National Geoinformation Center
for monitoring, assessment and prediction
natural and anthropogenic risks and disasters

Program: National Roadmap for Scientific Infrastructure 2017-2023,
Financing Institution: Bulgarian Ministry of Education and Science

Service-Microservice Architecture for Context-Aware Content Delivery in National Geoinformation Center of Bulgaria

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BRIEFLY

- main goals and purposes of National Geoinformation Center of Bulgaria (NGIC)
- conceptual architectural model of NGIC and sample partner organization
- solutions for development of context-aware services in NGIC

National Geoinformation Center (NGIC) of Bulgaria

Newly founded Bulgarian national scientific infrastructure (Program: National Roadmap for Scientific Infrastructure 2017-2023, funded by Bulgarian Ministry of Education and Science).

Main purpose: **to integrate the primary national Earth observation sources** and **to link them into a dynamic ICT-based network**.

NGIC is intended to provide infrastructure for solving important national and international tasks related with **prediction and prevention of natural and anthropogenic risks and disasters**.

Users – government structures, local authorities, business and the public.

Cooperation Network

Two groups of partners:

- DDSS (Data, Data products, Services and Software) providers:
  - National Institute of Geophysics, Geodesy and Geography – BAS (NIGGG);
  - National Institute of Meteorology and Hydrology (NIMH);
  - Institute of Oceanology – BAS (IO);
  - Geological Institute – BAS (GI);
- ICT support providers:
  - Institute of Mathematics and Informatics – BAS (IMI);
  - Institute of Information and Communication Technologies – BAS (IICT).

Acronim	Name and URL	State/Int.	Thematic areas	Data sources
AuScope	AuScope Programs	National (Australia)	Geodesy, Geodynamics, Earth Imaging, Geology, Education	Satellite, Air, In-situ, Historical geological datasets
Bhuvan	Gateway to Indian Earth observation	National (India)	Earth surface products (disaster management, infrastructure, agriculture, urban planning, cultural heritage, education…)	Satellite, Data from state authorities, Crowdsourcing
EGDI	European Geological Data Infrastructure	International (EU)	Geology	Data from EU projects
EODC	Earth Observation Data Centre for Water Resources Monitoring	National (Austria)	Water resources, Earth observation	Satellite
EPOS	European Plate Observing System	International (EU)	Earth observation	Data from EU national research centers
ETRIS DZZ	Integrated Remote Sensing Information Distribution Network (ЕТРИС Д33)	National (Russia)	Atmosphere, Ocean, Earth, Climate	Satellite
GEOSS	Global Earth Observation System of Systems	International (World)	Earth monitoring	Data providers
GEZGIN	National Satellite Data Sharing Platform	National (Turkey)	Land surface	Satellite
JMA	Japan Meteorological Agency Activities	National (Japan)	Weather, Climate, Earthquakes, Volcanoes, Landslides,	Satellite, Air, Surface, Underground
NCEO	National Centre for Earth Observation	National (UK)	Earth, Atmosphere, Ocean research observations	Satellite, Air, Surface
NESDIS	National Environmental Satellite, Data, and Information Service (GEARS – Ground Enterprise Architecture Services)	National (USA)	Atmosphere, Ocean, Earth, Climate	Satellite

Acronim	Governing body	Organization governance model	Architecture concepts applied
AuScope	State funded non-profit company (AuScope Ltd)	Vertical	Services
Bhuvan	State agency (Indian Space Research Organization)	Vertical	Services
EGDI	Project consortium (EU funding program)	Federated	Services, microservices implementation discussed
EODC	Steering committee through a state company (EODC GmbH)	Federated	Services and microservices
EPOS	Project consortium (EU funding program)	Federated	Services, microservices implementation planned
ETRIS DZZ	State corporation (Roscosmos)	Vertical	No sufficient information
GEOSS	Partnership of more than 100 national governments (GEO)	Federated	Services
GEZGIN	Research organization (TUBITAK UZAY)	Vertical	Services
JMA	State agency (Japan Metereological Agency)	Vertical	Services and miroservices
NCEO	Distributed research center (National Centre for Earth Observation)	Federated	Services
NESDIS	Government body (National Oceanic and Atmospheric Administration)	Vertical	Services and microservices

