# Operation Preparation Environment (OPEN)

Workshop on Simulation and EGSE for Space Programmes (SESP 2017)
ESA-ESTEC, Noordwijk, The Netherlands

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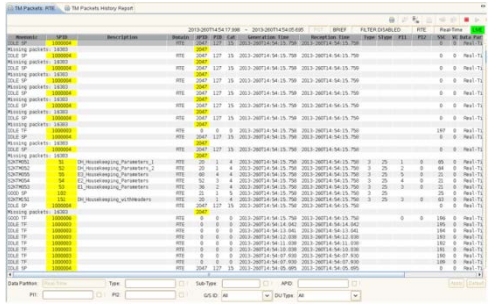
ADM-Aeolus
BepiColombo
Cluster II
Cryosat-2
EarthCare
Euclid
ExoMars TGO 16
ExoMars ESP 20
GAIA
GALILEO LEOPs
Integral
LISA Pathfinder
Mars Express
METOP-C LEOP
Seosat
Sentinel-1A
Sentinel-1B
Sentinel-2A
Sentinel-5P
Sentinel-3A
Sentinel-6
Solar Orbiter
Swarm
XMM-Newton

# OPEN - Tailoring data

## Operators defined data consumed by the ground data systems

Such as

- Monitoring and Control models of the controlled system
- Data structures exchanged with the controlled system (e.g. TM/TC packets)
- Operations Procedures (manual, automated, on-board)
- Expressions, derived parameter definitions
- User Defined Displays (alphanumeric, scrolling, matrix, plots, mimics)
- Sequences
- Mission planning rules
- Timelines, schedule templates
- Simulator set-up scripts
- ...



# OPEN - Context

- No coherent and complete solution supporting the mission operators in their tasks related to operations preparation
- A large variety of tools which cannot be easily integrated and follow different technologies, governance cycles & principles
    - Some tools are proprietary
    - No synergy between the spacecraft and ground station operators communities
- Significant effort to generate and manage the mission information artifacts
- Effort to develop a fully fledged solution covering all use cases in a way which enables an effective user productivity is considered very high
- Future generation missions will be based on the new mission control system kernel (European Ground Systems Common Core - EGS-CC) and associated data model

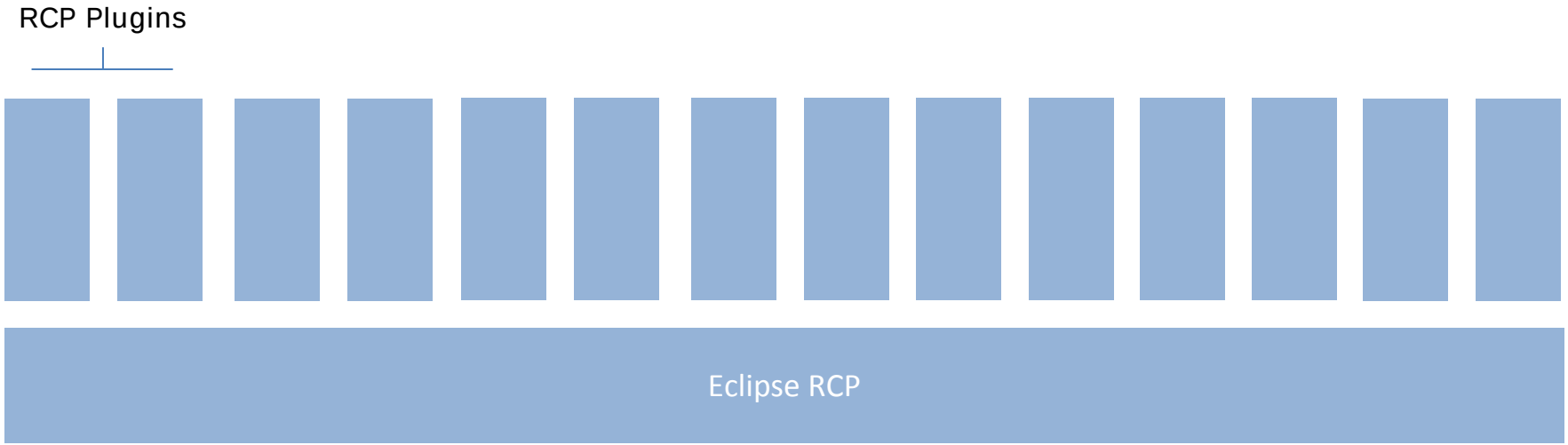
# How can we improve?

# OPEN - Objectives

- The ideal goals of an Operation Preparation Environment are:
  - streamline the mission operations preparation activities and enable a reduction of the required efforts by operators
  - provide a consistent environment where all applications related to operations preparation can be hosted and avoid proliferation of heterogeneous implementations
  - harmonize the tools used by the spacecraft and ground stations operations teams
  - extend the support of advanced features (e.g. configuration management) to all artifacts related to mission operations
- A secondary objective is to support the transition from the current generation Mission Control System Infrastructure (SCOS-2000) to the future generation (EGS-CC based) of ground data system infrastructure

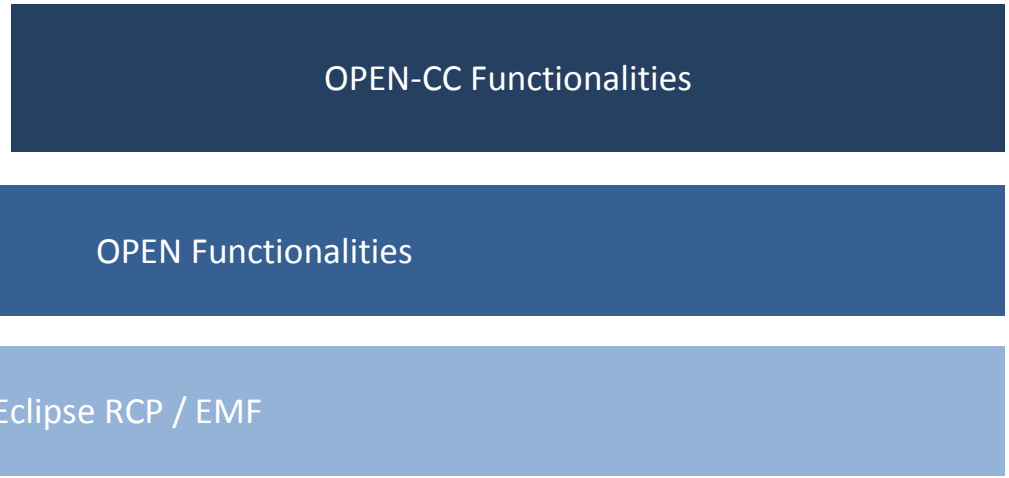
A rich client platform (RCP) is a programmer tool that makes it easier to integrate independent software components

