Information modelling of computing and storage services/resources

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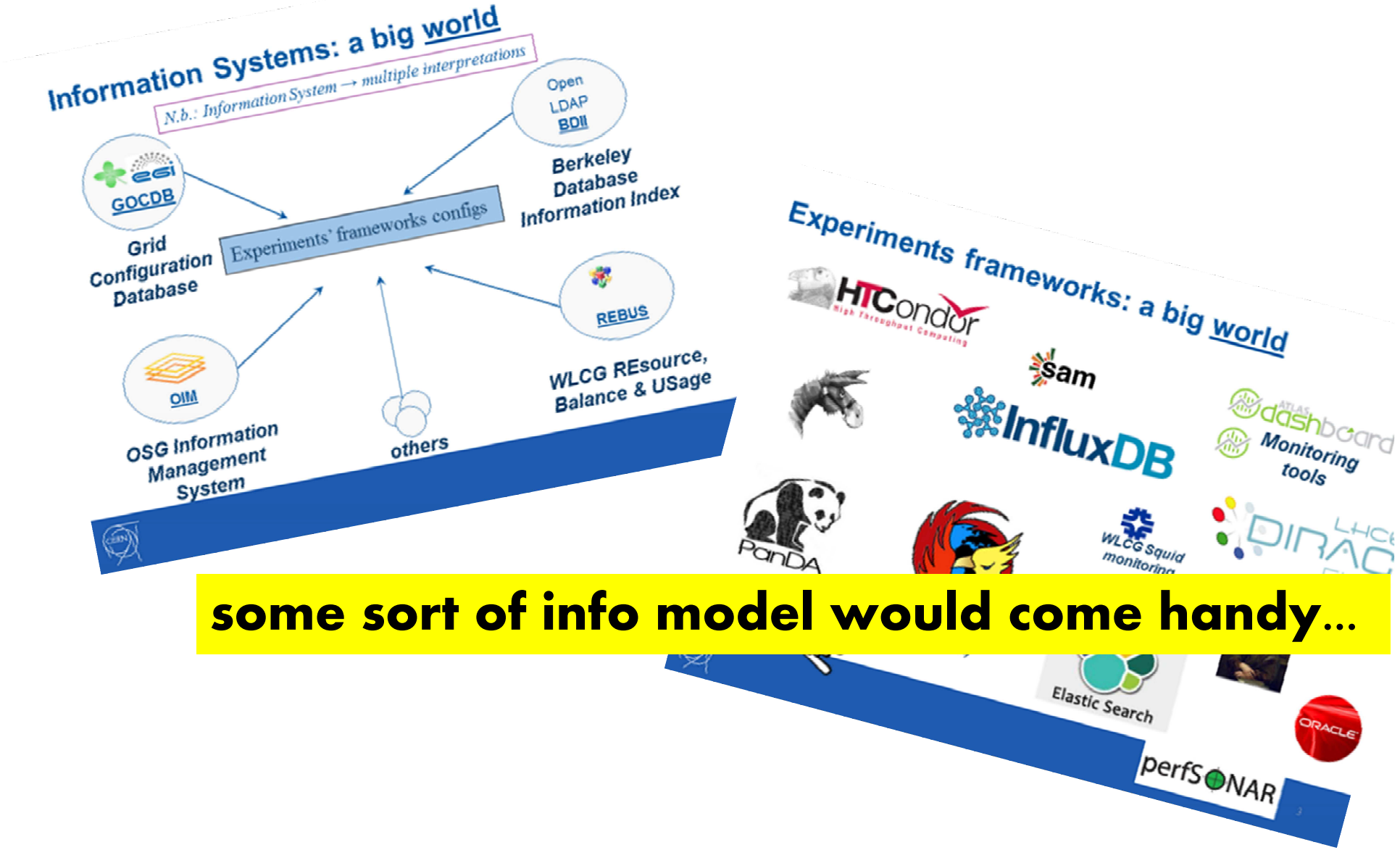
Motivation: what is it & why is it needed?

- Information modelling: the process of describing (complex) objects or systems via
  - creating an abstraction layer
  - identification of its key components
  - definition of the component properties
  - specification of the component relations

"Now! *That* should clear up a few things around here!"

