Maat - Single Source of Truth for network service automation

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GN5-1

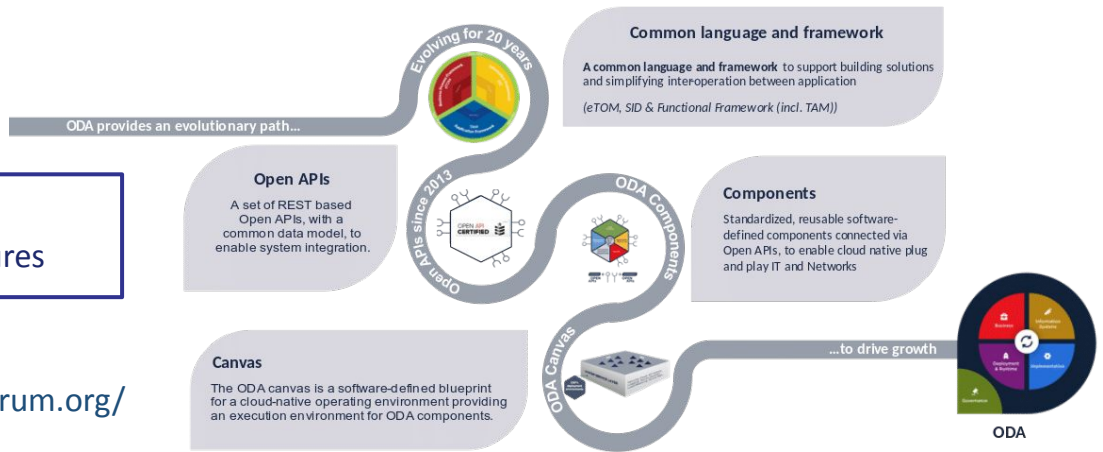
Digital platforms enabling automation and orchestration

How to design a consistent and reusable automation and orchestration functionalities in digital platforms?

- TMF Open Digital Architecture (ODA) is a complete enterprise architecture blueprint for open digital platforms, replacing traditional operational and business support systems
- ODA helps in designing agile, flexible, interoperable ecosystems
- Use of standardised data models and APIs for seamless integration and communication between diverse systems and component

GÉANT NETDEV OAV Architectures:
https://wiki.geant.org/display/NETDEV/OAV+Architectures

https://www.tmforum.org/



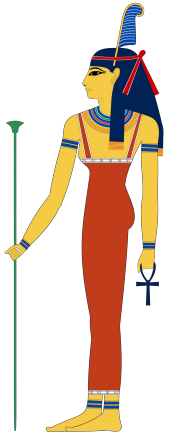
Source of Truth (SoT)

- Represents the desired state of the network - declarative approach
  - Any changes in the desired state are applied by a relevant declarative tool
  - Only a state in SoT is the proper one (and should be reflected on an infrastructure)
- A key component of the Infrastructure as Code (IaC) that supports the managing and provisioning of infrastructure through code instead of through manual processes
- May include multiple data sources and multiple types of data
- Compliant with ODA as a component with a set of APIs, data models and an important role in the workflows (TMF eTOM)

Maat

Maat is a microservice for open digital platforms to manage the information about physical and logical resources and/or services

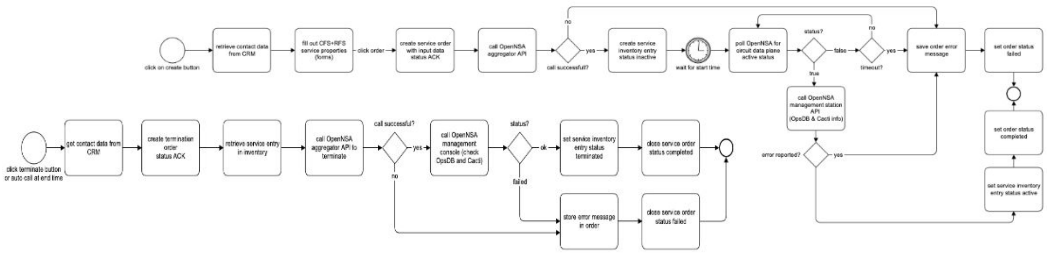
- Integration with other tools via REST APIs
  - AuthN with OAuthN 2.0 and Keycloak
- JSON-based data model for resources and services
- Based on a NoSQL database
- Structure and data type validation of incoming REST POST messages
  - Use of openapi 3.0 json schema files
  - Flexible customisable schema
  - Support of multiple schema files (multiple data models in Maat)
- Event notification mechanism
  - Supporting application EventListener for storing the history of events