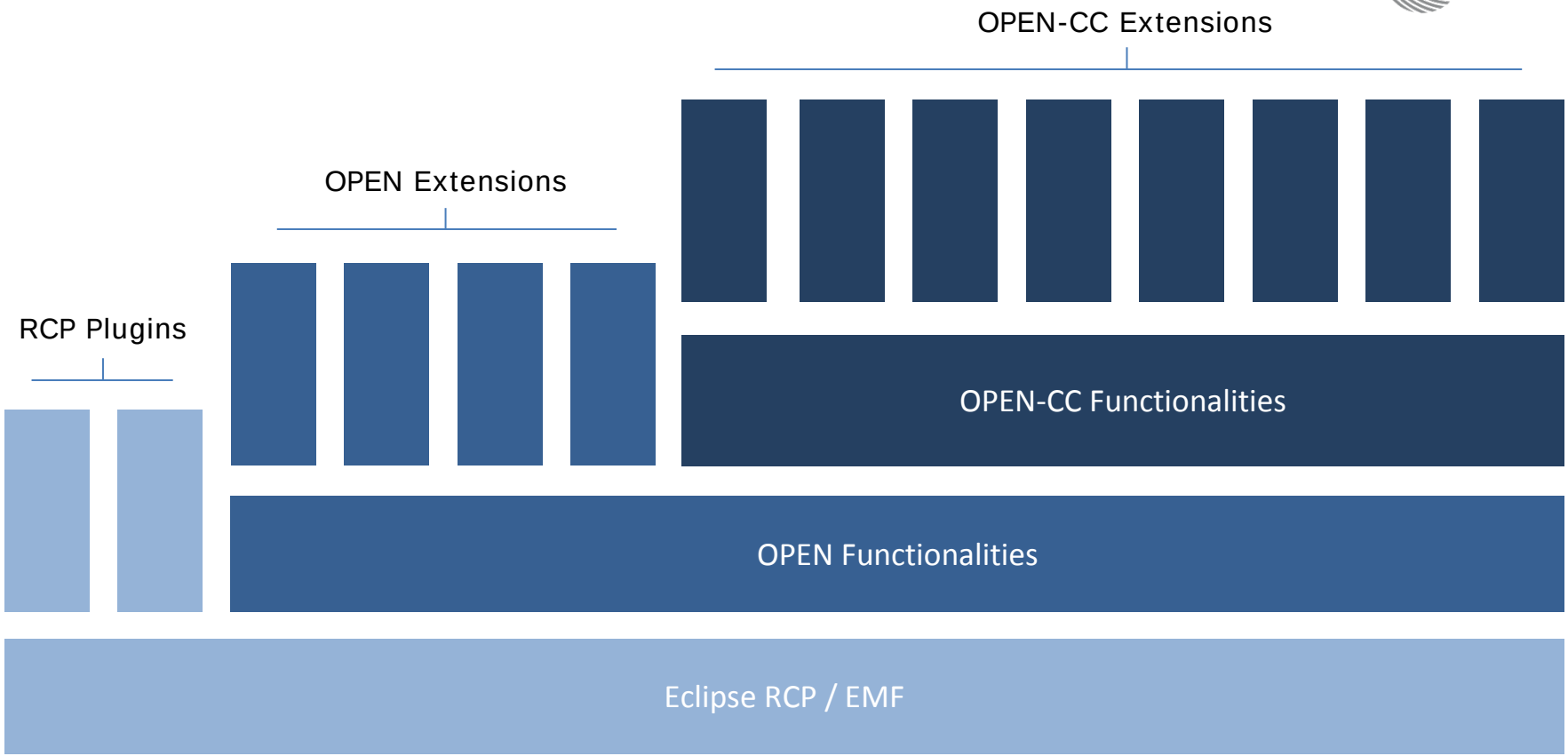
Eclipse RCP


RCP Plugins
Eclipse RCP

OPEN Functionalities

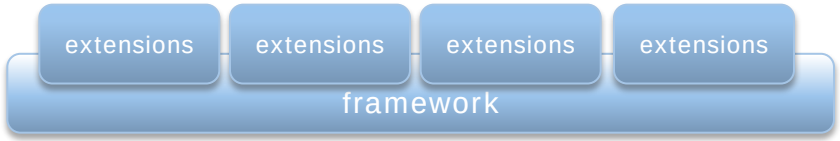
Eclipse RCP / EMF

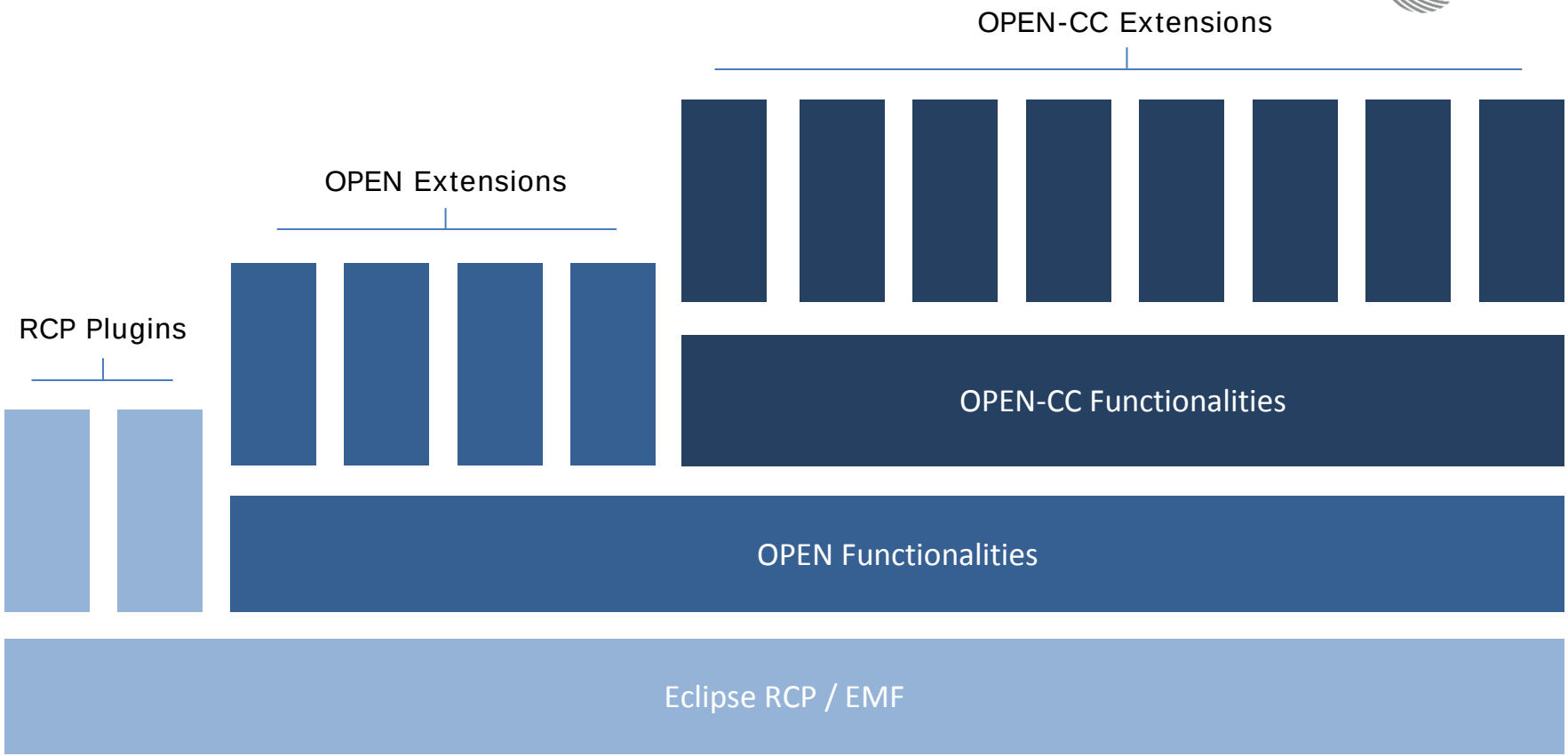

OPEN-CC Functionalities
OPEN Functionalities
Eclipse RCP / EMF


OPEN-CC Extensions
OPEN Extensions
RCP Plugins
OPEN-CC Functionalities
OPEN Functionalities
Eclipse RCP / EMF

# OPEN – Core principles

- The basic idea is to define, develop and deliver a unified environment where all operators tasks related to mission operations preparation can be efficiently supported
- The environment will support the ability to deploy specialised ‘extensions’ which are specific of a given data type but interact with the framework e.g. to make use of data sets generated by other extensions
- The OPEN framework will support the common operations for all data types of operators relevance
- The strategic agreement is that the framework will support the EGS-CC data model to serve the future generation missions (EGS-CC based)
- The extensions providing the actual ‘user front-end’ functionality may originate from several sources (funding and organisational)

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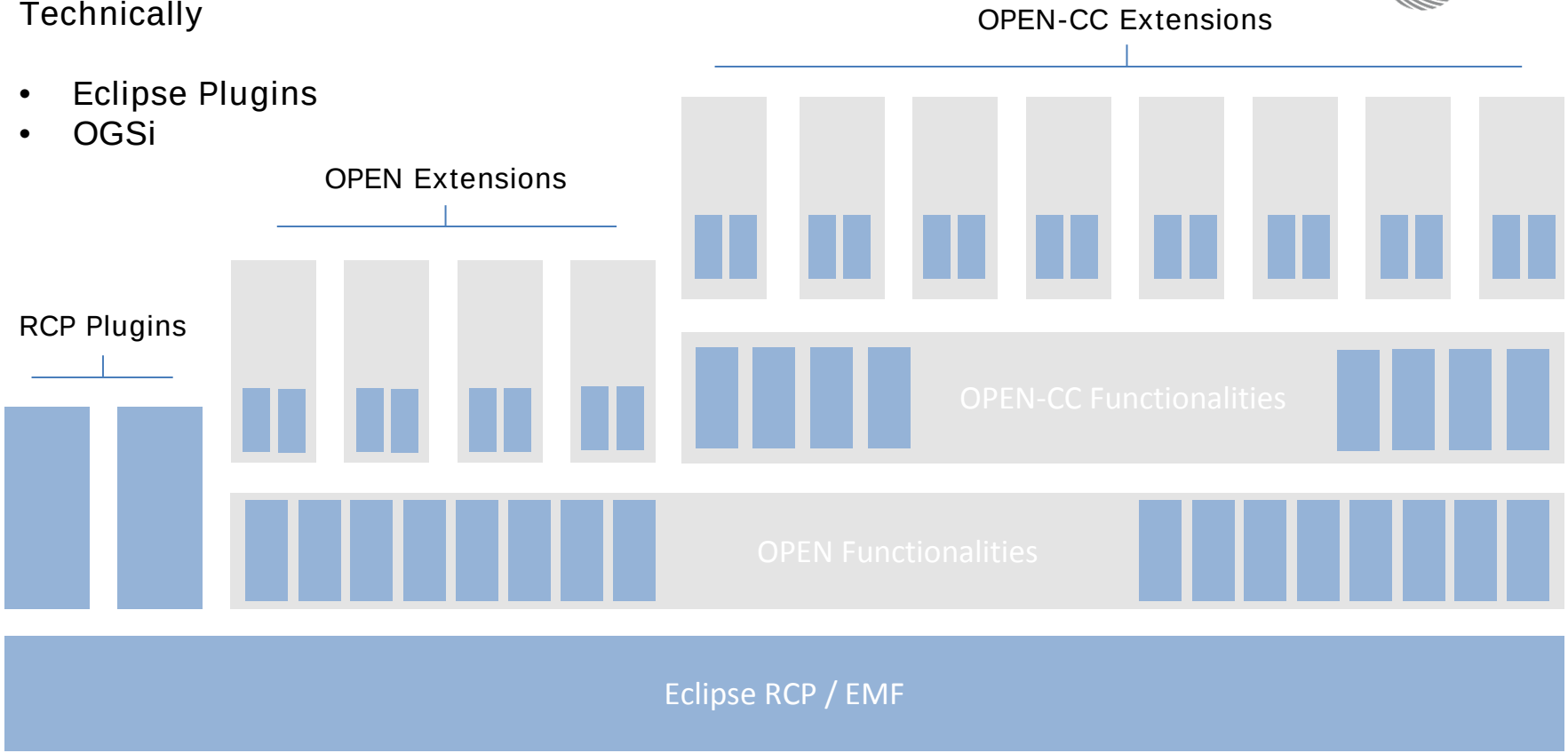
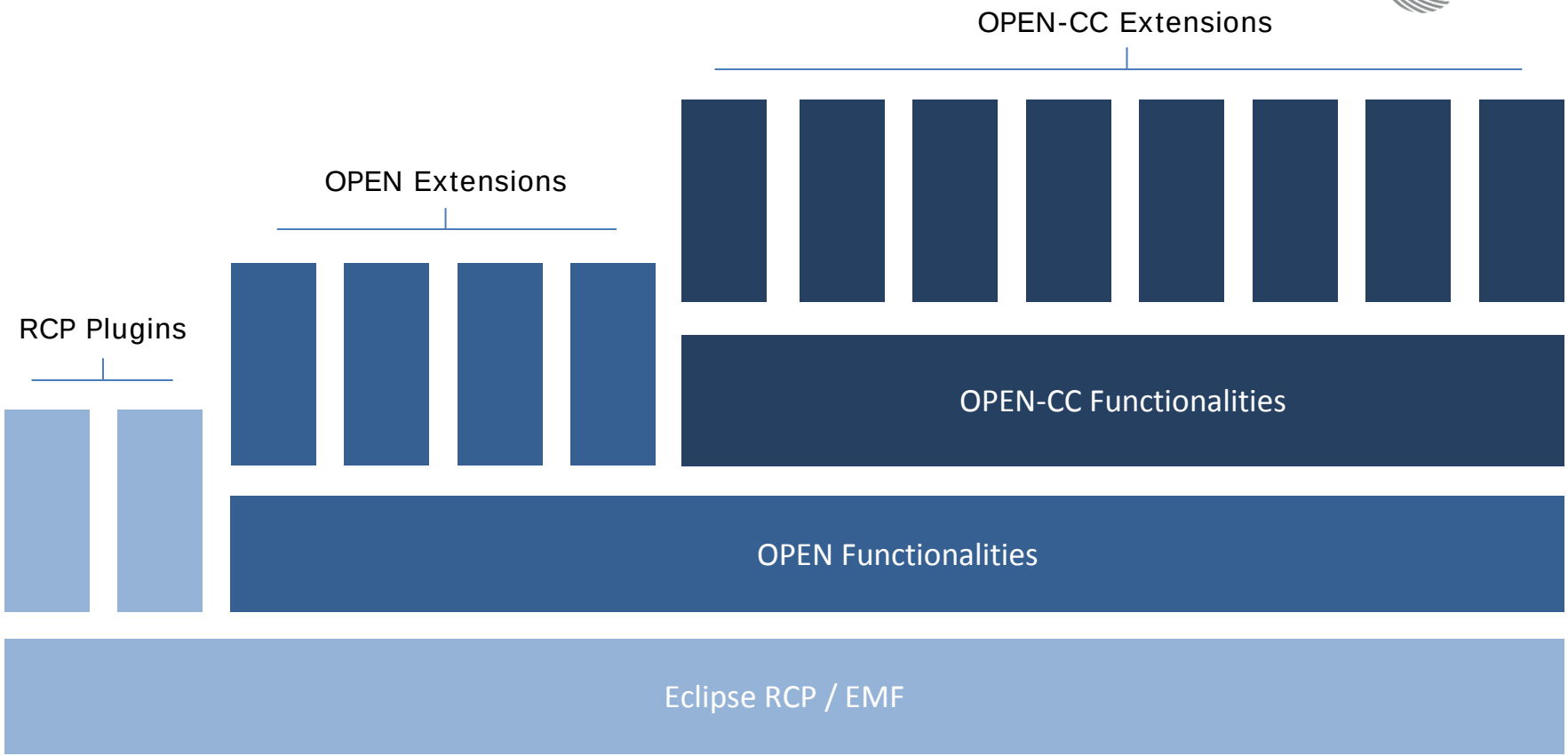
Technically