- Without a common model:
  - there may be a huge difference what we say
  - and what the other understands
  - ... or what we think the other understands
- Critical when information is to be shared among different communities
  - *or computing services/systems*

WLCG landscape: a big world with many players



some sort of info model would come handy…

Why creating a suitable info model is soo difficult?

- Time consuming, iterative process
- The task may look trivial at the first time
- Requires commitment and communication from all players
- Cross-domain pre-existing knowledge & readiness for compromise
- Long term investment with large probability of failure
  - the outcome is either too specific or too generic


Early experiments in transportation

Therefore, it is often decided

- Let's just quickly put something together that „works for me"

... a clear recepy for disaster:

- defragmentation and continous reinventing the wheel
  - with various „extensions" and „add-ons"

A previous attempt: GLUE2

A broad community effort started in 2007 and built upon earlier works

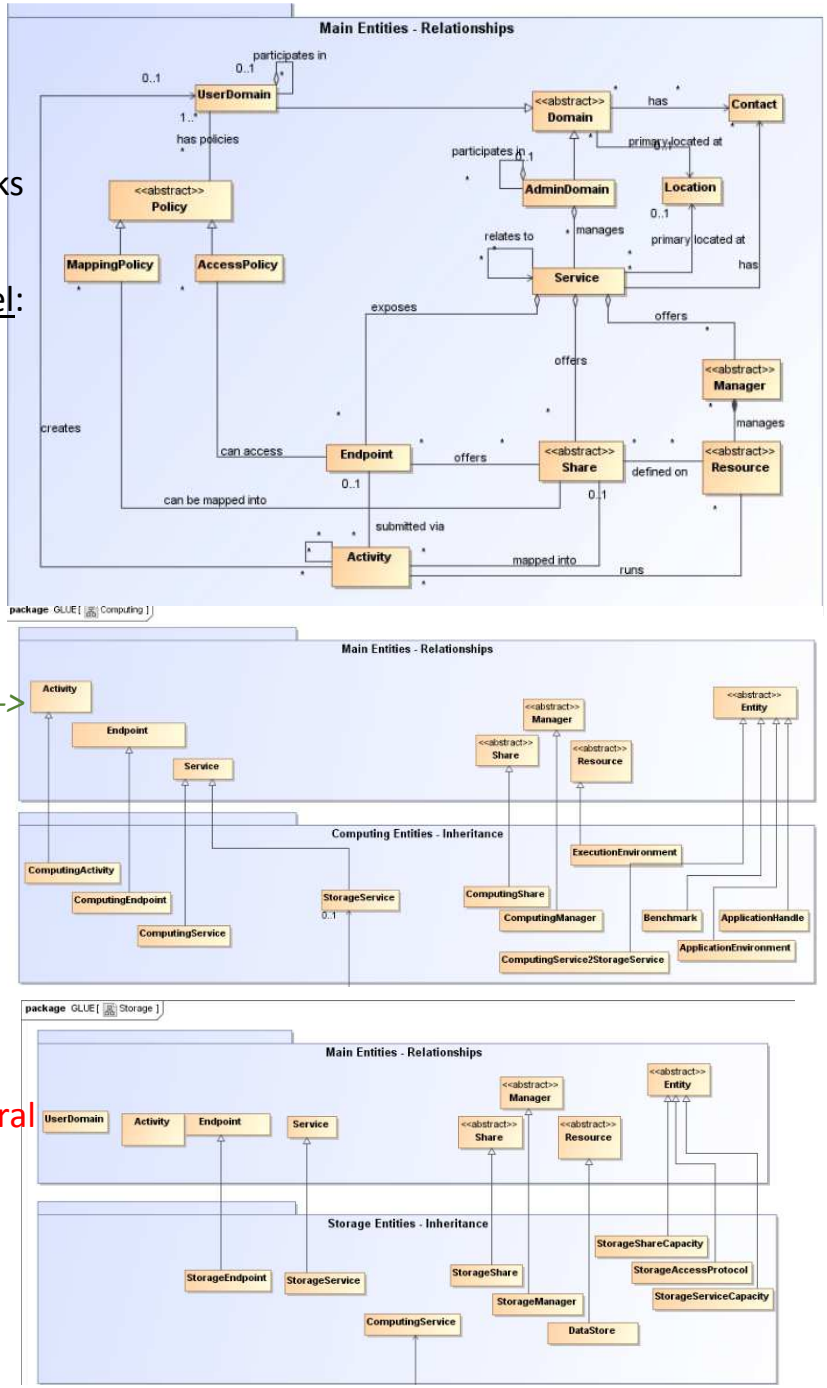
- A still active standardization group within OGF
- GLUE 2 (GFD.147, 2009) specification: a conceptual abstract model:
  - Main entities: *domain, service, endpoint, share, manager, resource, activity, policy*
  - Renderings for *LDAP, XML, SQL and JSON*