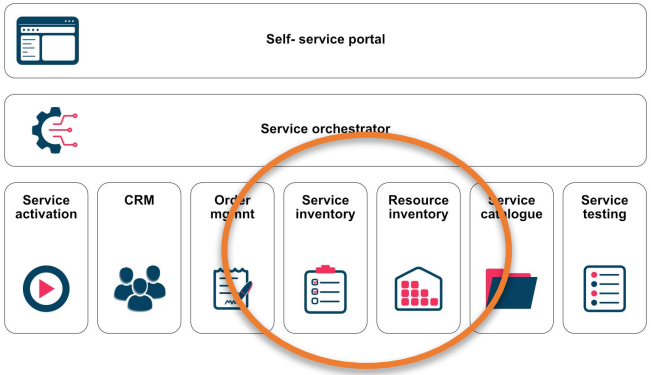


Maat

Maat as a Source of Truth in a distributed modern digital platform enabling automation and orchestration

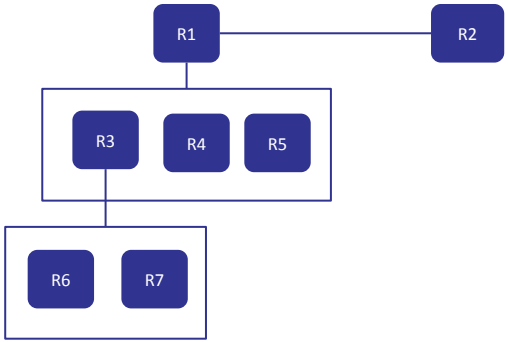
- lesson learned from the work on the GÉANT Connection Service
- feedback from the users

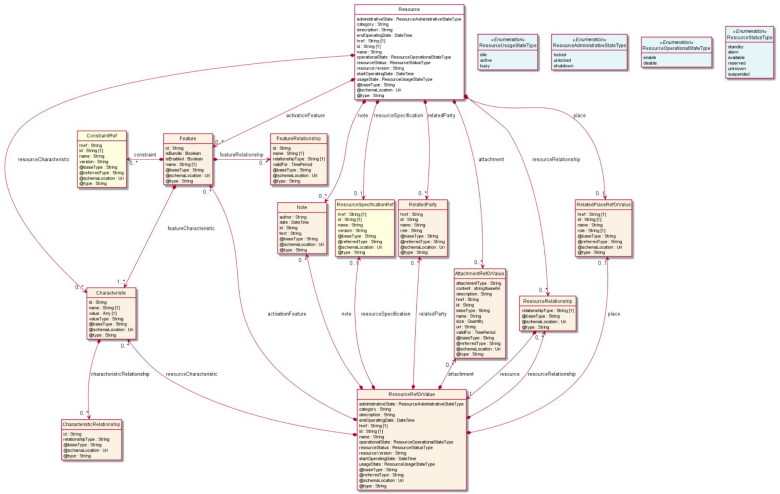




Maat – Resource data model

- Resource as a basic object
- Resource can be composed of other resources
- Resource has attributes and characteristics
- Relationships between Resources
  - chains of references
- Definition of a Resource can be easily extended





https://github.com/tmforum-apis/Open_Api_And_Data_Model/tree/master/schemas/Resource

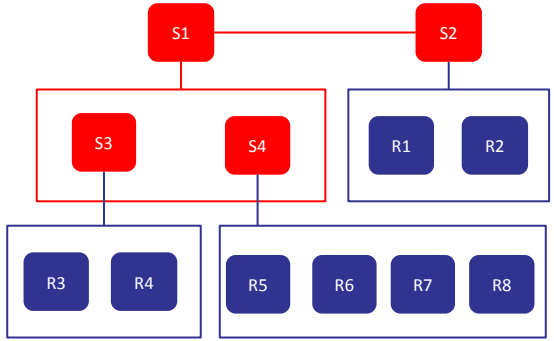
Maat – Resource data model (example)