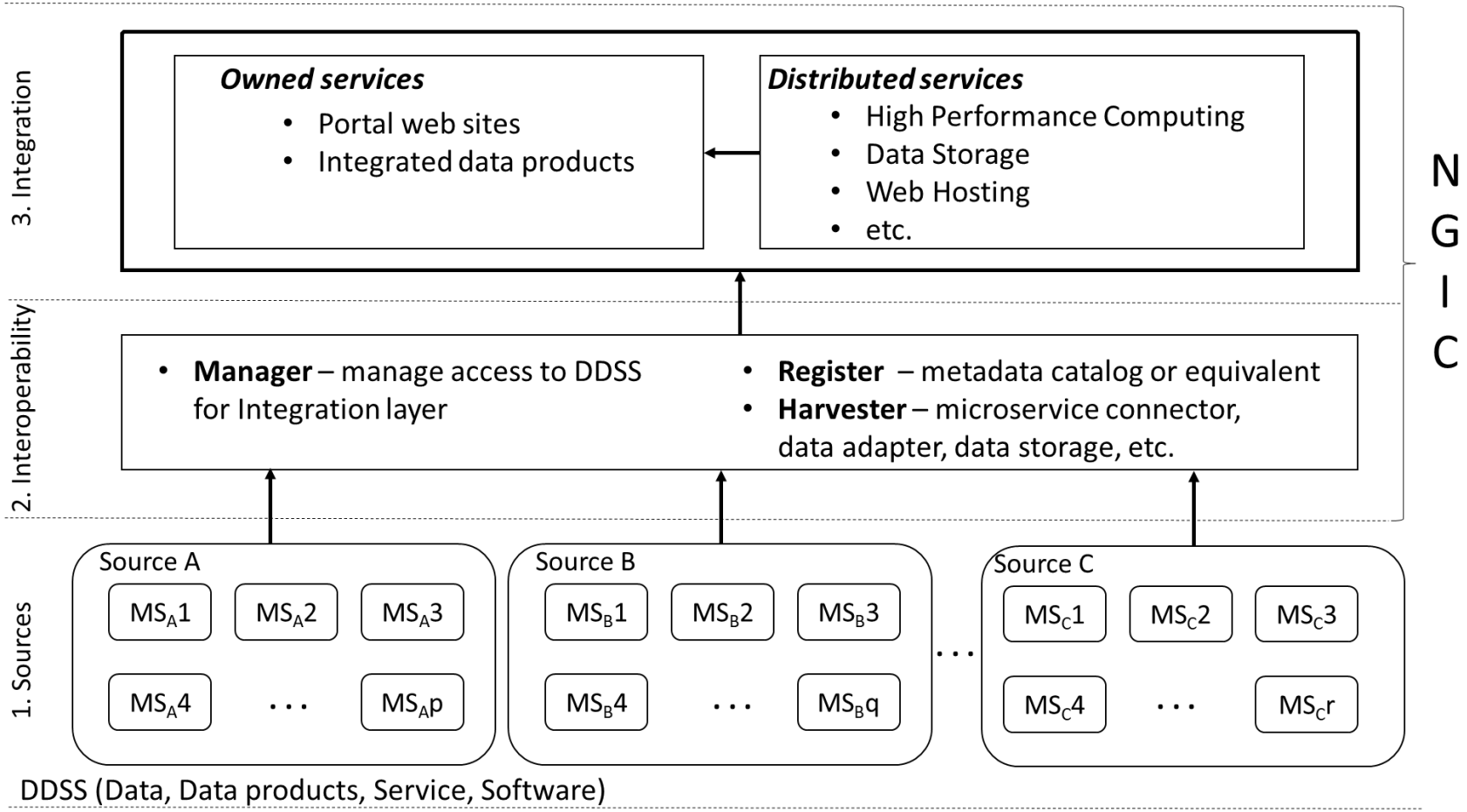
Conceptual Model of NGIC

- Federated organization model:
  - when the sources of data are owned by various independent entities
  - and a common goal for integration exists.

- The integration cause necessity of building some of the subsystems with vertical governance.

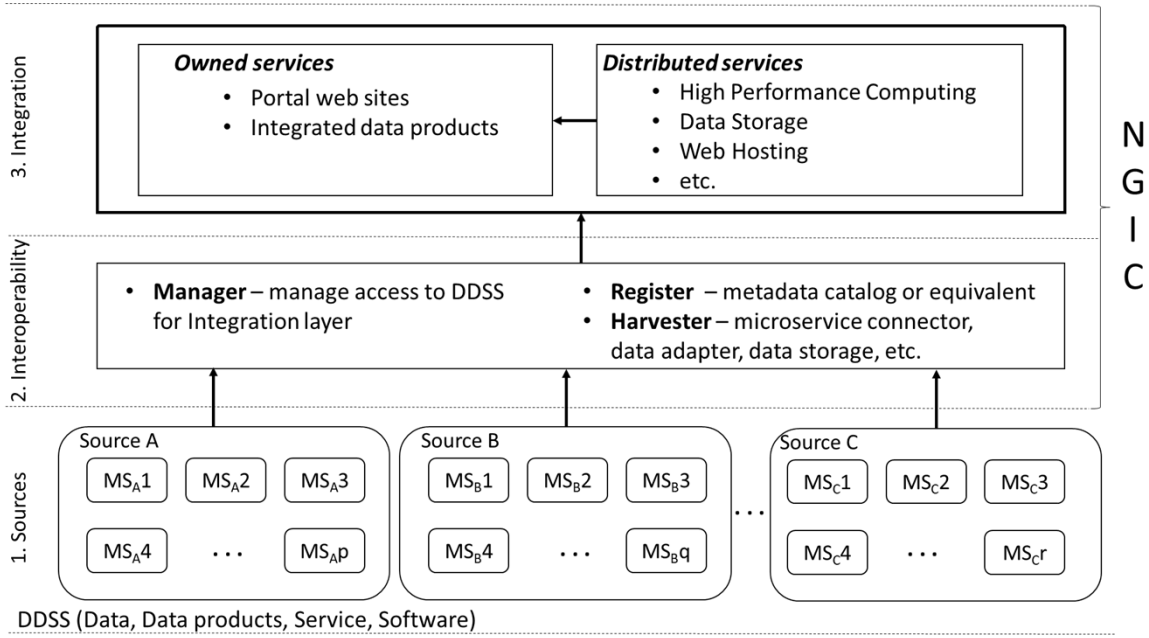
- Microservices as concept are used or at least planned for implementation in most of them.