- Eclipse Plugins
- OGSi

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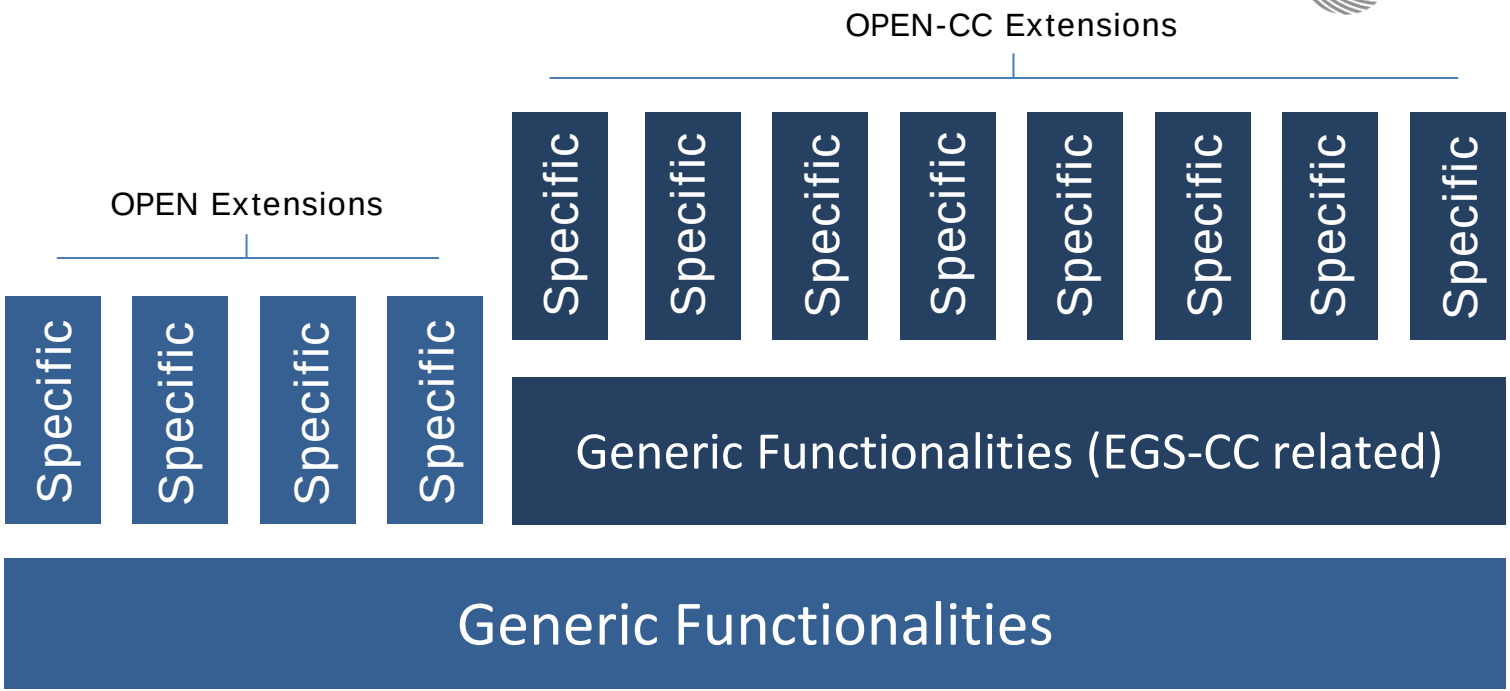
OPEN-CC Extensions
Specific
Specific
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OPEN Extensions
Specific
Specific
Specific
Specific
Generic Functionalities (EGS-CC related)
Generic Functionalities

# Functionalities

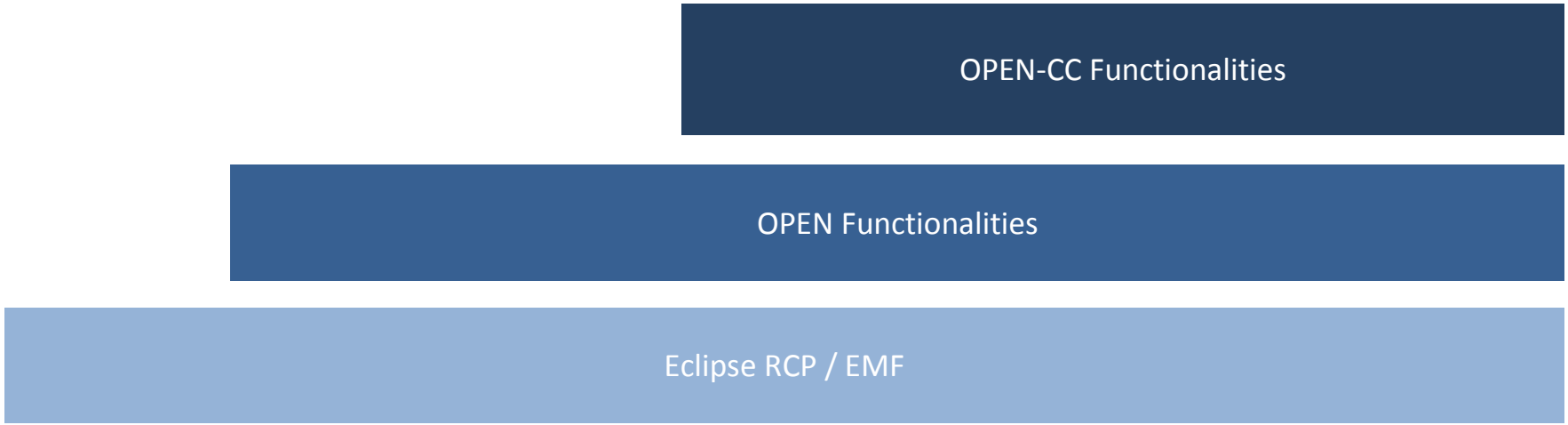
- Version Control
- Workflow Management
- Import/Export
- Data/Model Migration
- Model Explorer, Search
- Consistency Check Management
- Generic Model Object Editor
- Compare & Merge (also EMF)
- Model query, batch processing
- Dependency exploration
- Diagramming
- User Management
- ..