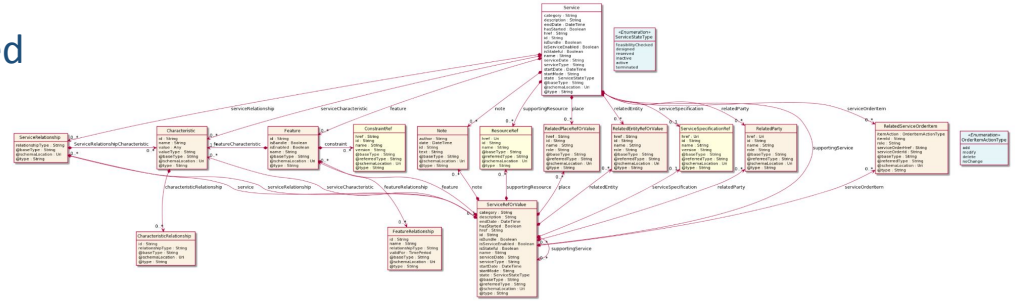

```
{
    "@type": "LogicalResource",
    "category": "protocol.bgp.group",
    "name": "man",
    "@schemaLocation":
"https://raw.githubusercontent.com/GEANT-NETDEV/Inv3-schema/main/TMF639-ResourceInventory-v4-ext_20240121-1.
json",
    "resourceRelationship": [
      {
        "relationshipType": "contains:protocol.bgp.group.neighbor",
        "resource": {
          "id": "8dec579c-febc-410c-bcaf-6be7e34781a5",
          "href":
"https://p4-inv3-2.rare.nmaas.eu:443/resourceInventory/resource/8dec579c-febc-410c-bcaf-6be7e34781a5"
        }
      }
    ],
    "resourceCharacteristic": [
      {
        "name": "type",
        "value": "external"
      },
      {
        "name": "export",
        "value": "lhc-out-man"
      }
    ],
    "href": "https://p4-inv3-2.rare.nmaas.eu:443/resourceInventory/resource/9ea94908-8310-47b9-9c51-4c4e40df68b1",
    "serviceRelationship": [
      {
        "relationshipType": "refers:protocol.bgp",
        "service": {
          "id": "ffd4fb9b-b599-4d44-bef5-13466d68e277",
          "href":
"https://p4-inv3-2.rare.nmaas.eu:443/serviceInventory/service/ffd4fb9b-b599-4d44-bef5-13466d68e277"
        }
      }
    ],
    "id": "9ea94908-8310-47b9-9c51-4c4e40df68b1"
}
```

```
{
    "@type": "LogicalResource",
    "category": "protocol.bgp.group.neighbor",
    "name": "192.168.151.246",
    "description": "SomeName",
    "@schemaLocation":
"https://raw.githubusercontent.com/GEANT-NETDEV/Inv3-schema/main/TMF639-ResourceInventory-v4-ext_20240121-
1.json",
    "resourceCharacteristic": [
      {
        "name": "peer-as",
        "value": "128743"
      }
    ],
    "href": "https://p4-inv3-2.rare.nmaas.eu:443/resourceInventory/resource/8dec579c-febc-410c-bcaf-6be7e34781a5",
    "resourceRelationship": [
      {
        "relationshipType": "refers:protocol.bgp.group",
        "resource": {
          "id": "9ea94908-8310-47b9-9c51-4c4e40df68b1",
          "href":
"https://p4-inv3-2.rare.nmaas.eu:443/resourceInventory/resource/9ea94908-8310-47b9-9c51-4c4e40df68b1"
        }
      }
    ],
    "id": "8dec579c-febc-410c-bcaf-6be7e34781a5"
}
```

Maat – Service data model

- Service as a basic object
- Service can be composed of other services
- Service has attributes and characteristics
- Relationships between Services
  - chains of references
- Service may have links to Resources
- Definition of a Service can be extended





https://github.com/tmforum-apis/Open_Api_And_Data_Model/blob/master/schemas/Service/Service.schema.json