Conceptual Model of NGIC



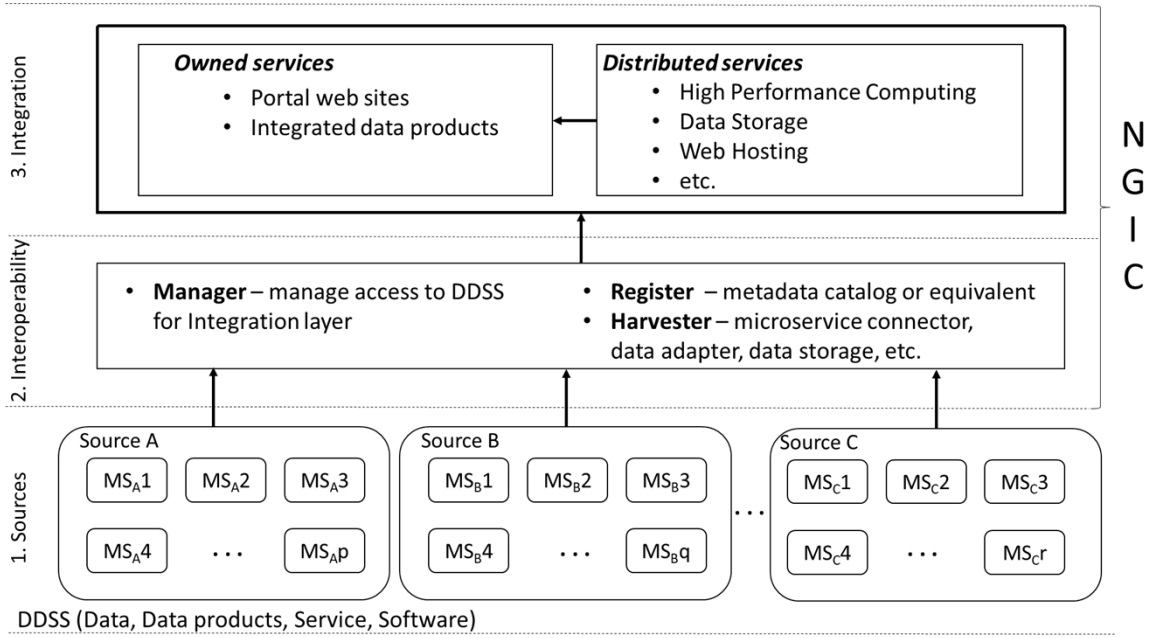
"SOURCES" LAYER

- It contains the providers of Data, Data products, Services and Software (DDSS).
- Providers are presented as sources – collections of microservices.
- Microservises by definition are designed with purpose for providing maximum agility to development of the system:
  - expansion through adding new DDSS by existing source, or a new source,
  - shrinking through excluding either DDSS or entire source.



"INTEROPERABILITY" LAYER

- "Manager" (mandatory) – regulate the access to DDSS;
- "Register" – provide automation of discovery and selection of DDSS;
- "Harvester" – includes advanced automated subsystems for data collection from the sources (like data harvesters, data adapters, storages for data buffering, etc.).

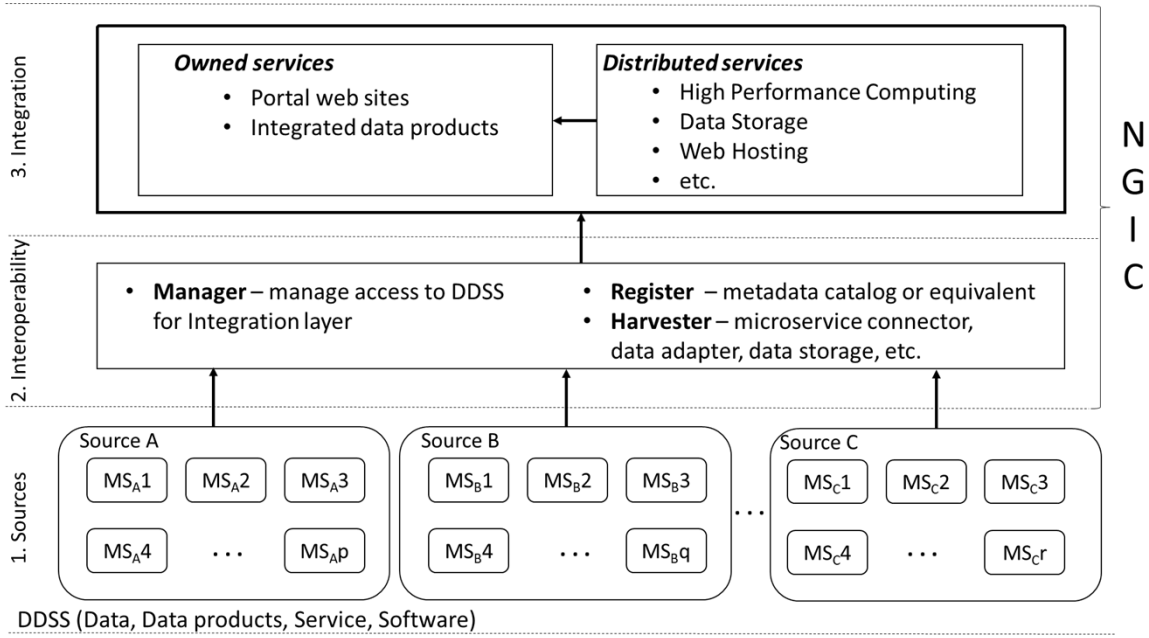


"INTEGRATION" LAYER

It produces integrated data products (IDP).

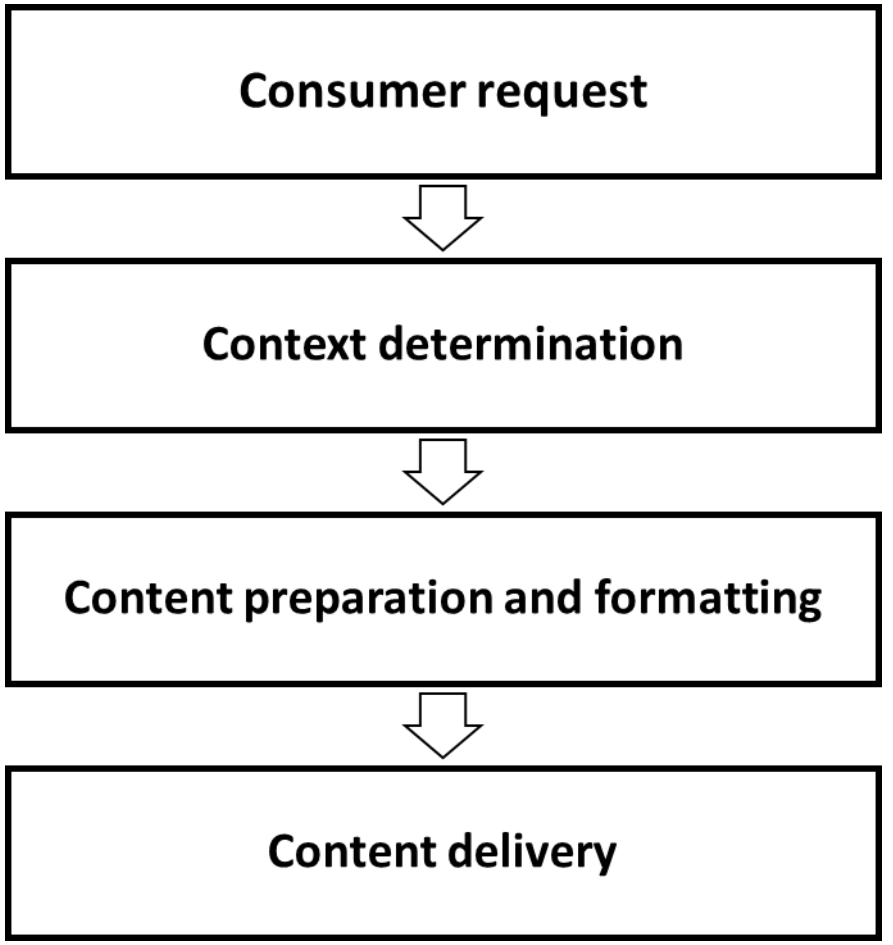
- The service architecture is built around two columns:
  - owned services – provide the access to the IDP
  - distributed services, assured by the ICT support providers or third-party providers.

