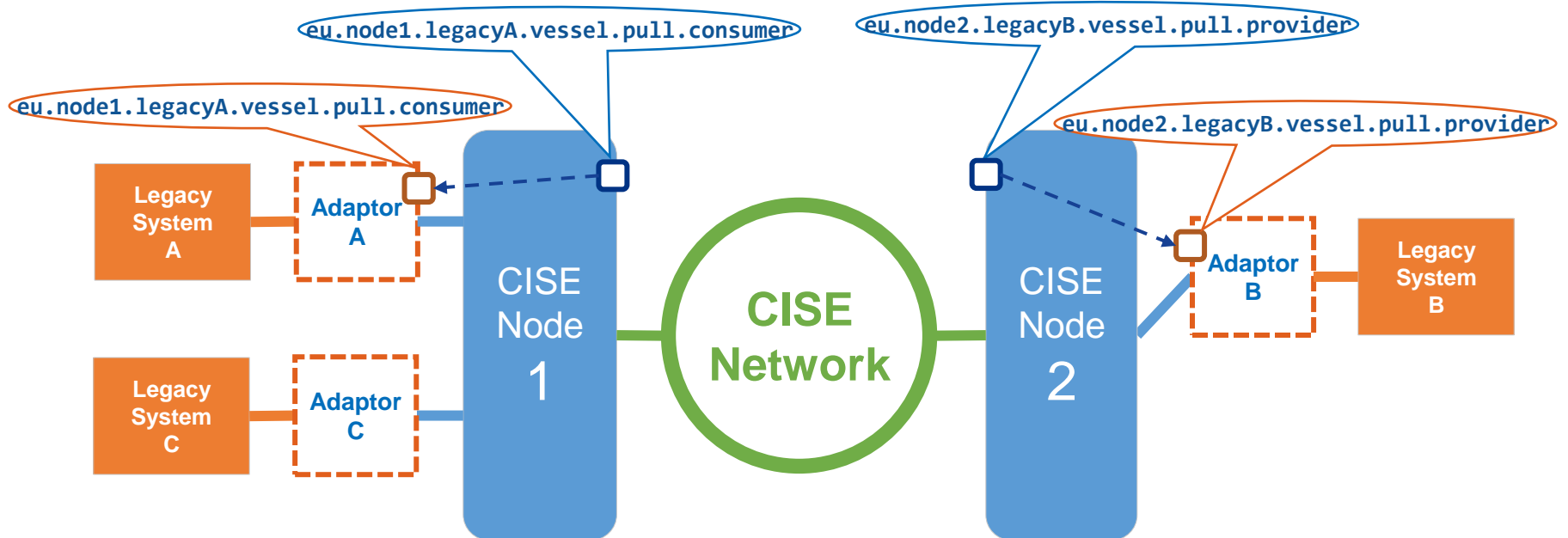
Initial organisation

How information exchange works

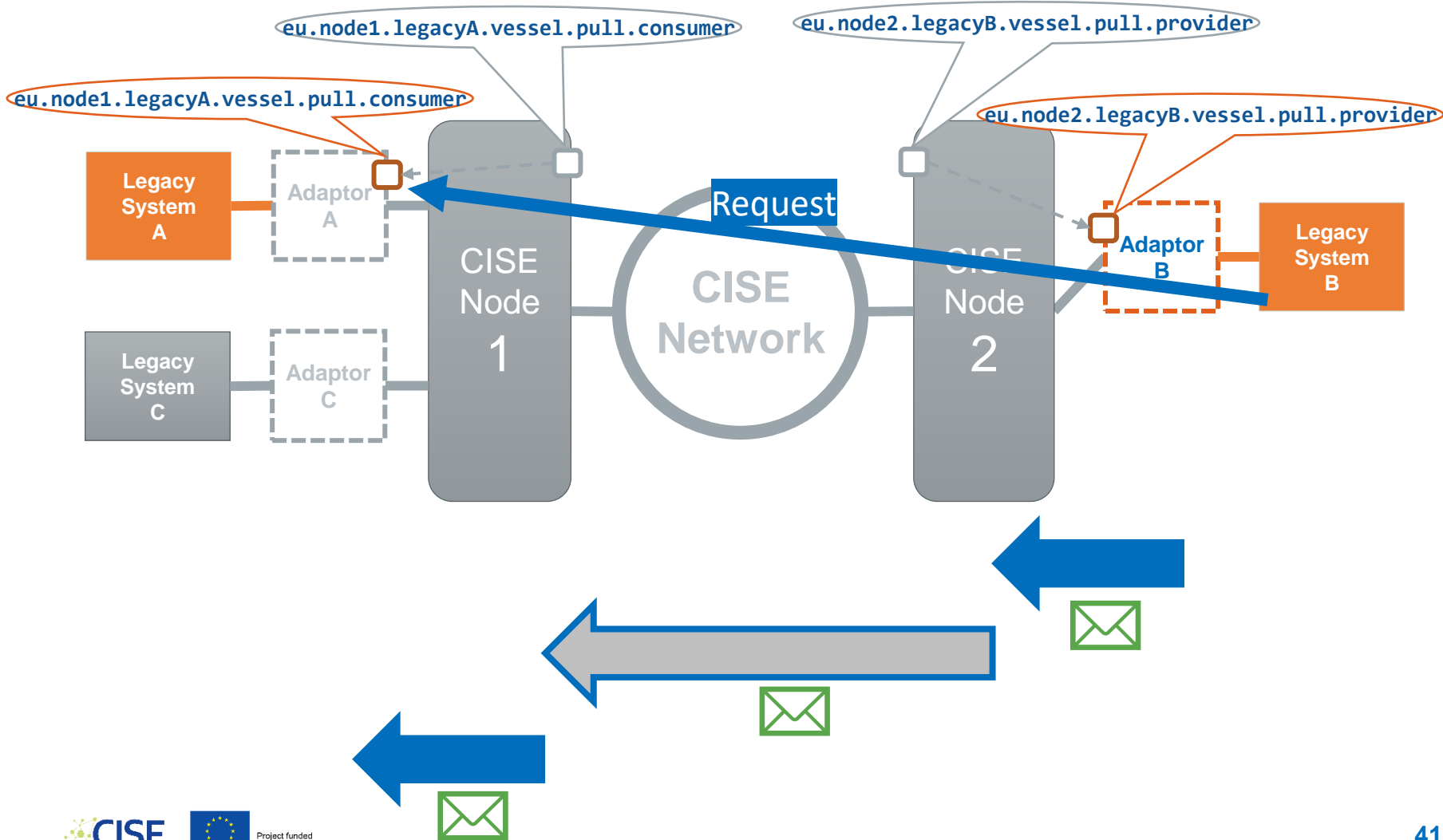# How information exchange works
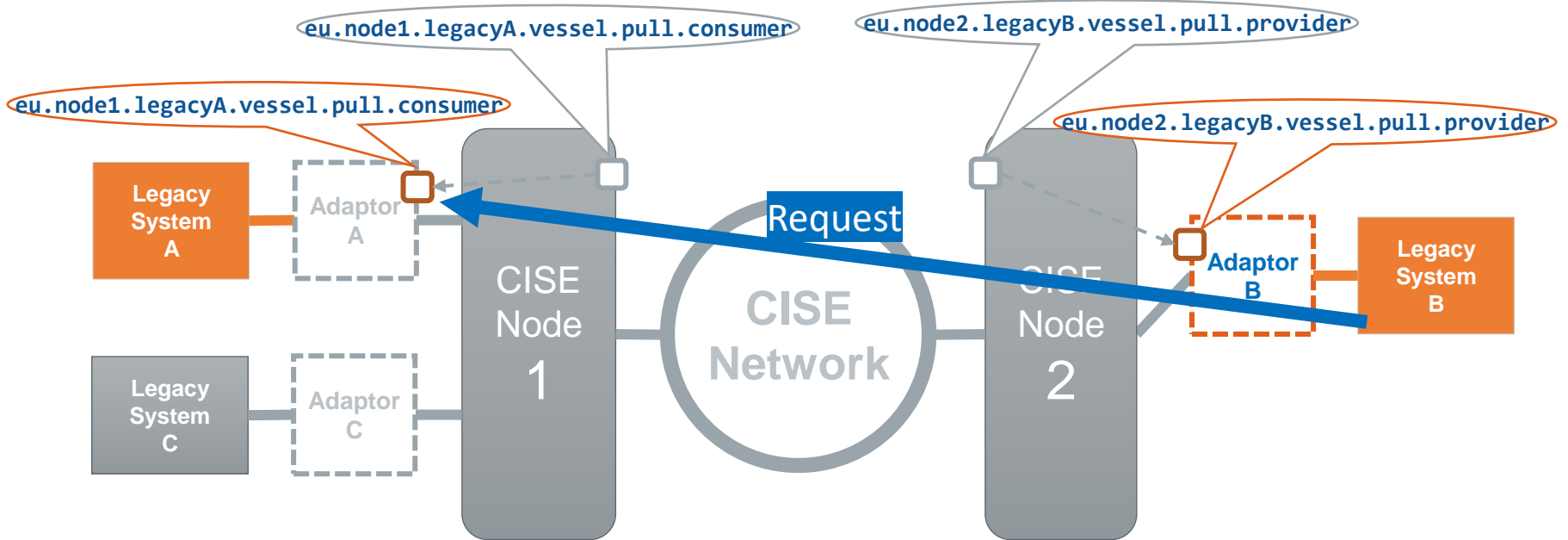
How information exchange works

CISE Messages

Defined according to the CISE Service Model

Types:
- PullRequest, PullResponse, Push
- Acknowledgement (sync, async)
- Feedback

Carry: information, information requests, subscription requests, confirmation of delivery, etc.