Maat – Service data model (example)


```
{
    "@type": "Service",
    "category": "routing-instance.vrf",
    "name": "LHCone",
    "@schemaLocation":
"https://raw.githubusercontent.com/GEANT-NETDEV/Inv3-schema/main/TMF638-ServiceInventory-v4.json",
    "supportingResource": [
      {
        "id": "d854cf5b-d7b2-40a2-afbf-0a0af05a6cb0",
        "href":
"https://p4-inv3-2.rare.nmaas.eu:443/resourceInventoryManagement/v4.0.0/resource/d854cf5b-d7b2-40a2-afbf-0a0af05a
6cb0"
      }
    ],
    "serviceRelationship": [
      {
        "relationshipType": "contains:protocol.bgp",
        "service": {
          "id": "ffd4fb9b-b599-4d44-bef5-13466d68e277",
          "href":
"https://p4-inv3-2.rare.nmaas.eu:443/serviceInventoryManagement/v4.0.0/service/ffd4fb9b-b599-4d44-bef5-13466d68e2
77"
        }
      }
    ],
    "serviceCharacteristic": [
      {
        "name": "vrf-target.community",
        "value": "target:3501:152001016"
      },
      {
        "name": "vrf-table-label",
        "value": "null"
      }
    ],
    "href":
"https://p4-inv3-2.rare.nmaas.eu:443/serviceInventoryManagement/v4.0.0/service/5d880276-5b21-49a7-a2bd-f1e28b4e8
ee7",
    "serviceDate": "2024-01-22T15:47:42.107584162Z",
    "id": "5d880276-5b21-49a7-a2bd-f1e28b4e8ee7"
}
```

```
{
    "@type": "Service",
    "category": "protocol.bgp",
    "@schemaLocation":
"https://raw.githubusercontent.com/GEANT-NETDEV/Inv3-schema/main/TMF638-ServiceInventory-v4.json",
    "supportingResource": [
      {
        "id": "9ea94908-8310-47b9-9c51-4c4e40df68b1",
        "href":
"https://p4-inv3-2.rare.nmaas.eu:443/resourceInventoryManagement/v4.0.0/resource/9ea94908-8310-47b9-9c51-4c4
e40df68b1"
      }
    ],
    "href":
"https://p4-inv3-2.rare.nmaas.eu:443/serviceInventoryManagement/v4.0.0/service/ffd4fb9b-b599-4d44-bef5-13466d6
8e277",
    "serviceDate": "2024-01-22T15:45:28.701242857Z",
    "serviceRelationship": [
      {
        "relationshipType": "refers:routing-instance.vrf",
        "service": {
          "id": "5d880276-5b21-49a7-a2bd-f1e28b4e8ee7",
          "href":
"https://p4-inv3-2.rare.nmaas.eu:443/serviceInventoryManagement/v4.0.0/service/5d880276-5b21-49a7-a2bd-f1e28b
4e8ee7"
        }
      }
    ],
    "id": "ffd4fb9b-b599-4d44-bef5-13466d68e277"
}
```

Maat – Resource validation example

REST POST message

```
{
  "@type": "Resource",
  "name": "Resource1",
  "location": "Poznan",
  "note":[
    {
      "author": "Martin",
      "date": "2024-01-23T00:00:00.000Z",
      "text": "Example text"
    }
  ],
  "@schemaLocation": "https://raw.githubusercontent.com/GEANT-NETDEV/Inv3-schema/main/ResourceInventory-example-1.json"
}
```

Schema file: ResourceInventory-example-1.json

```
"Resource": {
  "type": "object",
  "required": [
    "id",
    "name"
  ],
  "properties": {
    "id": {
      "type": "string",
      "description": "Unique identifier of the resource"
    },
    "name": {
      "type": "string"
    },
    "location": {
      "type": "string"
    },
    "note": {
      "type": "array",
      "items": {
        "$ref": "#/definitions/Note"
      },
      "description": "A list of notes made on this resource"
    }
  }
},
"Note": {
  "type": "object",
  "required": [
    "text"
  ],
  "properties": {
    "author": {
      "type": "string",
      "description": "Author of the note"
    },
    "date": {
      "type": "string",
      "format": "date-time",
      "description": "Date of the note"
    },
    "text": {
      "type": "string",
      "description": "Text of the note"
    }
  }
}
```

- @schemaLocation is obligatory
- id is created dynamically by Maat

https://github.com/GEANT-NETDEV/Inv3-schema

Maat – Open API

Open API dashboard for January 2024

tmforum

All time totals: **802,153** Open API downloads by **45,730** developers from **2,750** organizations | **81** Organizations have certified **981** Open APIs