The IDP itself are prepared by owned and distributed services.



NGIC AS A PLATFORM FOR CONTEXT-AWARE SERVICES

- The basic steps of the process of consumer context gathering and content delivery are sequenced in four basic steps:



THE CONTENT

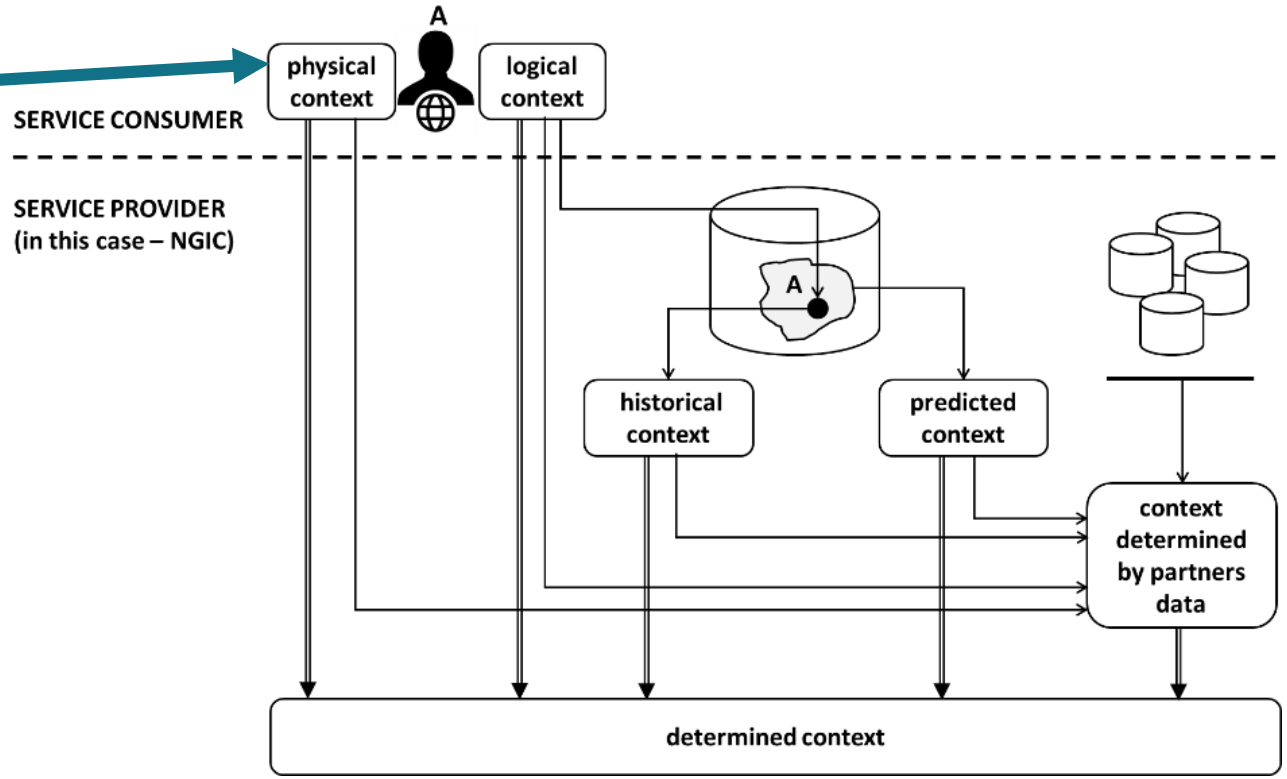
- **Raw data set** extracted by sensor networks operated by partners in NGIC (sources).
- **Data product, software or service** prepared and managed by one of the partners.
- **Integrated data product**, which is prepared by a production process managed in NGIC, using as input DDSS from one or several partners.

Context Determination and Sources of Context in NGIC

- **Physical context** – such as current location of the device, from which the request is invoked, screen size, communication capabilities, network identity, GPS sensors, etc.

- **Logical context** – information about identity, privileges, preferences, etc.

The physical context can be gathered directly from sensors in a mobile device or from data in the header of HTML request by the consumer.