Plus:

- Definition of entities & attributes
  - semantics, attr. value syntax, relationship
  - provides enumerations, attribute types
- Main objects are corretly identified
  - Nicely captures the *service -> storageservice, service -> computeservice* inheritance

Minus:

- The community never really figured out howto deploy the model
- Too general and too complex, allows too much flexibility
  - therefore various „profiles” got created e.g. http://go.egi.eu/glue2-profile
- Renderings: not enough iterations
  - Inherited some of the bad BDII choices
- Slow adoption, migration delays (GLUE1.x in US and in several EGI tools)
- Unfortunate extensions hooks
- All in all: GLUE2 somehow accumulated bad reputation and bad user experience



GLUE2 applicability study: space-usage.json (1/4)

Step 0:

- Storage Resource Reporting draft v0.6 by Alessandro & Oliver

```
{"capacity_id": "ATLASDATADISK",
    "status":"online/offline",
    "status_message": "The report can not be created because ...",
    "list_of_paths": ["/castor/ads.rl.ac.uk/prod/atlas/stripInput/atlasdatadisk/"],
    "total_space": 5000000000,
    "used_space": 2000000000,
    "num_files": 123456,
    "time_stamp":, 1447936989},
{"capacity_id": "ATLASSCRATCHDISK",
...
},
{"capacity_id": "ATLASLOCALGROUPDISK",
...
}
```

GLUE2 applicability study: space-usage.json (2/4)

Step 1&2:

„Since you mentioned standardizing, would you consider using an existing standard for describing services: GLUE? One can describe most of what you want already with GLUE and it has a JSON rendering. Here's a rough idea of how the output would look like:„

- StorageShare & StorageShareCapacity are used
- The objects are linked via Associations
- Missing info added via „OtherInfo” extension capability
  - Note Path (!)

```
{
  "StorageShare": [
    {
      "Associations": {
        "StorageShareCapacityID": [
          "atlas:big-site.example.org:ATLASDATADISK-usage"
        ]
      }
      "CreationTime": "2016-11-02T12:16:03Z",
      "ID": "atlas:big-site.example.org:ATLASDATADISK",
      "SharingID": "ATLASDATADISK",
      "ServingState": "production", # or closed|draining|queueing
      "Path": "/atlas/data",
      "AccessLatency": "ONLINE",
      "Tag": "ATLASDATADISK",
      "OtherInfo": [
        "NumberOfFiles=123456",
        "Path=/vo/atlas/data",
        "Path=/users/atlas-vo/data",
        "Problem=The report cannot be created because ...",
      ]
    },
<skipping>
  "StorageShareCapacity": [
    {
      "Associations": {
        "StorageShareID": "atlas:big-site.example.org:ATLASSCRATCHDISK"
      }
      "CreationTime": "2016-11-02T12:16:03Z",
      "ID": "atlas:big-site.example.org:ATLASSCRATCHDISK:usage",
      "TotalSize": 5000, # NB. values are in GB (not GiB)
      "UsedSize": 2000
    },
<skipping>
  ]
}
```

GLUE2 applicability study: space-usage.json (3/4)

Step 3:

„no need for such a complex structure and we could merge some of the GLUE2 objects”

- Assume one-to-one relation of Share & ShareCapacity
- Add the useful attributes from StorageShareCapacity into StorageShare
- Get rid of Associations
- That is: reuse GLUE2 attributes but diverge from, sacrifice GLUE2 json rendering structures

```
"StorageShare": [
    "CreationTime": "2016-11-02T12:16:03Z",
    "ID": "atlas:big-site.example.org:ATLASDATADISK",
    "SharingID": "ATLASDATADISK",
    "ServingState": "production", # or closed|draining|queueing
    "Path": "/atlas/data",
    "AccessLatency": "ONLINE",
    "Tag": "ATLASDATADISK",
    "OtherInfo": [
      "NumberOfFiles=123456",
      "Path=/vo/atlas/data",
      "Path=/users/atlas-vo/data",
      "Problem=The report cannot be created because ...",
    ]
     "TotalSize": 3000,    # these are the two capacity attributes
     "UsedSize": 1298      # these are the two capacity attributes
  },
```