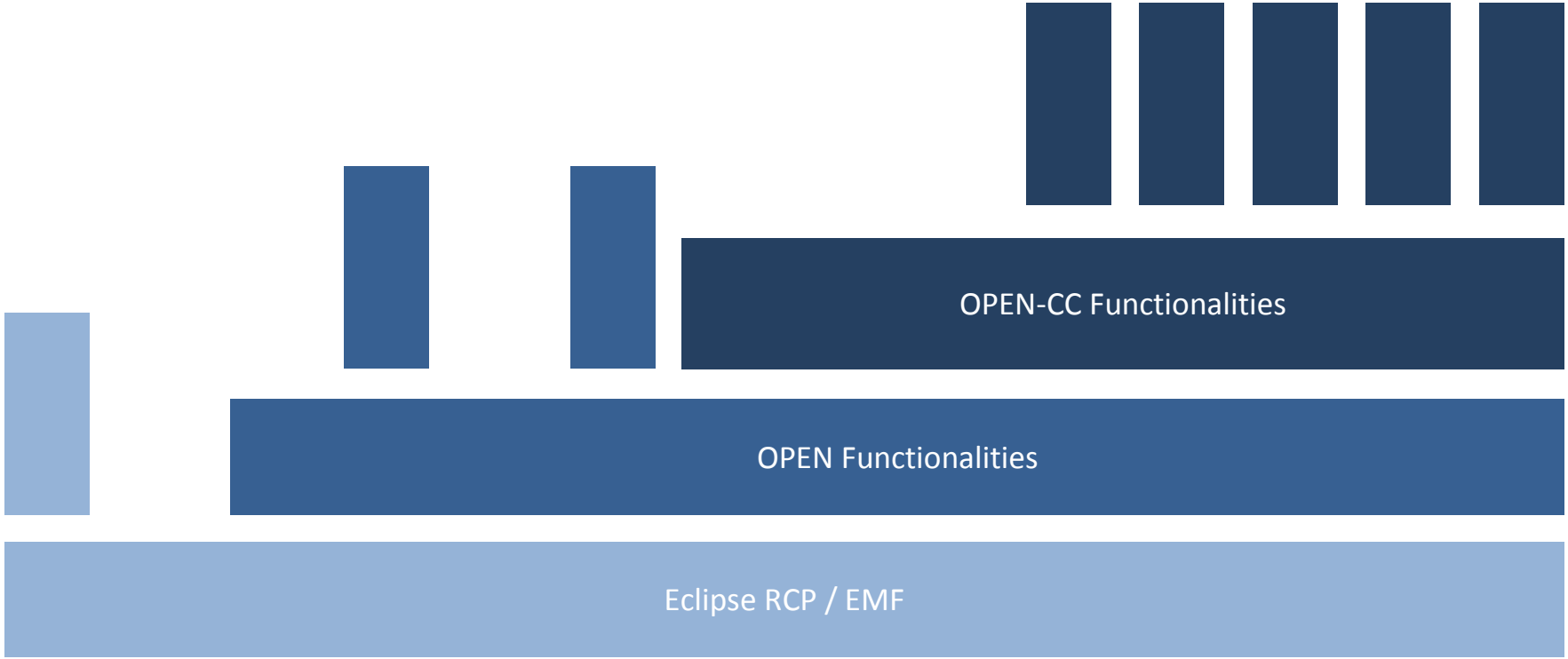
- EGC-CC CDM Data Management
- CDM Views (MCM View, CI View, Category and QUDV Model View, ..)
- Monitoring & Control Data Definitions
- Constraints Management (OCL) – CDM Check, Mission Specific Checks
- Data Management in CI Groups and CI Assembly
- Mapping Management
- CDM Search
- ..

OPEN-CC Functionalities

OPEN Functionalities

# How can this be used?

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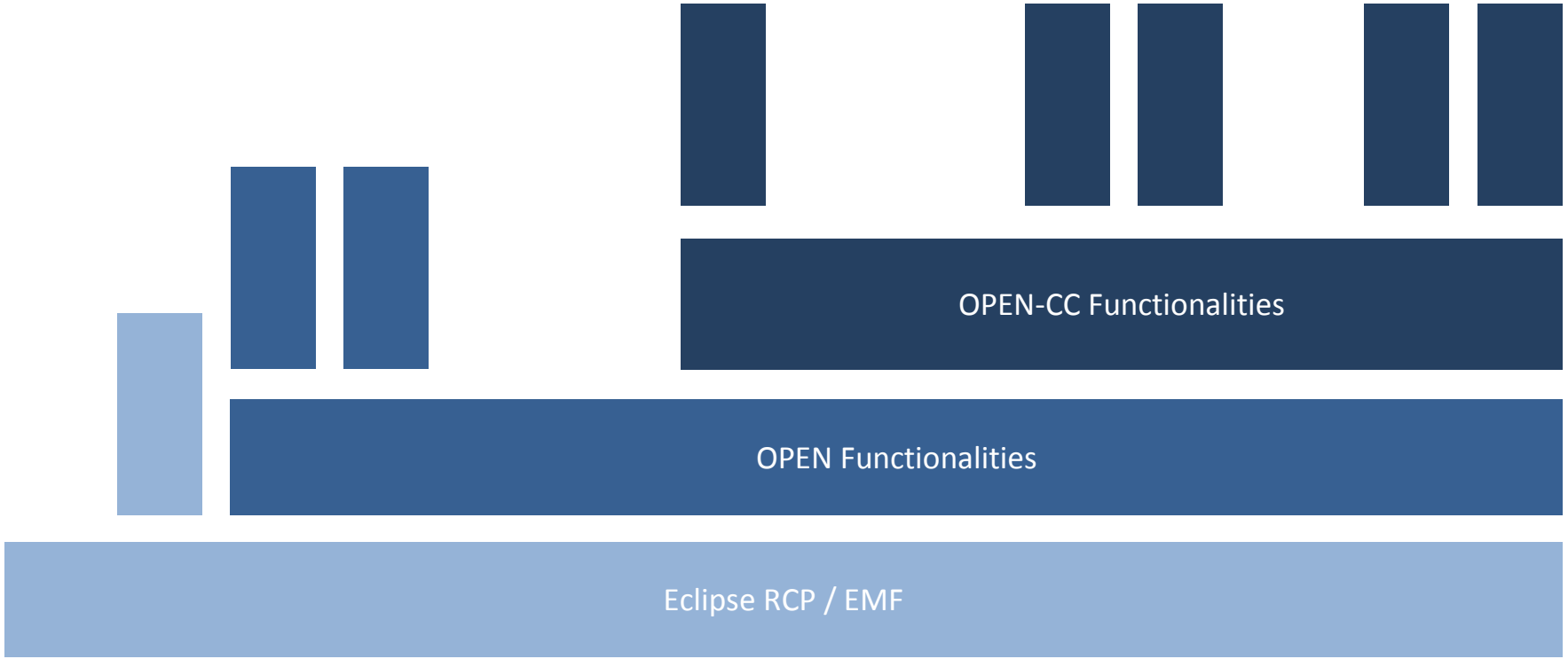
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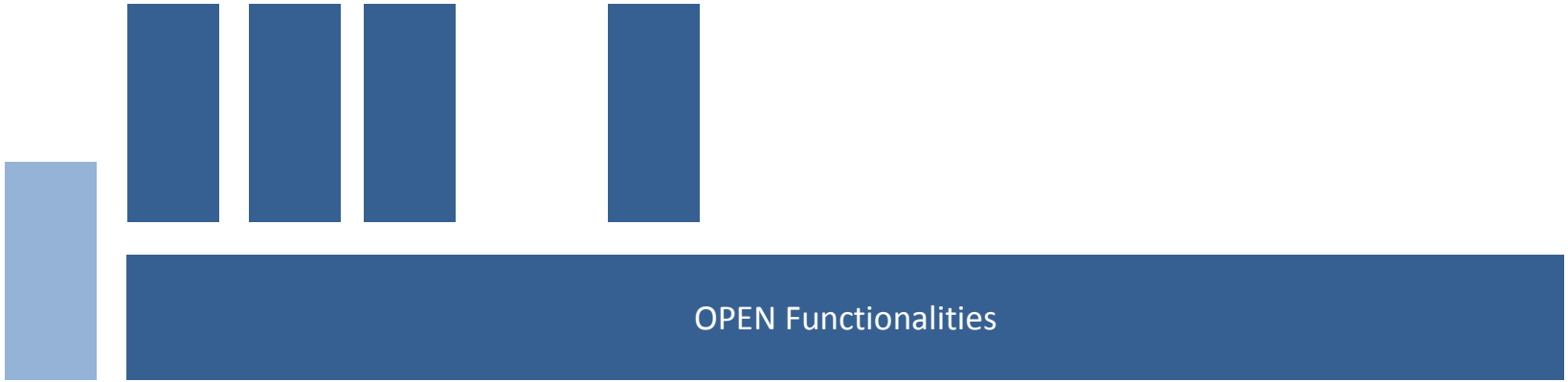
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# OPEN - Deployment and application

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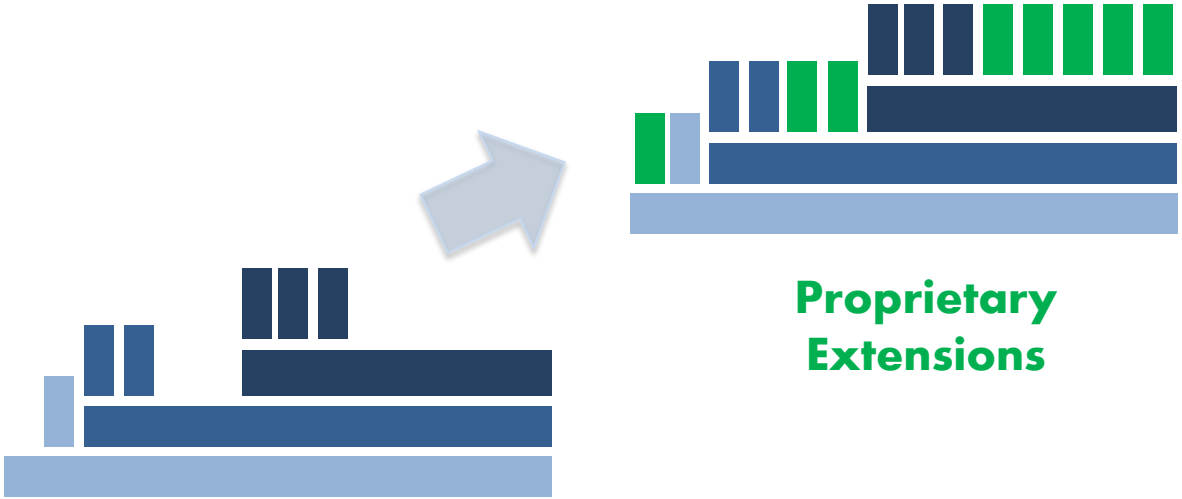