XML documents
- Three sections: **envelop**, **payload** and **signature**

Message Structure

Envelop

- Identification
- Addressing:
  - From service X
  - To service Y
- Operation
  - Push, pull, etc.

Payload

- Information exchanged
- Formatted using the CISE Data Model
- Metadata on the payload: sensitivity, etc.

Signature

- Ensures the authenticity of the message sender
- XMLSignature standard
  `https://www.w3.org/TR/xmldsig core1/`

Message exchange: Pull Request

(Corner 4) **Legacy System A** — (Corner 3) **CISE Node 1** — (Corner 2) **CISE Node 2** — (Corner 1) **Legacy System B**

1. PullRequest
2. Sync Acknowledgement
3. PullRequest
4. Sync Acknowledgement
5. PullRequest
6. Sync Acknowledgement

Action

Optional: Confirmation of delivery

7. Async Acknowledgement
9. Async Acknowledgement

* Same protocol for any message sent from Corner 1/4

Example: Request to a pull service

```xml
<PullRequest>
    <CorrelationID>fd5b2bb2-8095-4acf-b6cb-3dd78ba8a572</CorrelationID>
    <CreationDateTime>2019-02-24T14:46:55.145Z</CreationDateTime>
    <MessageID>fd5b2bb2-8095-4acf-b6cb-3dd78ba8a572</MessageID>
    <Priority>High</Priority>
    <RequiresAck>true</RequiresAck>
    <Sender>
        <ServiceID>eu.node2.legacyB.vessel.pull.provider</ServiceID>
        <ServiceOperation>Pull</ServiceOperation>
        <!-- More info -->
    </Sender>
    <Recipient>
        <ServiceID>eu.node1.legacyA.vessel.pull.consumer</ServiceID>
        <ServiceOperation>Pull</ServiceOperation>
        <!-- More info -->
    </Recipient>
    <!-- Payload and Signature -->
</PullRequest>
```

Identification

Addressing

Example: Request to a pull service

```xml
<PullRequest>

    <!-- Envelop -->

    <Payload>

        <InformationSecurityLevel>NonClassified</InformationSecurityLevel>

        <InformationSensitivity>Green</InformationSensitivity>

        <Purpose>NonSpecified</Purpose>

        <Vessel>

            <MMSI>228002000</MMSI>

            <ShipType>FishingVessel</ShipType>

        </Vessel>

    </Payload>

    <!-- Signature -->

    <!-- Envelop -->

</PullRequest>
```