GLUE2 applicability study: space-usage.json (4/4)

Step 104:

„here comes the cleaned up version of the next iteration example for storage space reporting based on GLUE2 terminology. The storage space is modelled by the (modified) GLUE2 StorageShare entity"

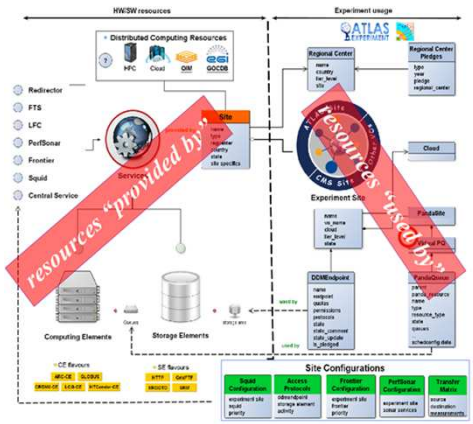
- Composed of VALID GLUE2 attributes
- It was necessary to introduce additional (new) attribute: NumberofFiles
- Violates GLUE2 json structure
- Redefines Path as multivalued attribute

Conclusion:
It is not feasable to use the current GLUE2 JSON rendering while it can be benefitial to re-use some of the attributes.


```
{   "StorageShare": [
       "PolicyRule": "vo:ATLAS",
       "CreationTime": "2016-11-02T12:16:03Z",
       "ID": "atlas:big-site.example.org:ATLASDATADISK",
       "SharingID": "HUMAN_READABLE_NAME_OF_THE_SHARE",
       "ServingState": "production",
       "Path": ["/atlas/data", "/users/atlas-vo/data", "/another/path"],
       "AccessLatency": "ONLINE",
       "Tag": ["ATLASDATADISK", "SCRATCHDISK"],
       "TotalSize": 3000,
       "UsedSize": 1298,
       "NumberOfFiles": 123456,
       "OtherInfo": "The report was created successfully, all green."
       ]
},
```

A more suitable approach for WLCG:

Computing Resource Information Catalog

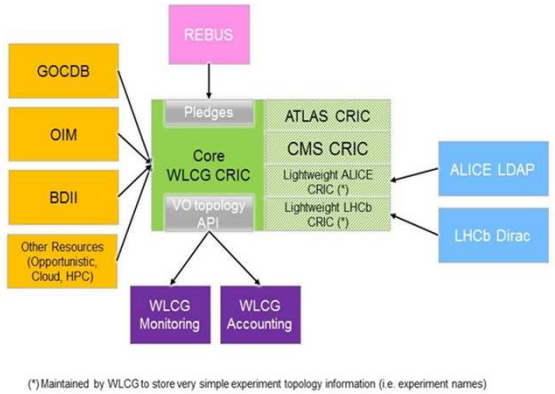


The information model:

- ensures clear separation between „provided by" and „consumed by"
- abstraction from physical resource to experiment frameworks
- integrates configuration and status information (resources, services)
- describes the experiment topology in terms of computing infrastructure

Main goals, the driving force behind the info model:

- create the CRIC framework which would allow various groups to define their own topology
- a light CRIC core + simplified CRIC experiments plugin, with basic REST (JSON) exports of e.g. compute or storage units