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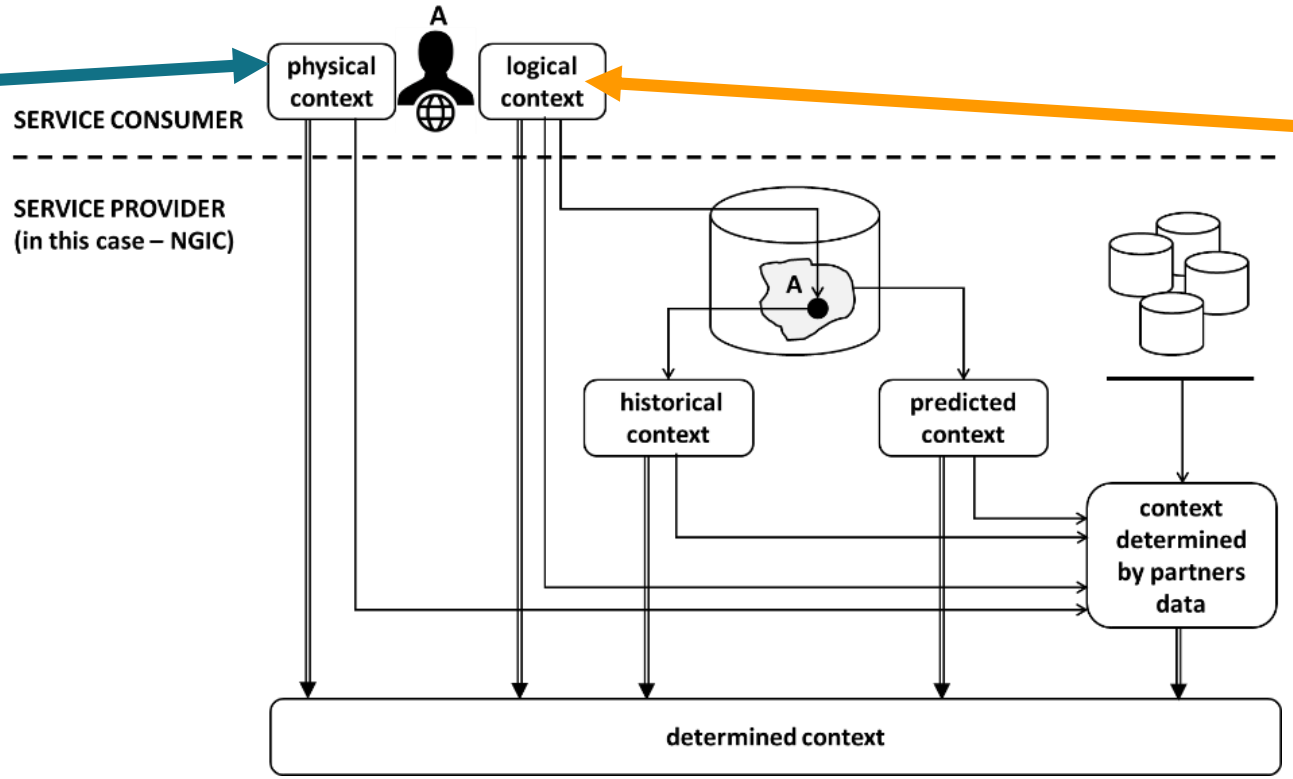

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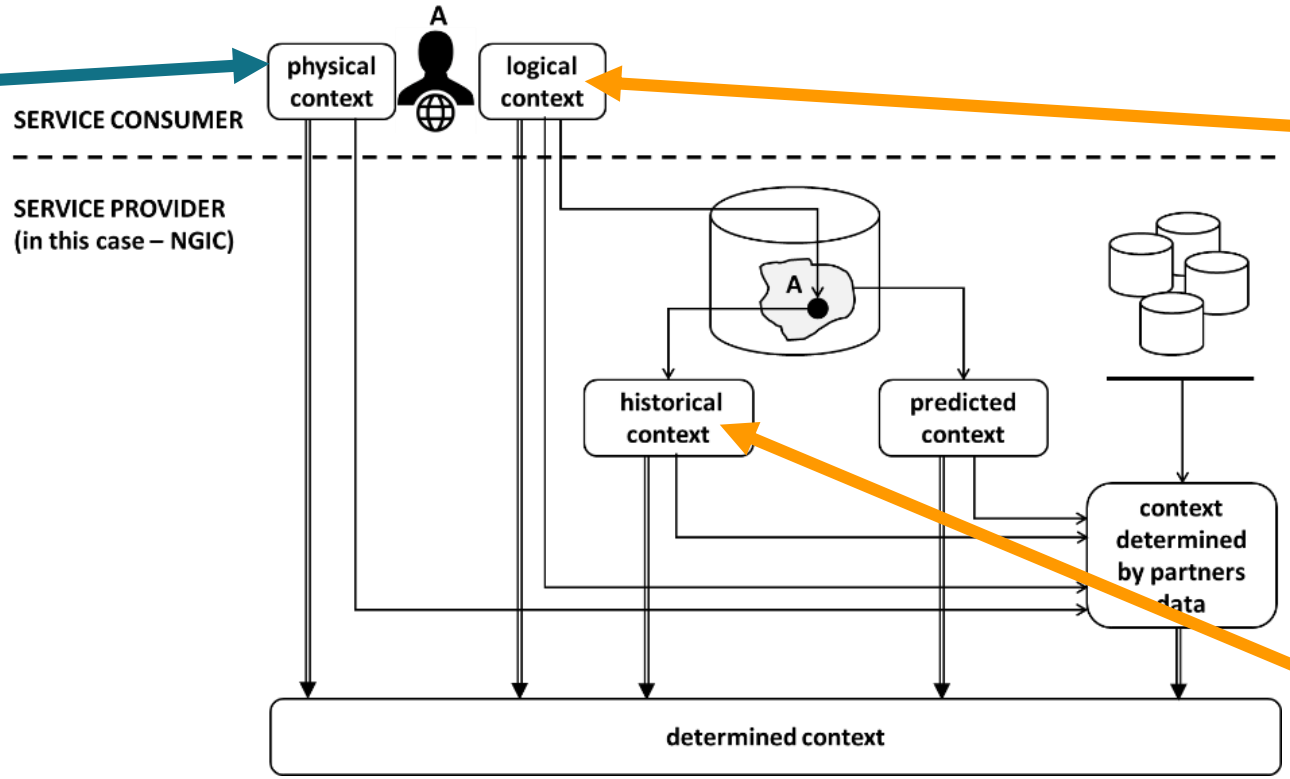