CISE Data Model

Do you have any information on a **fishing vessel** with MMSI **228002000**?

```
<PullRequest>

    <!--Envelop -->

    <!--Payload -->

    <Signature xmlns="http://www.w3.org/2000/09/xmldsig#">

    <SignedInfo> <!--How to create the signature --> </SignedInfo>

<SignatureValue>o1VHn11tIGFvni0whnY4cKj01LkDl4B3bAw99i7OBbG7ZTnzWNQX1WG79r+Rl4blXMSnnrhyRg3WA7
zSCVmHqx3ca4V6MyFOJAJ0iwjWasNBmxrntzCsKO/CElb31N3AlH4zGmgpOiLG4mDKNJ8V3ZLMfXLQLjyaZrRrPlvdUNWBidApi
g4y9aGGCJWjji3m9l4OIDbGKFFcTqOxw66xG0SsV0u39kVFuLHmBCWoo7Kt2NEiPw8MAo/+9xEOs05U6uCRR0IrxzoDcZtwAHha
YBYs4bT/DHwIrYf0f68xG/9ec2n+xWAl88dAOsCrqQkdV3PDGSYYQF90jwhh7h1aw==</SignatureValue>

        </Signature>

        <!-- Envelop -->

</PullRequest>
```
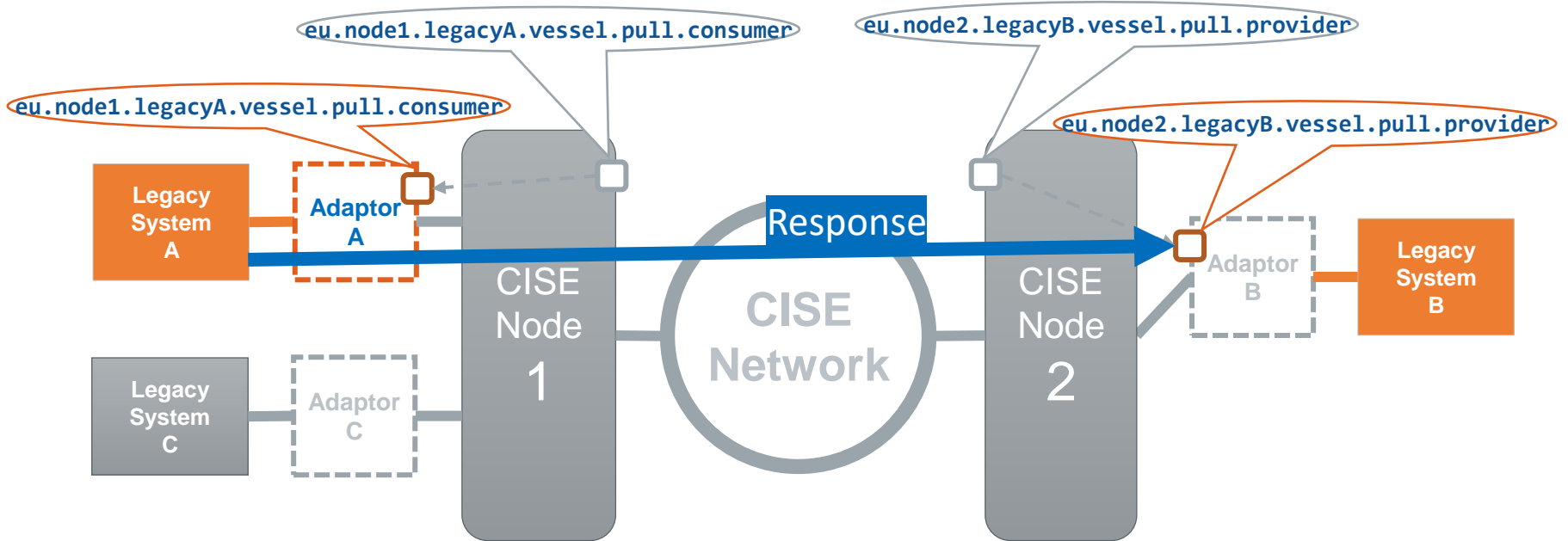
Example: Request to a pull service

```xml
<PullRequest>

    <!--Envelop -->

    <!--Payload -->

    <!--Signature -->

    <PullType>Request</PullType>

    <ResponseTimeOut>1000</ResponseTimeOut>

    <Requests>

        <ExpectedResponseTime>32</ExpectedResponseTime>

        <MaxEntitiesPerMsg>100</MaxEntitiesPerMsg>

        <MaxNumberOfRequests>1</MaxNumberOfRequests>

        <QueryByExampleType>BestEffort</QueryByExampleType>

    </Requests>

</PullRequest>
```