DOWNLOADS THIS MONTH

API downloads	19,321
Unique organizations	450
Unique individuals	2,659

TOP DOWNLOADERS*

Parent Account	Rank	Downloads
Vodafone Group	1	1,136
AT&T Inc.	2	830
Bell Canada	3	754
Tech Mahindra Limited	4	619
Orange	5	584
Jio Platforms Limited	6	579
Deutsche Telekom AG	7	481
Tata Consultancy Services	8	445
Amdocs Management Limited	9	433
Accenture	10	357
TM Technology Services Sdn Bhd	11	353
Entel PCS Telecomunicaciones S.A.	12	314
Verizon Communications	13	265
Celfocus	14	256
BT Group plc	15	252
Ericsson Inc.	16	241
PiA Bilişim Hizmetleri A.Ş.	17	226
IBM Corporation	18	203
TELEFONICA	19	182
Axiata Group Berhad	20	177

* Organizations with 5+ unique users in the month

Useful links

Open API table | Pre-production API table |
183 Open API manifesto signatories (current TM Forum members)

CERTIFICATIONS

OPEN API CERTIFICATION LEADERBOARD

TOP APIs CERTIFIED

LATEST OPEN API CERTIFICATIONS

WHAT'S NEW

LATEST API UPDATES APPROVED

Gen5 TMF640 Service Activation
TMF632 Party Management

THIS MONTH'S MOST POPULAR APIs

API Full Name	Rank	Downloads
TMF622 Product Ordering	1	1,362
TMF666 Account Management	2	1,115
TMF620 Product Catalog Manage...	3	988
TMF629 Customer Management	4	806
TMF632 Party Management	5	766
TMF637 Product Inventory Mana...	6	661
TMF639 Resource Inventory Man...	7	627
TMF641 Service Ordering Manag...	8	607
TMF621 Trouble Ticket	9	557
TMF638 Service Inventory Manag...	10	475
TMF678 Customer Bill Managem...	11	407
TMF673 Geographic Address Ma...	12	375
TMF669 Party Role Management	13	369
TMF679 Product Offering Qualific...	14	365
TMF651 Agreement Management	15	359

NEW API RESEARCH & CASE STUDIES

How Telstra is advancing its network-as-a-service with new service management Open APIs

CSPs see CAMARA collaboration as a model for standards

A week in telecoms: Deutsche Telekom sets up new network API unit

https://github.com/tmforum-apis

Maat – Open API

Resource Management API

- List resources
  GET /resource?fields=...&{filtering}
- Retrieve resource (including selection of fields and filters)
  GET /resource/{id}?fields=...&{filtering}
- Create resource
  POST /resource
- Patch resource
  PATCH /resource/{id}
- Delete resource
  DELETE /resource/{id}
- Register listener
  POST /hub
- Unregister listener
  DELETE /hub/{id}
- Publish Event to listener
  POST /client/listener

Service Management API

- List services
  GET /service?fields=...&{filtering}
- Retrieve service (including selection of fields and filters)
  GET /service/{id}?fields=...&{filtering}
- Create service
  POST /service
- Patch service
  PATCH /service/{id}
- Delete service
  DELETE /service/{id}
- Register listener
  POST /hub
- Unregister listener
  DELETE /hub/{id}
- Publish Event to listener
  POST /client/listener

https://github.com/tmforum-apis/Open_Api_And_Data_Model/tree/master/apis/TMF639_Resource_Inventory
https://github.com/tmforum-apis/Open_Api_And_Data_Model/tree/master/apis/TMF638_Service_Inventory

Maat and NetBox

- NetBox - a SoT that is well-known and popular in the NRENs community
- Maat is considered to be more flexible for data model extensions
- Deployment option: NetBox as a resource inventory and Maat as a service inventory
- Advanced NetBox GUI vs Maat GUI that is still in development
- Both tools expose REST APIs
    - TMF Open APIs in Maat

Maat – pilot deployments

- Maat (as Inventory3 -> old name) has been added to the NMaaS catalogue
- Test instance for GP4L
- Test instance for the Polish PIONIER network
  - PSNC develops a platform for automating and orchestrating network services
  - Maat as the SoT
  - Production deployment in 2024
- Public repo available soon
  - License release procedure is ongoing

Thank you!

netdev@lists.geant.org

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Maat or Maʿat (Egyptian: m□□t /ˈmuʀʕat/, Coptic: ⲙⲉⲓ)[1] comprised the ancient Egyptian concepts of truth, balance, order, harmony, law, morality, and justice. Ma'at was also the goddess who personified these concepts, and regulated the stars, seasons, and the actions of mortals and the deities who had brought order from chaos at the moment of creation. Her ideological opposite was Isfet (Egyptian jzft), meaning injustice, chaos, violence or to do evil.