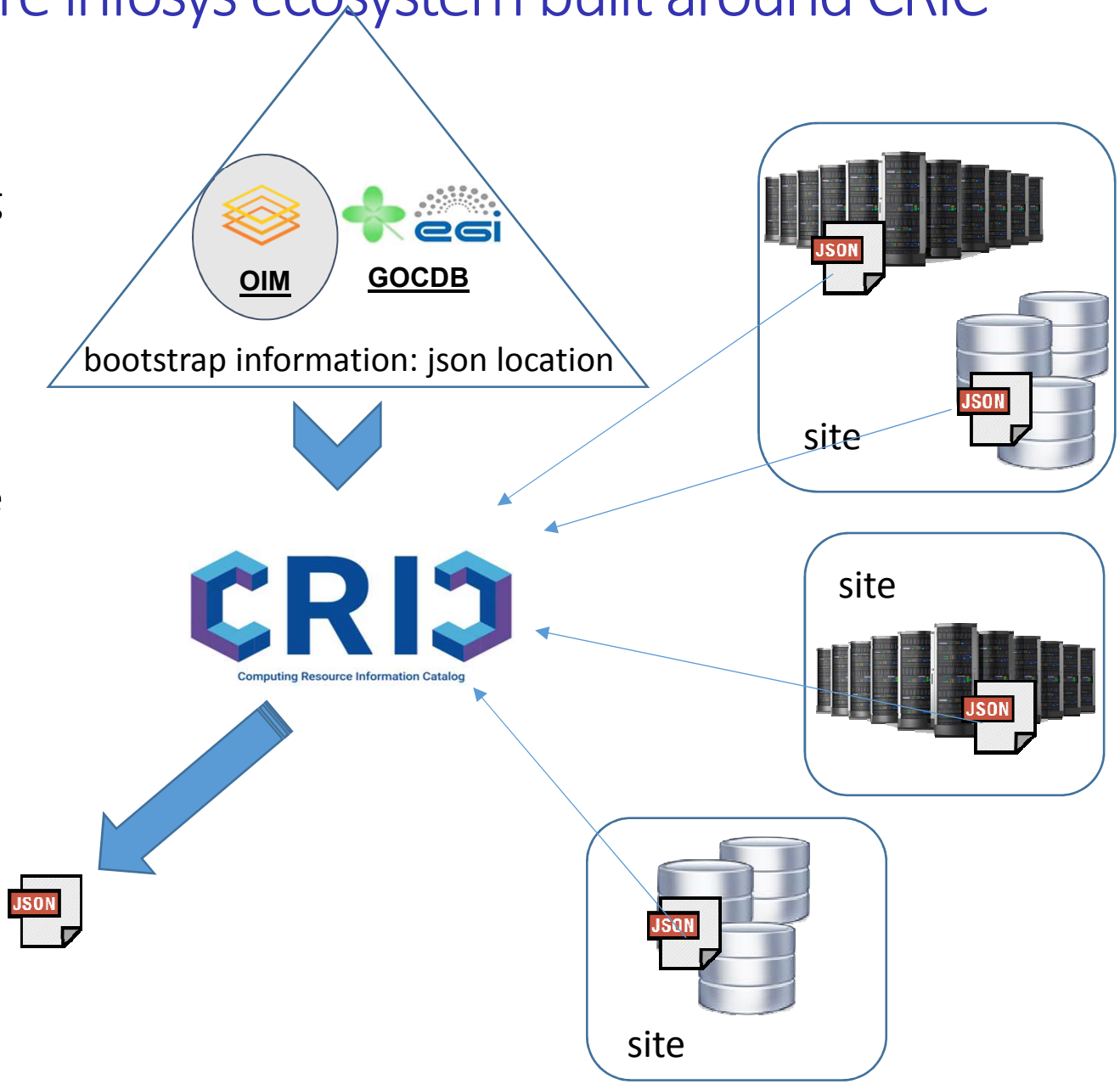


(*) Maintained by WLCG to store very simple experiment topology information (i.e. experiment names)

A vision of a future infosys ecosystem built around CRIC

- Compute, Storage, etc.. services deployed at sites are described by „simple json” according to info model
- Index services (e.g. GOCDB, OIM) maintain bootstrap info for json location and the „fetch protocol”
- CRIC aggregates service descriptions & maintains all the topology information
- Info consumers obtain exported jsons from CRIC, structured according to use-cases

Composable info models is a must!