Request information only once

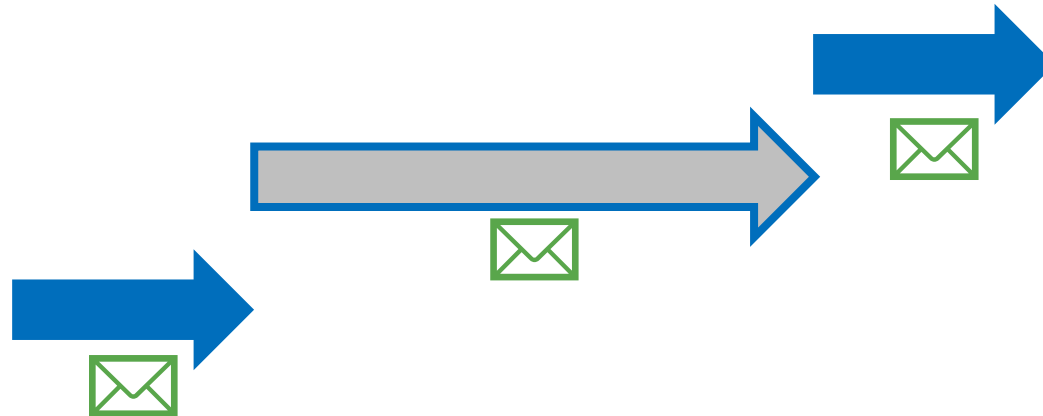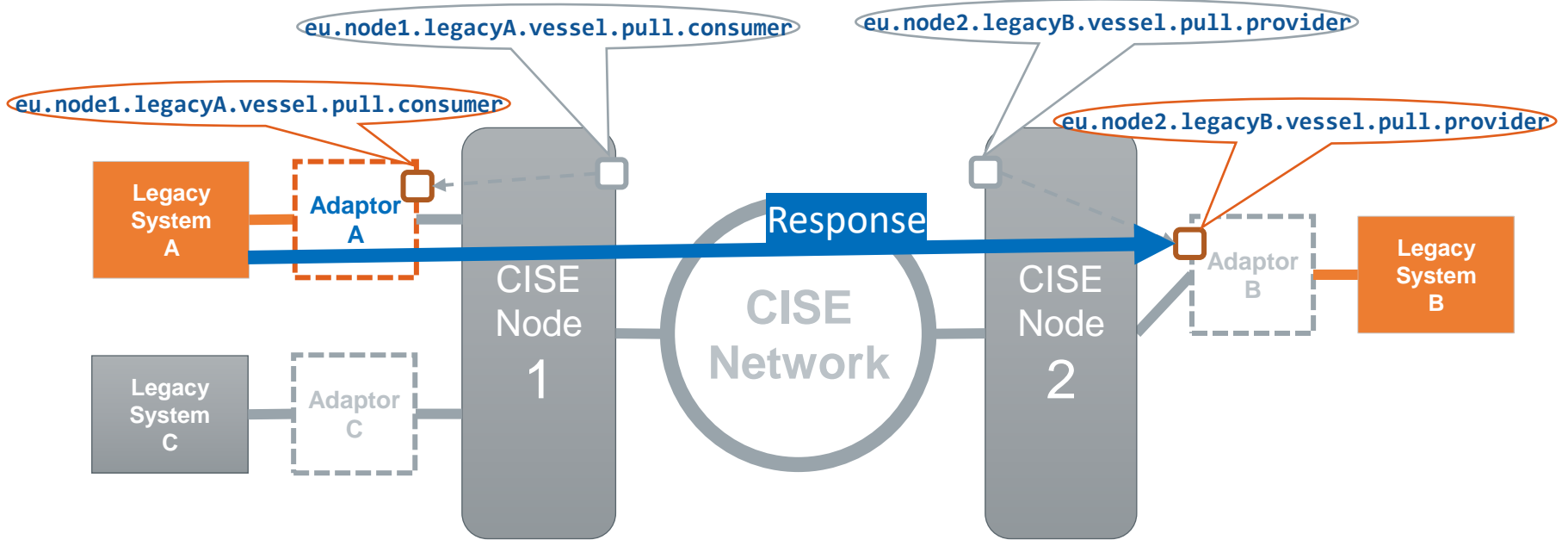I will wait 1000s for the response