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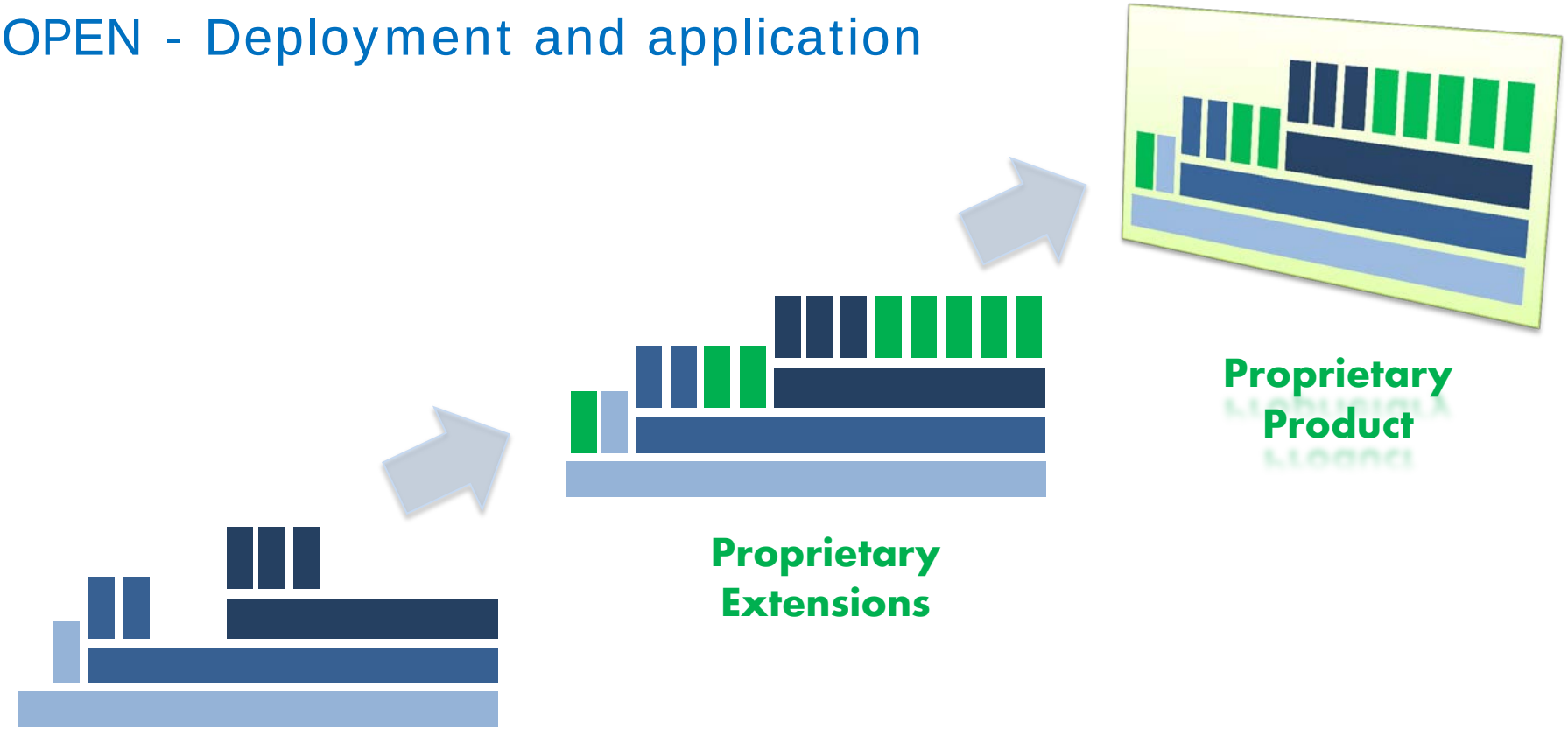
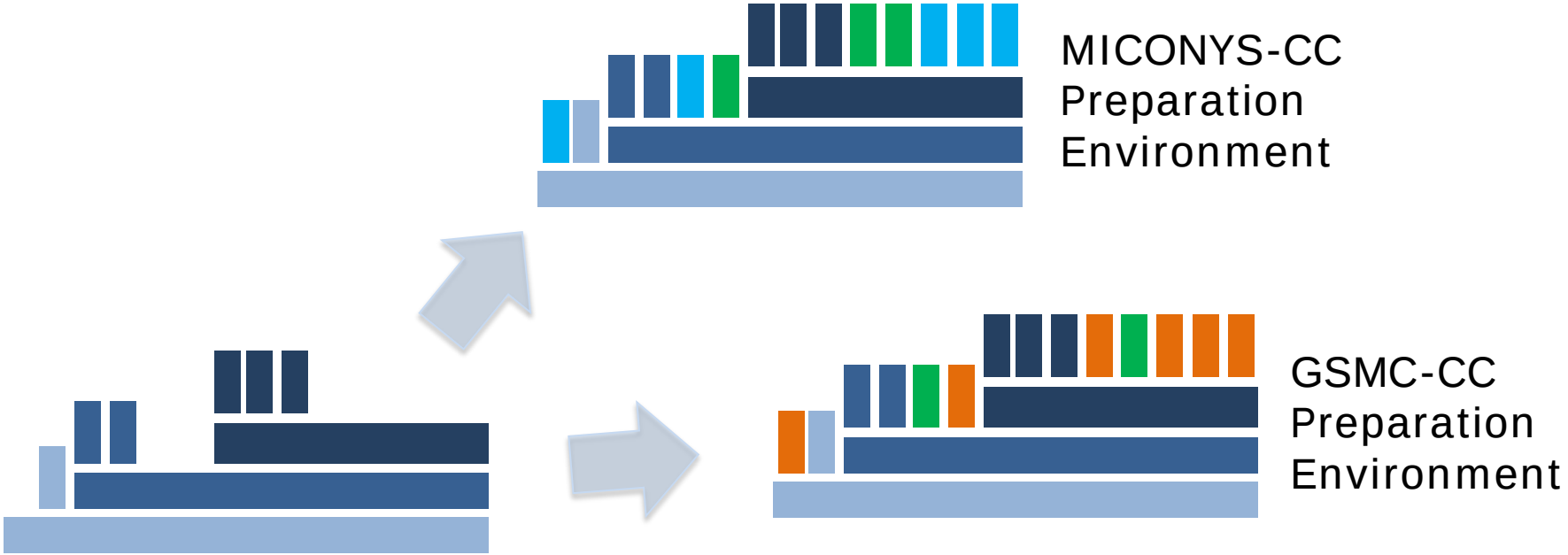
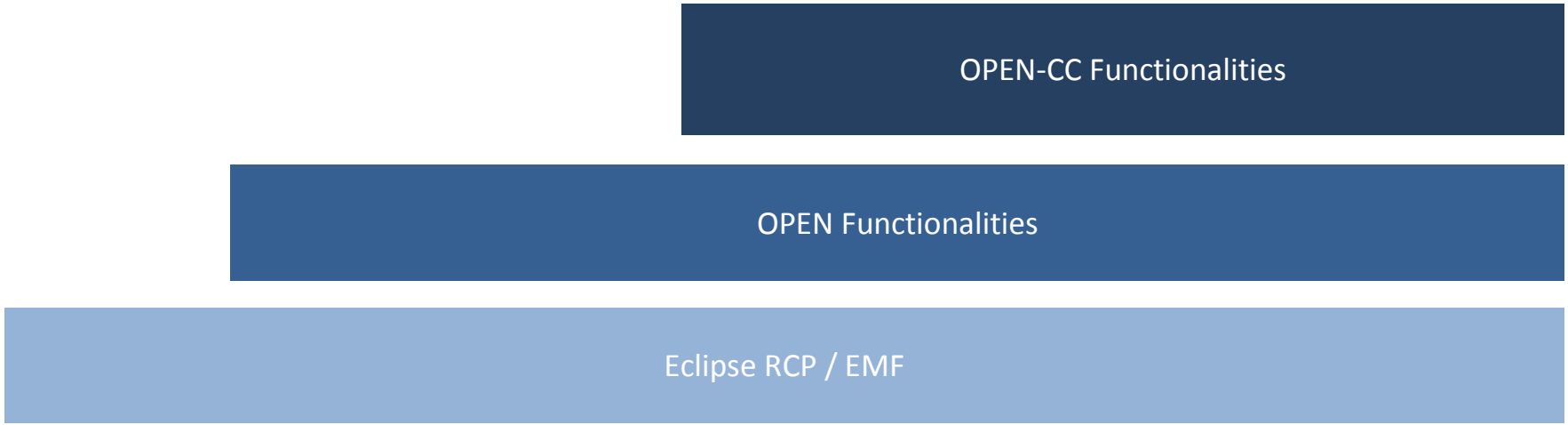