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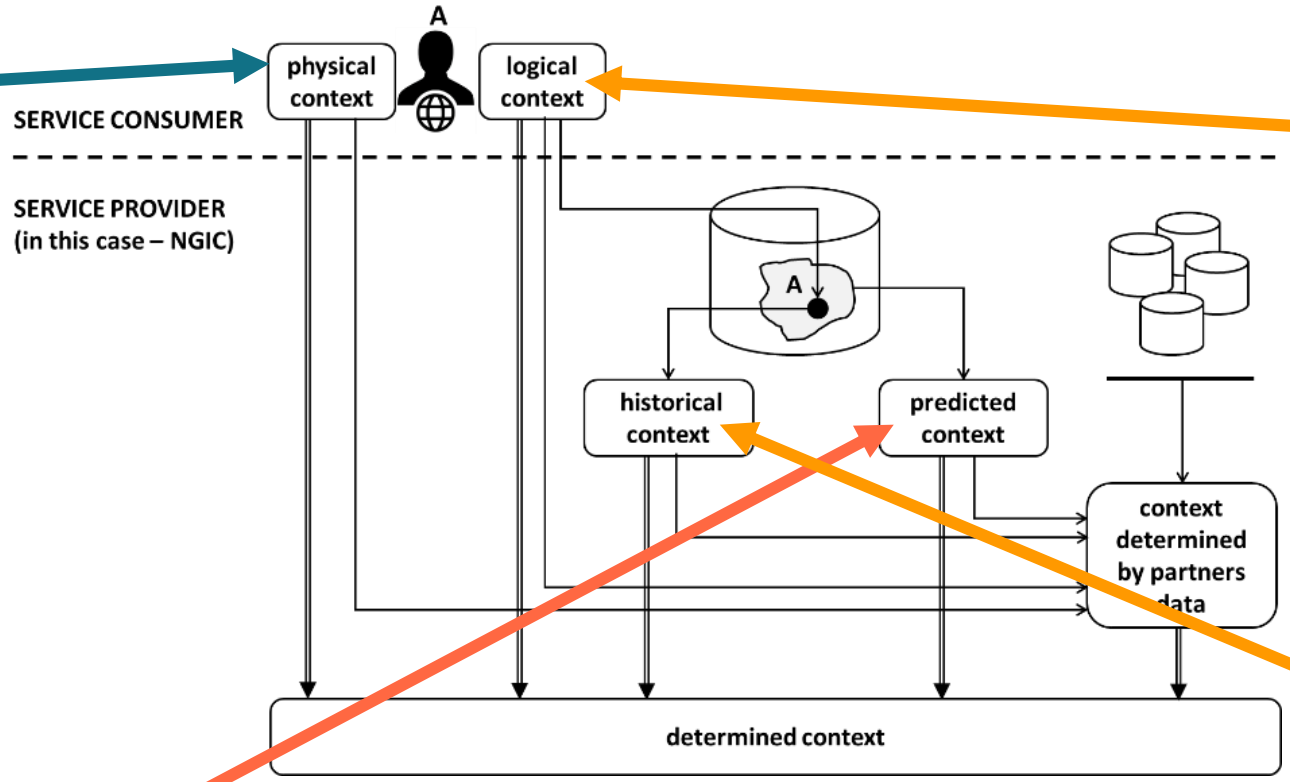

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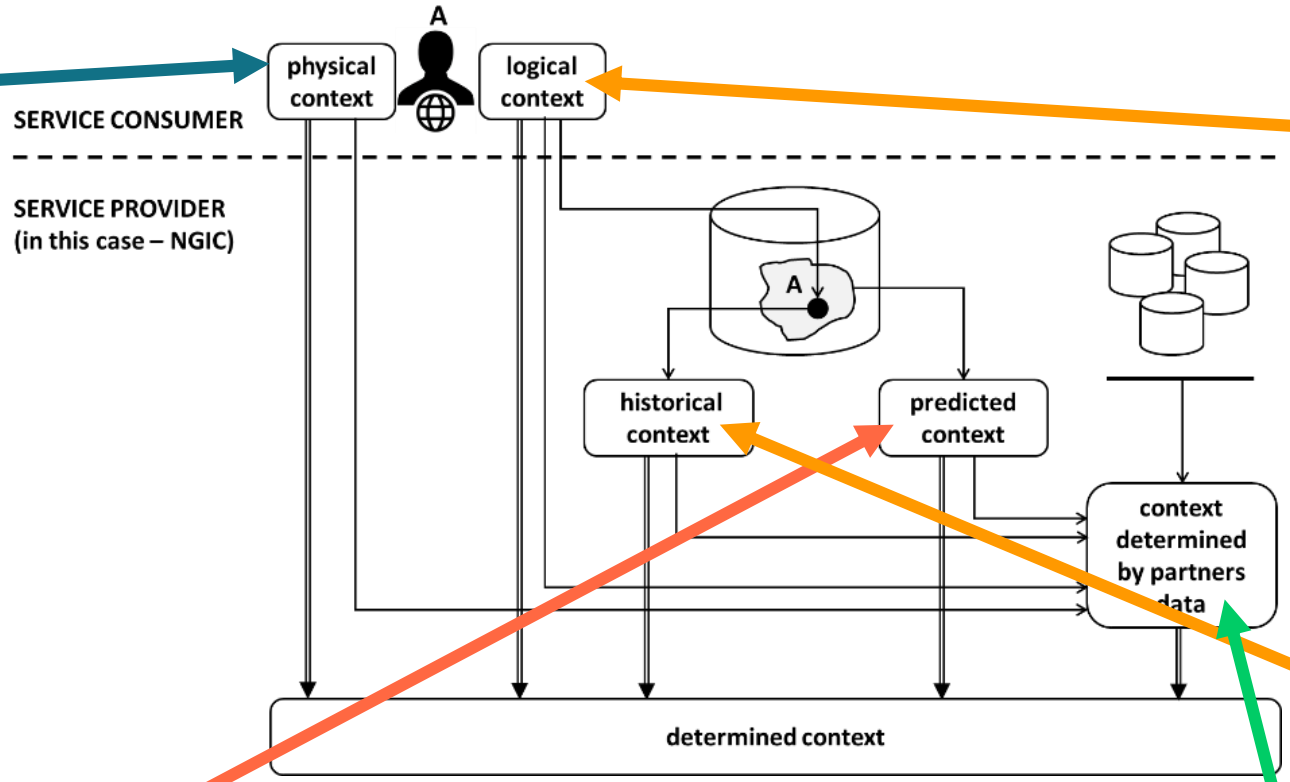