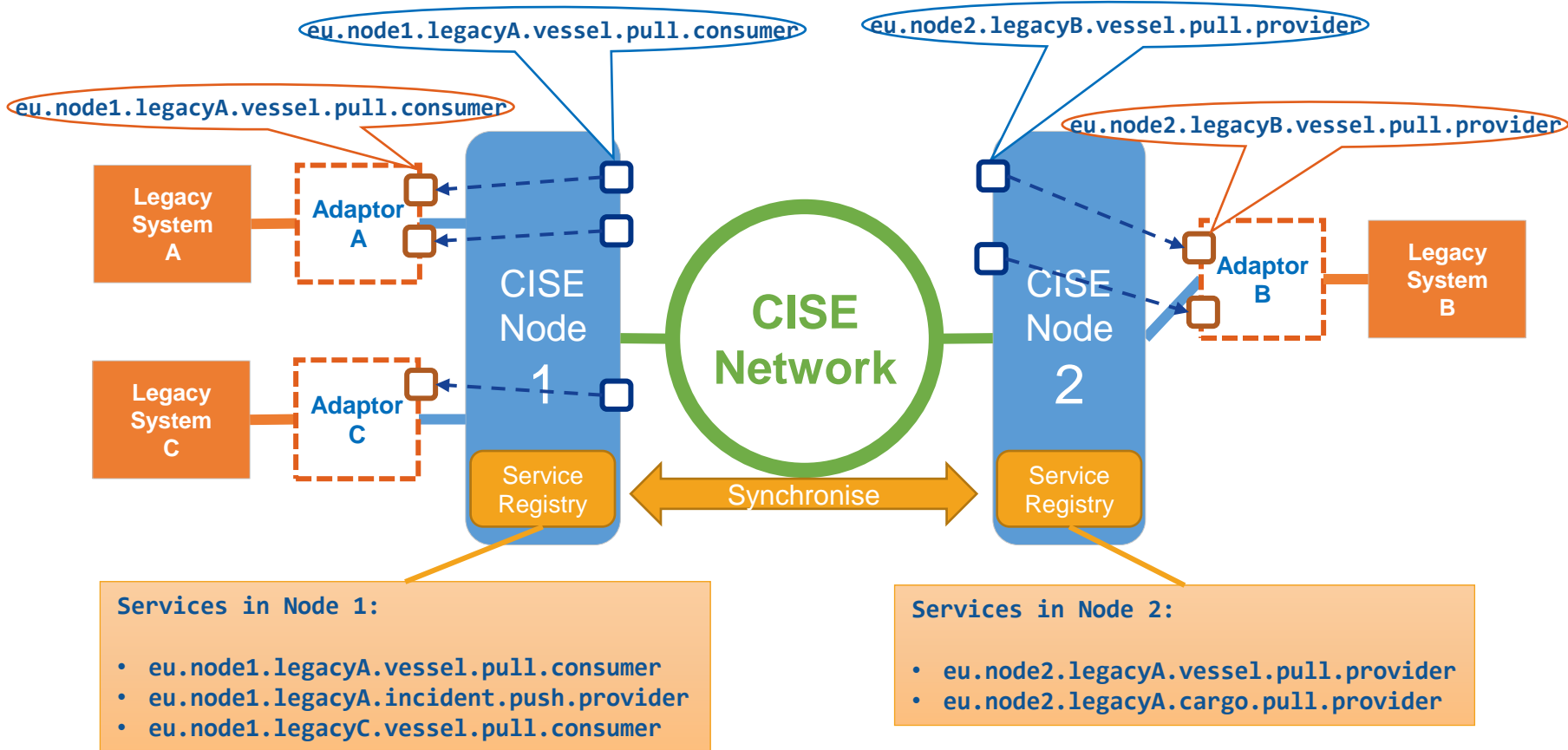# How information exchange works

How information exchange works

How information exchange works

The CISE Network

EMSA
European Maritime Safety Agency

CISE

Developed during EUCISE2020 (2014-2019)

- Unclassified Network, still secure for sensitive information
- VPN over the Internet
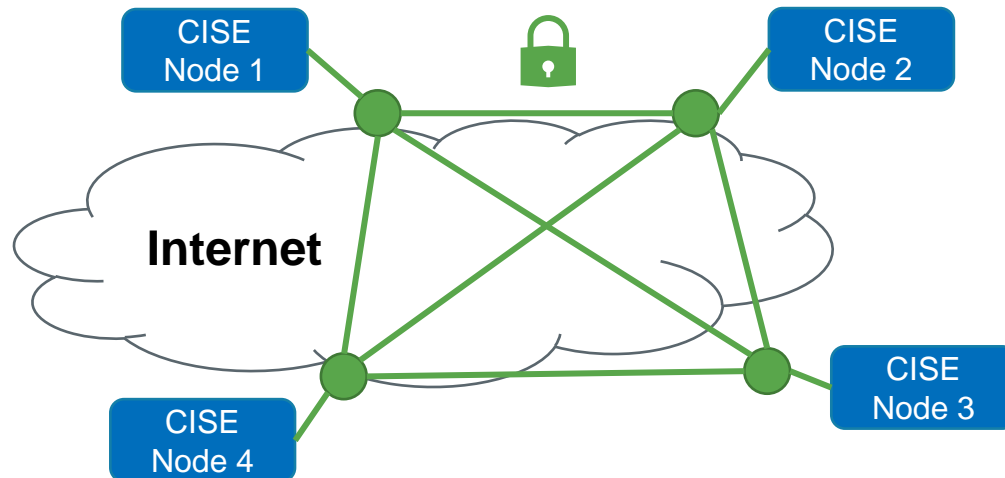
Status

- 12 nodes from MSs and EU agencies

- 25 ICT systems covering all the 7 different maritime sectors

The CISE Node

twitter.com/emsa_lisbon
facebook.com/emsa.lisbon

EMSA
European Maritime Safety Agency

CISE

Version 1 – EUCISE 2020 (2018 - 2021)