# ESOC Preparation Environments



# Where is the novelty?



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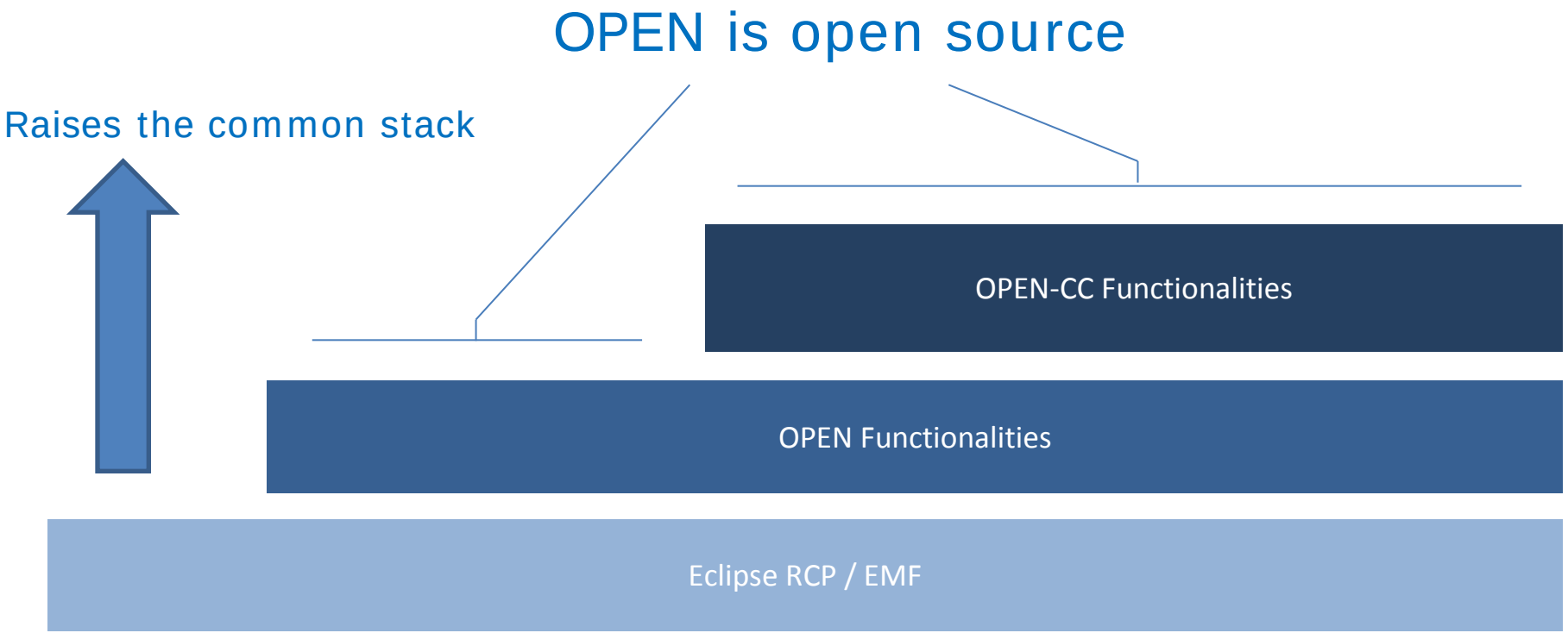


# OPEN - Implementation

- The framework is implemented in Java with compatibility to Linux, macOS and Windows
- Using a model based development approach, the framework relies on the Open Services Gateway initiative (OSGi) modular system and the Eclipse Rich Client Platform
- OPEN Extensions are developed as set of Eclipse plug-ins
- OPEN's data is stored and exchanged using a distributed version control system
- The framework is to be used as backbone framework for specific preparation environments, such as for
    - MICONYS-CC (spacecraft operations)
    - GSMC-CC (ground station operations)
- Final applications are delivered to users as desktop applications

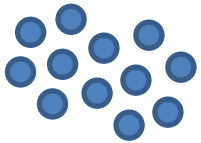
# OPEN – Example of basic functionality

- Version Control : Distributed revision control system (DRCS)
- Allows users to work productively when not connected to a network
- Communication is only necessary when sharing changes among other peers
- Numerous different workflows are possible
    - One or multiple "central" repositories possible
    - Permits centralised control of the data
- Full traceability,
    - between partner organisations
    - between members of the same team
    - --> Allow efficient exchange (comparison and merge)

# Distributed data management

Organisation A (e.g. phase C/D)

Organisation B (e.g. phase E, ESOC)



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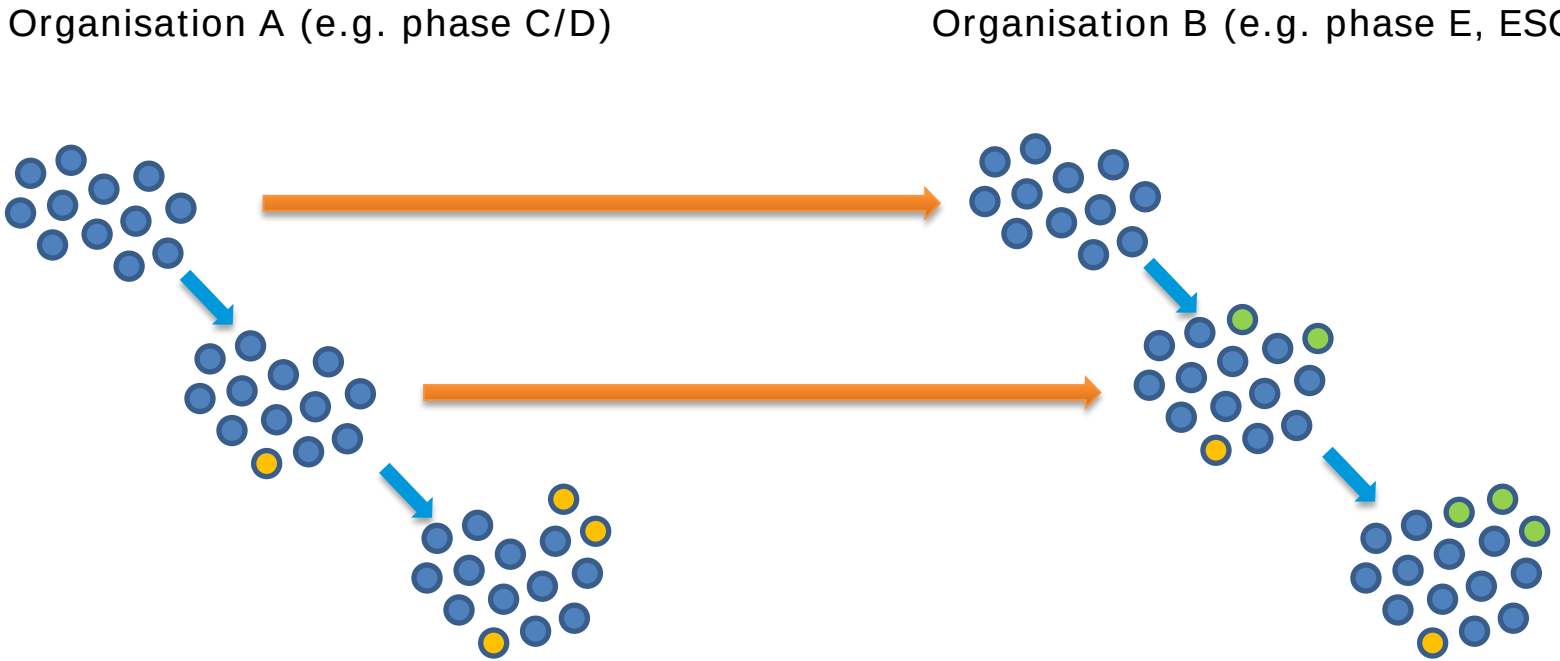

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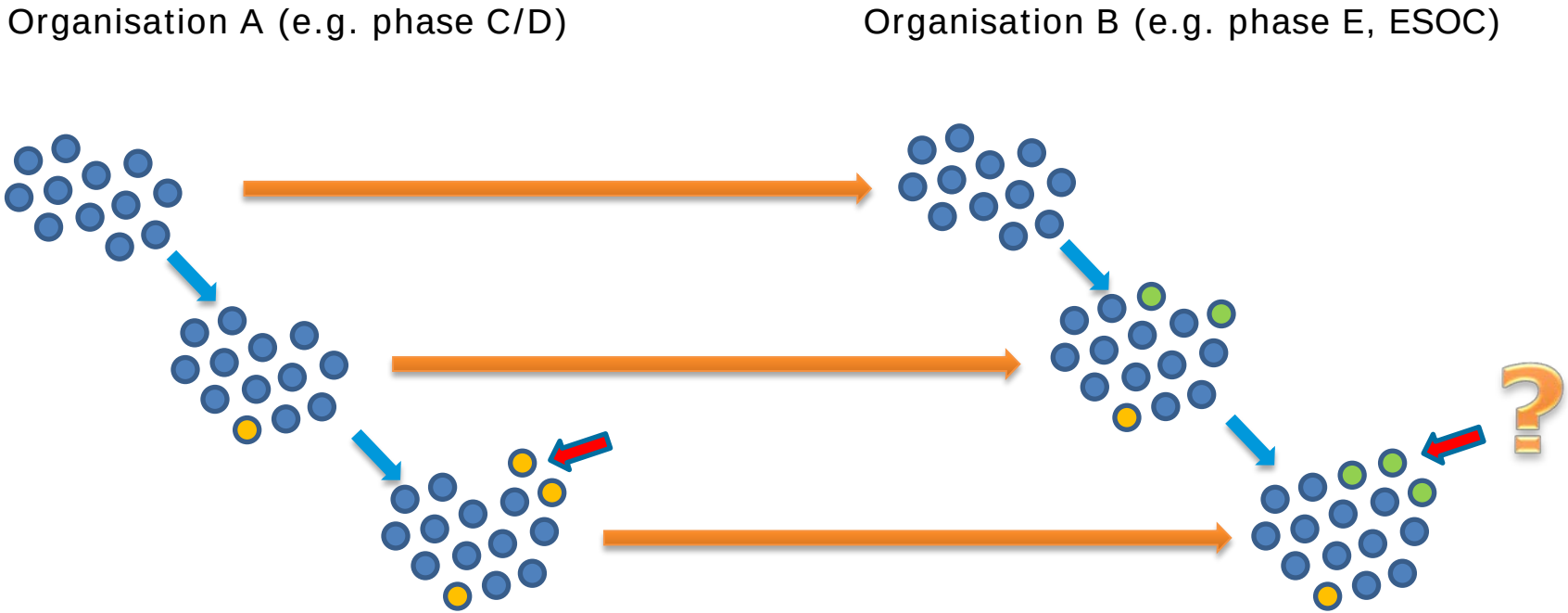