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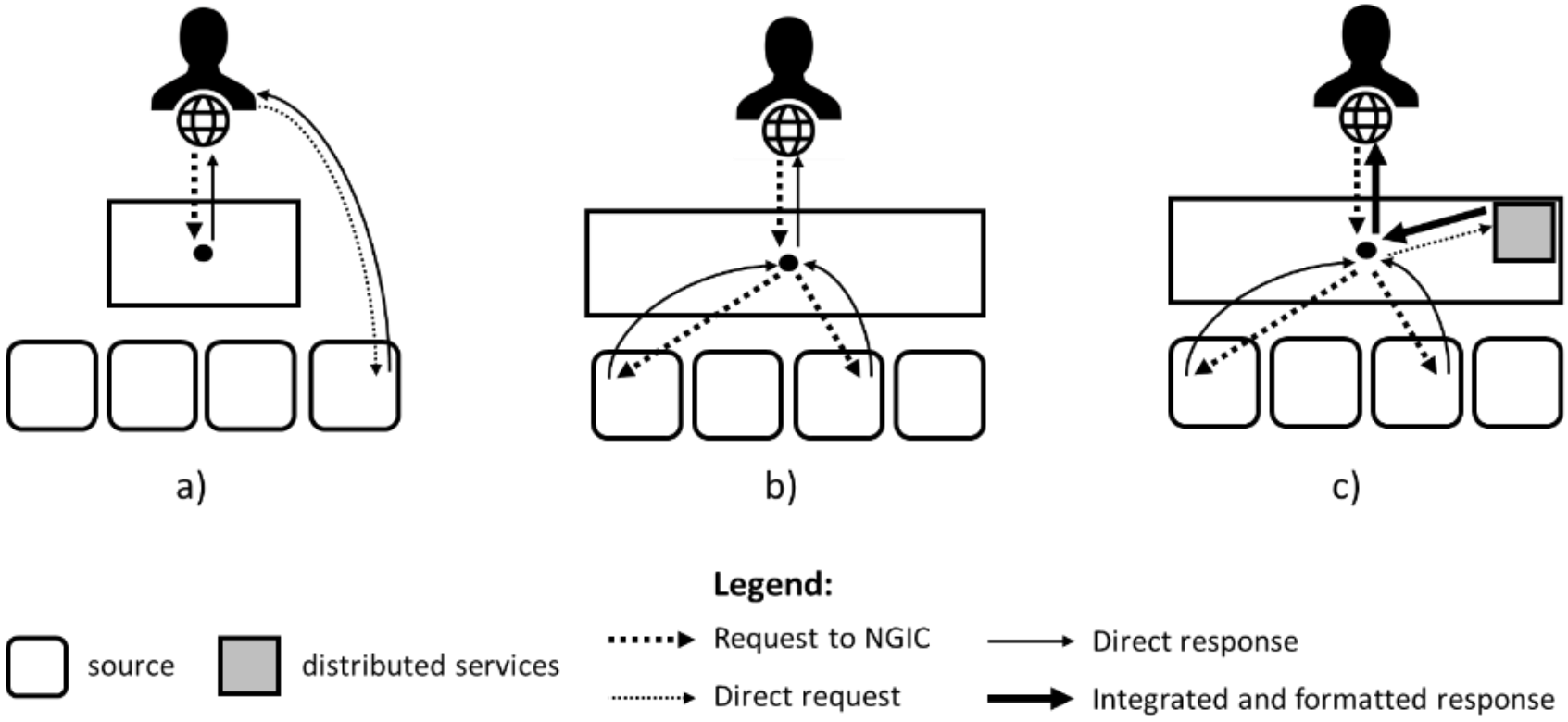
The last type of data that is used to determine the consumer context is provided by partners of NGIC (for instance: physical conditions of the environment according to data received by partners in the area around the consumer).