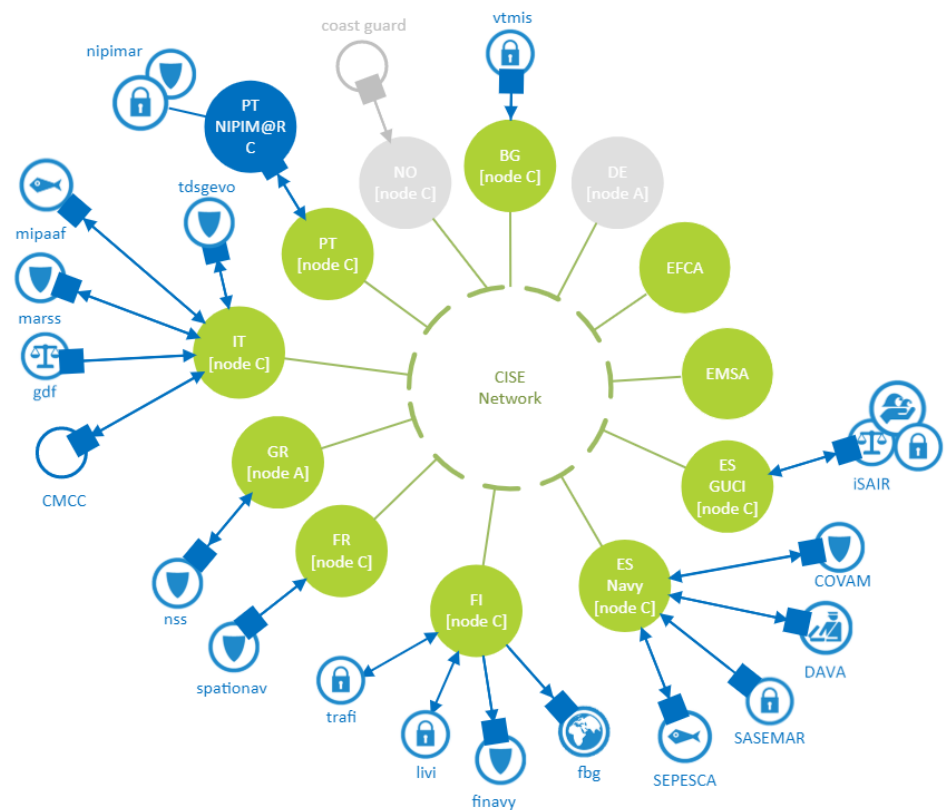- **Core Services**: Infrastructure services that enable the connection of the Participants (Legacy Systems)

- **Common Services**: Capabilities to exchange information in the network using the CISE Data and Service models

- Developed by a group of companies (RTI)
  - Java technology stack (Java 8) and several auxiliary subsystems

- Tested in the EUCISE 2020 project

Version 2 – Transitional Phase (2021-)

- Developed by JRC/EMSA (+ European Dynamics)
- Core and Common services
- Backward compatible with adaptors
- Cannot work with version 1

New | **microservice architecture**

infrastructure based on Kubernetes

technology stack

Microservices – Message workflow

Microservices – Administration Console

CISE Node - External interfaces

Adaptor

CISEMessageService ⬌ Messages ⬌ CISEMessageService

Health ⬌ Status

CISE Node

CISEMessageService ⬌ Messages

Sync ⬌ Services

Health ⬌ Status

CISE Node

Interface Node-Adaptor

Interface Node-Node

Project funded by the European Union

CISE Node - Infrastructure

Server / Cloud

Kubernetes / RKE

Cluster – CISE Node

Microservices

Submission Agent
[Software System]

quarkus.io, SOAP

Service Registry
[Software System]

quarkus.io, REST,
PostgreSQL

Subsystems

PostgreSQL

Kafka

Pod | Pod | Pod | Pod | Pod | Pod | Pod * | Pod *

Pod network

control plane | etcd | worker | worker | worker | worker

VM | VM | VM | VM | VM | VM | VM | VM | VM *

VLAN(s)

Project funded
by the European Union

CISE Node – Deployment view

X.X.X.0/16

CISE Network

CISE Node

Network segment	X.X.Y.0/24
Top-level domain	**de**
Node ID	**de.node**

CISE Node

Network segment	X.X.Z.0/24
Top-level domain	**pt**
Node ID	**pt.node**

CISE Node – Deployment view

* incomplete diagram

Microservices

- Java 11

- Quarkus.io framework

- Angular (+ MaterialUI)

Infrastructure + Subsystems

- RKE (Kubernetes)

- Longhorn

- Rancher

- Kafka

- PostgreSQL

- Prometheus + Graphana

- Keykloak

- ELK (ElasticSearch stack)