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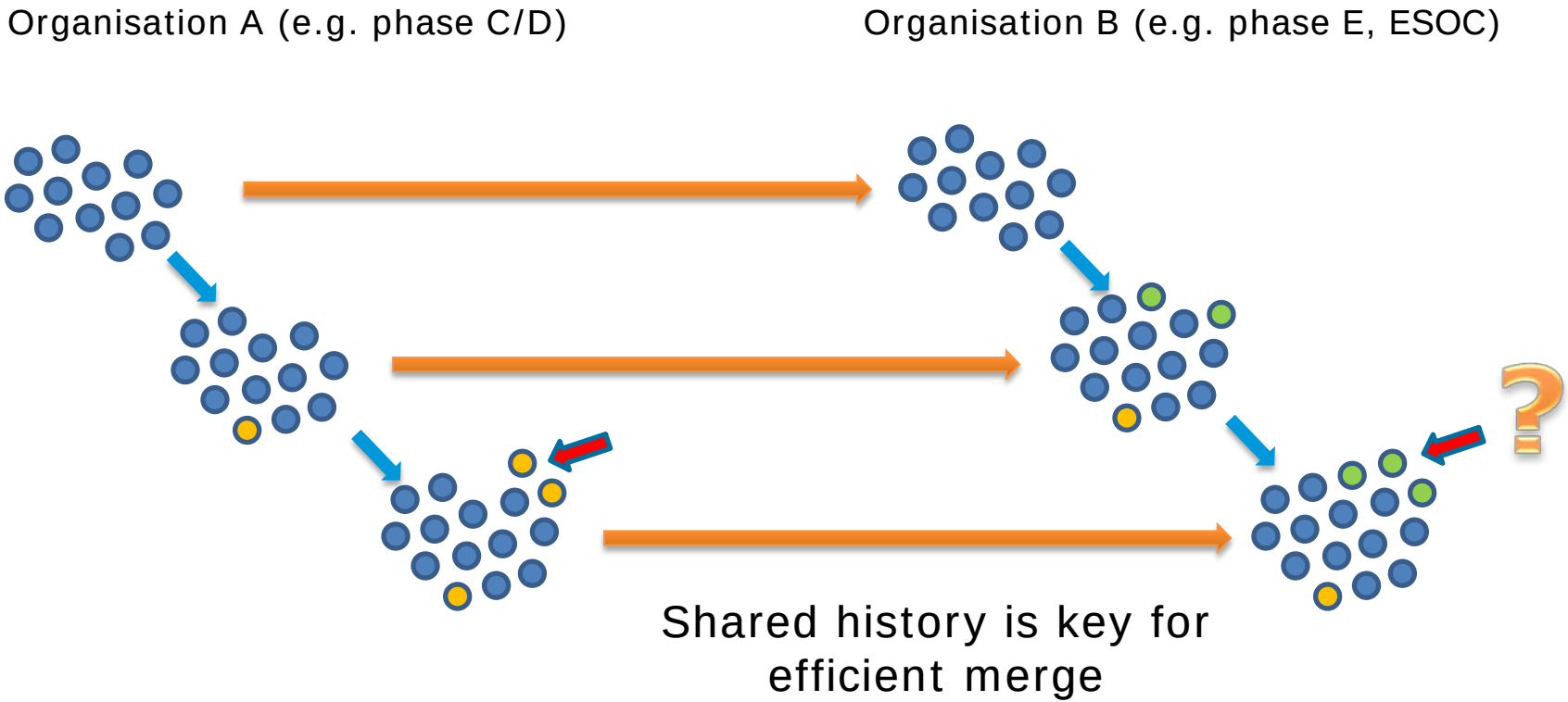

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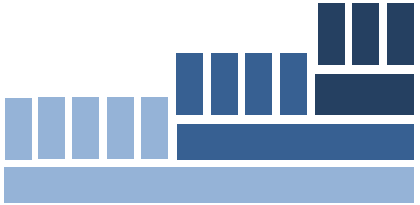

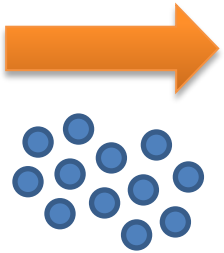

How to share the history?

# Distributed data management

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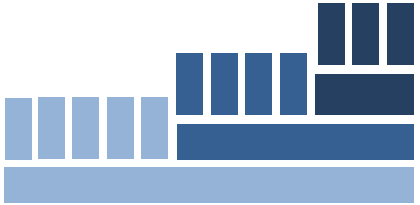

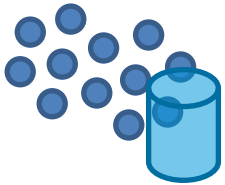

A centralised repository for everyone?

# Distributed data management

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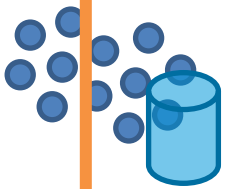
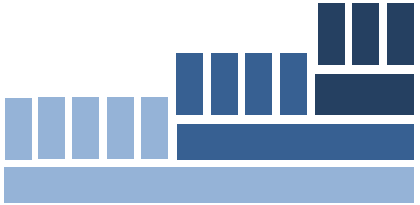


Organisation B (e.g. phase E, ESOC)



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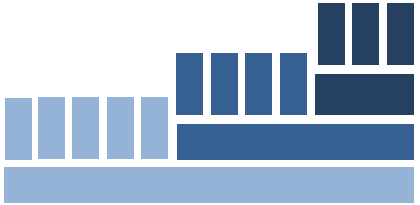

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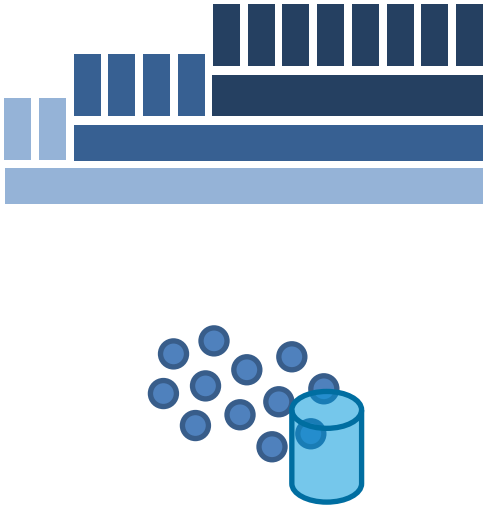

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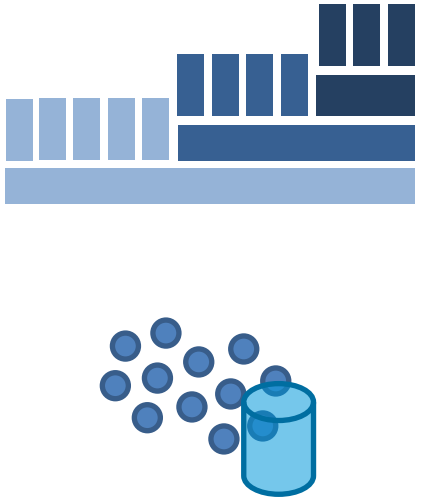