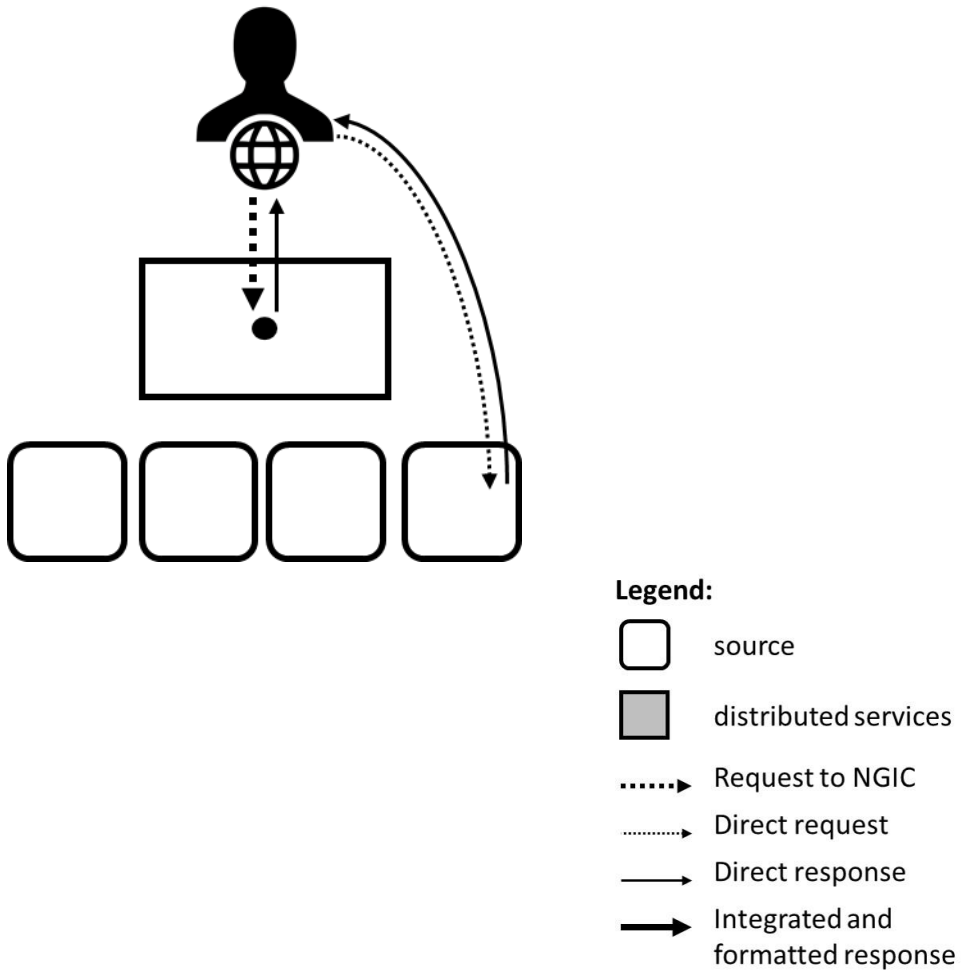
Content Preparation and Delivery



SCENARIO "A"

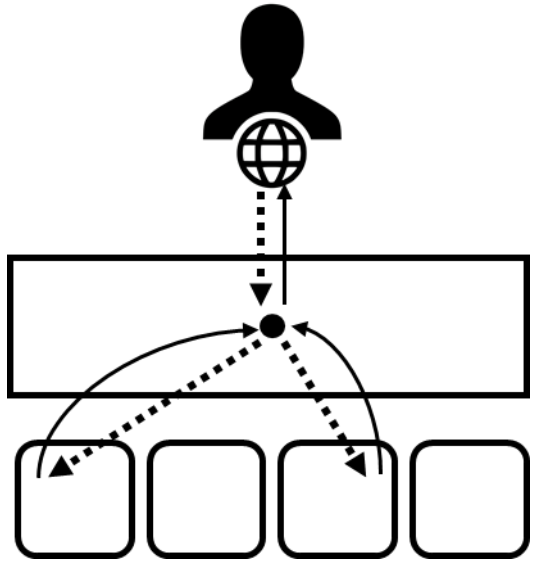
- After initial user request its context is determined
- By using static business rule the most relevant content is specified to be a DDSS that is available at a partner and is suitable to be consumed **as-is**
- the user receive the information how to contact directly to the partner's DDSS

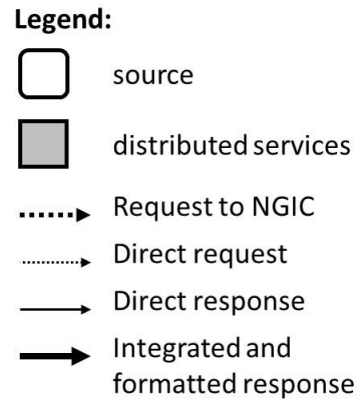
One of the first services developed in NGIC was "A catalog of information sources" and was an implementation of that scenario.



SCENARIO "B"

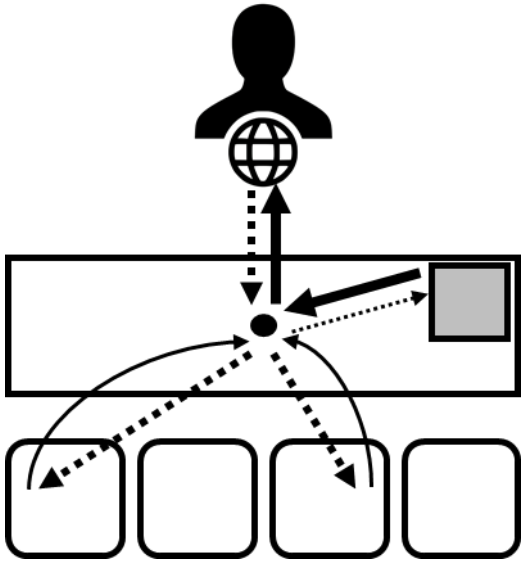
- After initial user request its context is determined
- By using static business rules the most relevant content is retrieved, formatted and delivered to the consumer.
- There are no other processing then **formatting** so information again is delivered **as-is** provided by the partner.
- A sample of implementation of that service is a case in which NGIC works as a billing system.





SCENARIO "C"

- After initial user request its context is determined
- Using static business rules or/and some AI mechanism the most relevant content is specified to be delivered
- The content is produced using DDSS from partners, and **an integrated product** is prepared.
- The final product is delivered to the customer within the parameters of the service contract.



Currently and in the Future

- The presented conceptual architecture is accepted by the governing body of NGIC.
- Various IT solutions are in process of implementation and the basic infrastructure is planned to become operational in 2020.
- The concept of context awareness is promoted to consumers that are engaged with civil protection with positive feedback.
- The service architecture that is used for delivery of NGIC products would allow non-sophisticated integration with various existing early warning systems.

- Although the results presented in this paper are based on early phase of system development, we presume they may be used as a case study of emerging GIC that is planned and designed to be context-aware from the beginning.

THANK YOU FOR THE ATTENTION!

We are open for suggestions and advices for improvement!