- and others

CISE Node in the Transitional Phase

EUCISE 2020

CISE Transitional Phase

Version 1

Maintenance

Roll-out

Version 2

Development

Evolutive Maintenance

2.0   2.1   2.2   2.3   2.4

First version
- Same functionalities as v1
- Backward compatible with adaptors

New versions with updates and new functionalities

CISE Node v2 - Roll-out
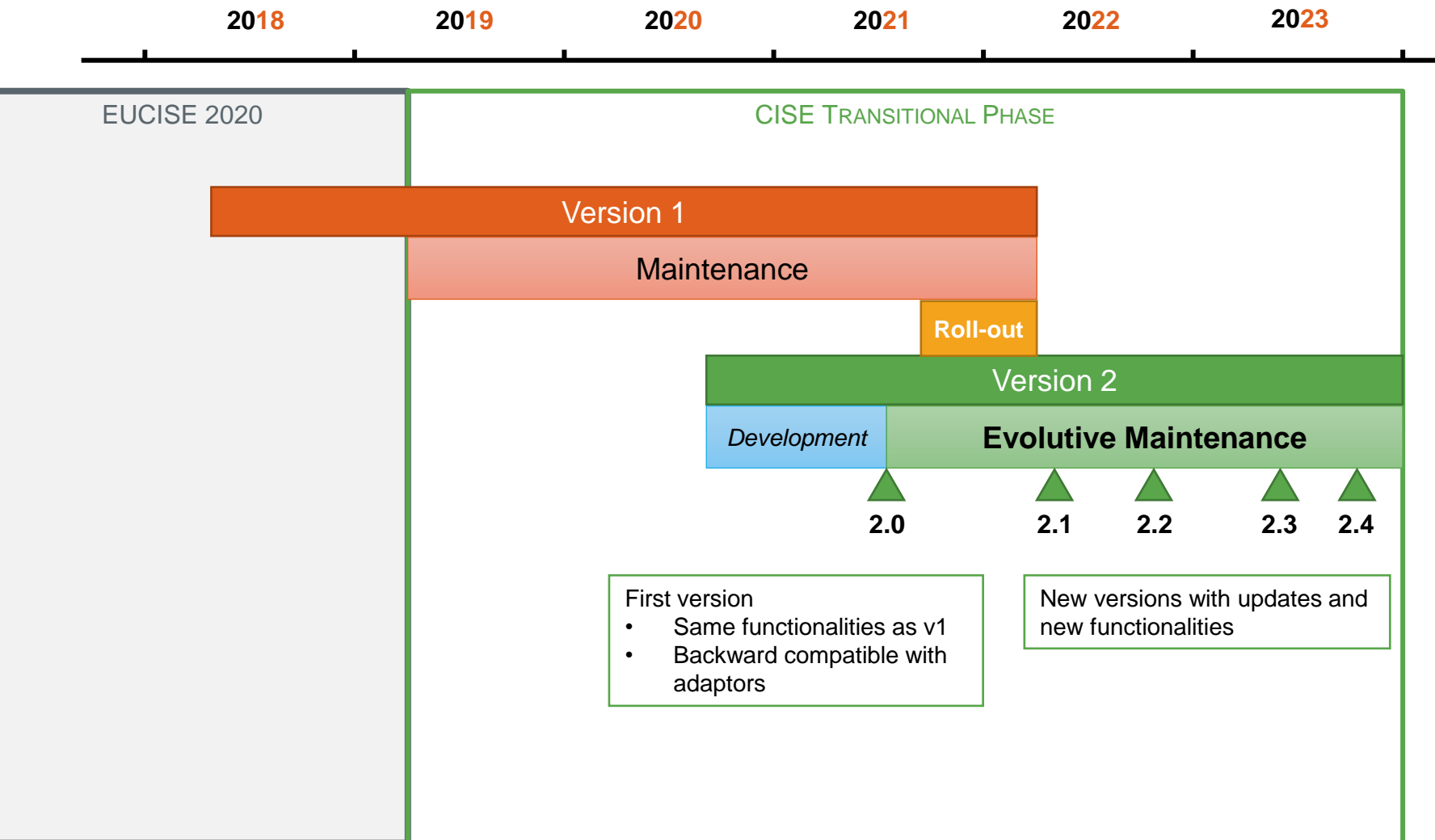
EMSA

mss@emsa.europa.eu

Installation request

3+1 STEPS, FULL SUPPORT

Preparation	Installation	Operation	Decommissioning (optional)
• Preparatory meeting • Information gathering • Create and test infrastructure • Configure and test CISE VPN	• Installation process (automatic) • Test of the software	• Connect node to CISE Network • Configure adaptors • Configure services • Training	• Uninstall Node v1 • Remove old infrastructure
1 - 4 weeks	**1 week**		**1 day**

Support from EMSA/JRC

CISE

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