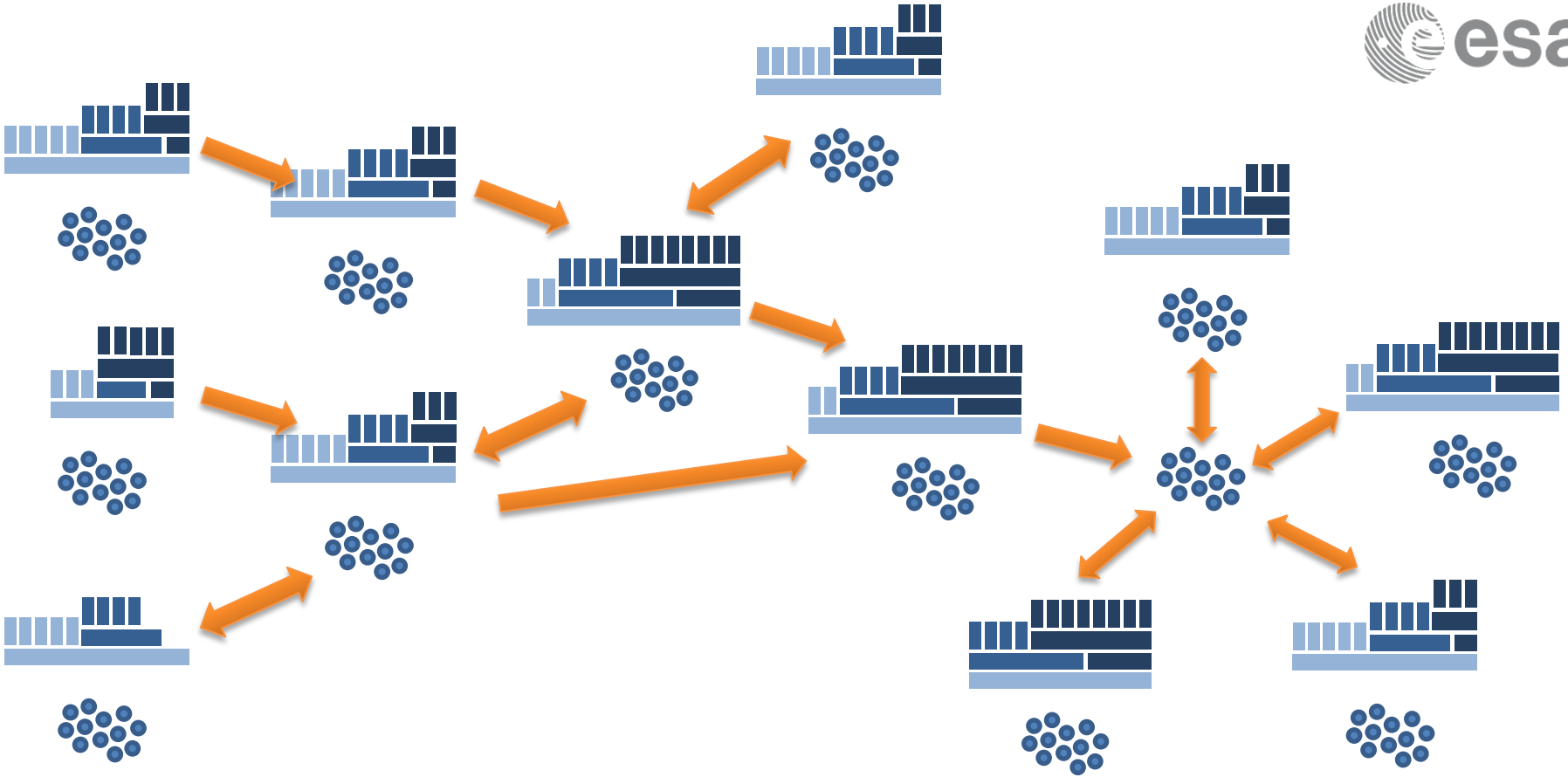

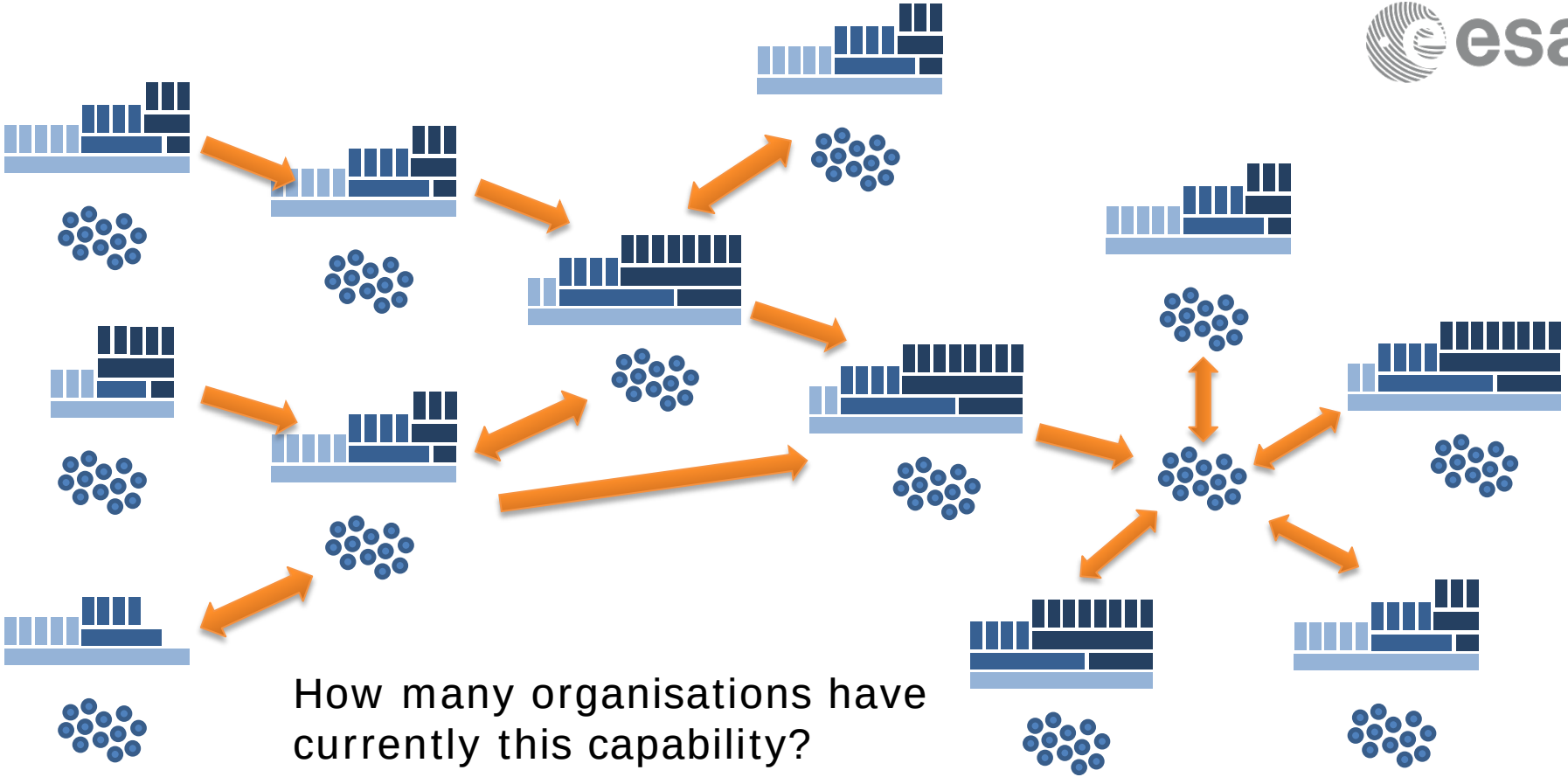
How many organisations have currently this capability?

# OPEN - Timeframe

- Overall Specification and Design finished
- Reusable prototyping done with previous and on-going activities
- Implementation starts 04/2017 with multiple companies
- Agile development with multiple releases in 2017 and 2018

# OPEN – Conclusion

- Operation Preparation Environment (OPEN)
  - New modern software framework
  - Goal: Provision of streamlined, consistent, unified preparation environments for spacecraft and ground stations operations teams to manage operations data required to tailor/operate the ground data systems
  - Mainly targeted towards EGS-CC systems, models and data
  - Extensible by third parties
  - Foreseen users
    - All future EGS-CC based ESA/ESOC missions
    - Licensed to third parties under ESA open source or community software license (allow commercialisation)

Thank you,

Questions?

The Next Generation Mission Operations Preparation Environment at ESOC

Francois Trifin, Anthony Walsh

More details

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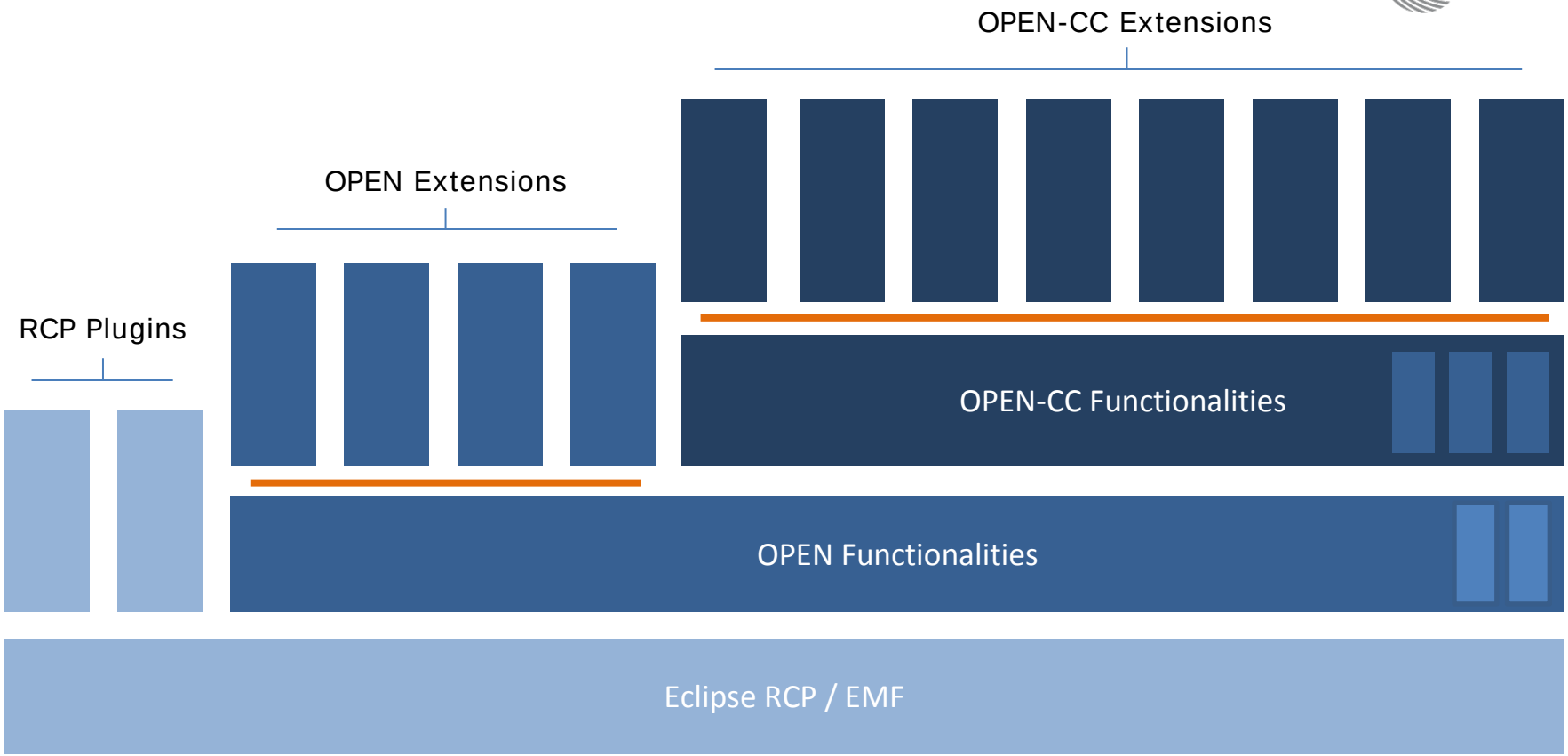
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