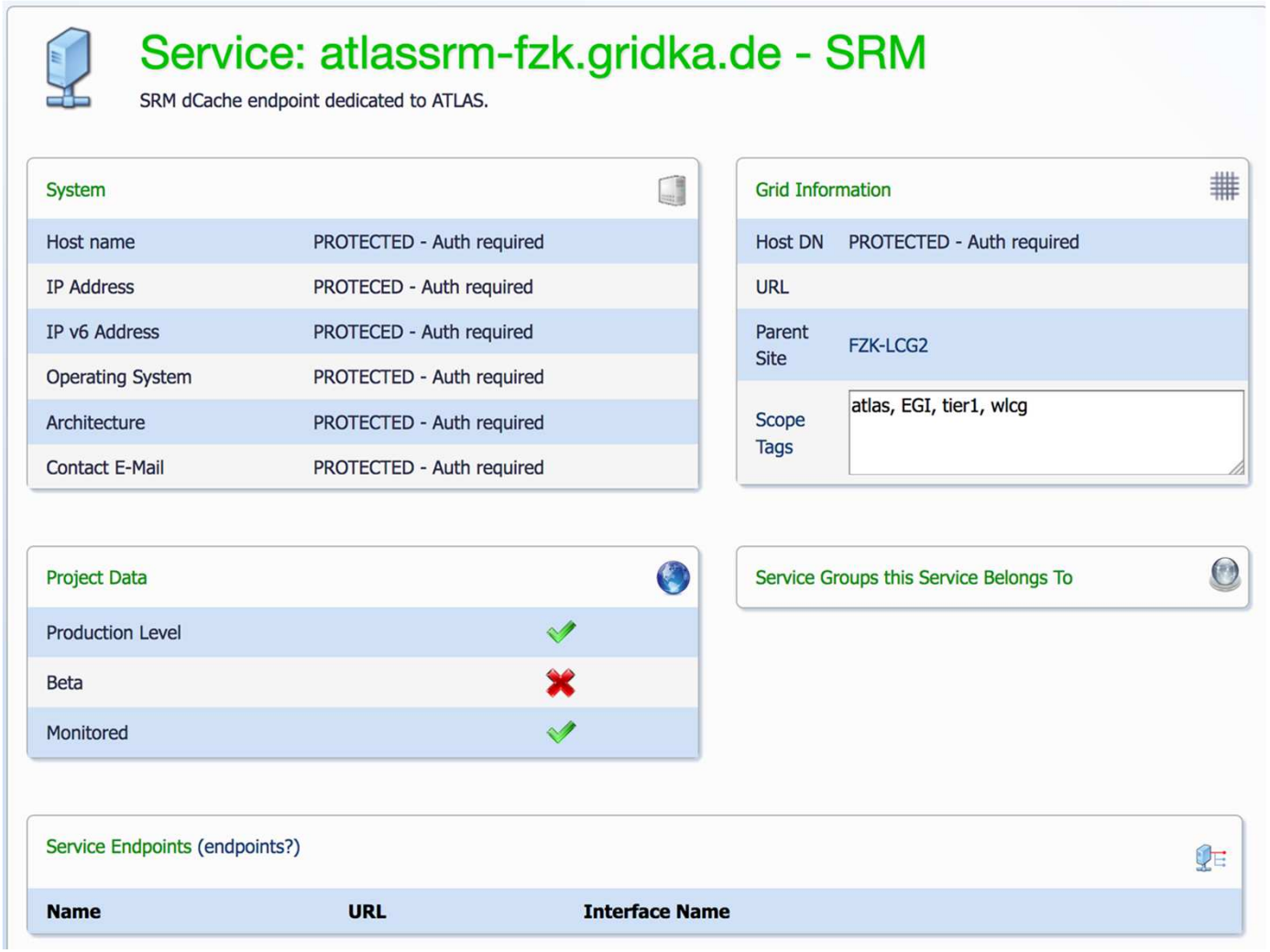


Info model: finding the proper balance

- Describe only those system characteristics that are really needed
- Dynamic - static separation
- Keep simple things simple
- BUT avoid oversimplification
- Allow flexibility without loosing structure
- ITERATIVE process

Pre-CRIC storage models

... either too little (too simplified)



Service: atlassrm-fzk.gridka.de - SRM

SRM dCache endpoint dedicated to ATLAS.

System

Host name	PROTECTED - Auth required
IP Address	PROTECED - Auth required
IP v6 Address	PROTECED - Auth required
Operating System	PROTECTED - Auth required
Architecture	PROTECTED - Auth required
Contact E-Mail	PROTECTED - Auth required

Grid Information

Host DN	PROTECTED - Auth required
URL	
Parent Site	FZK-LCG2
Scope Tags	atlas, EGI, tier1, wlcg

Project Data

Production Level	✓
Beta	✗
Monitored	✓

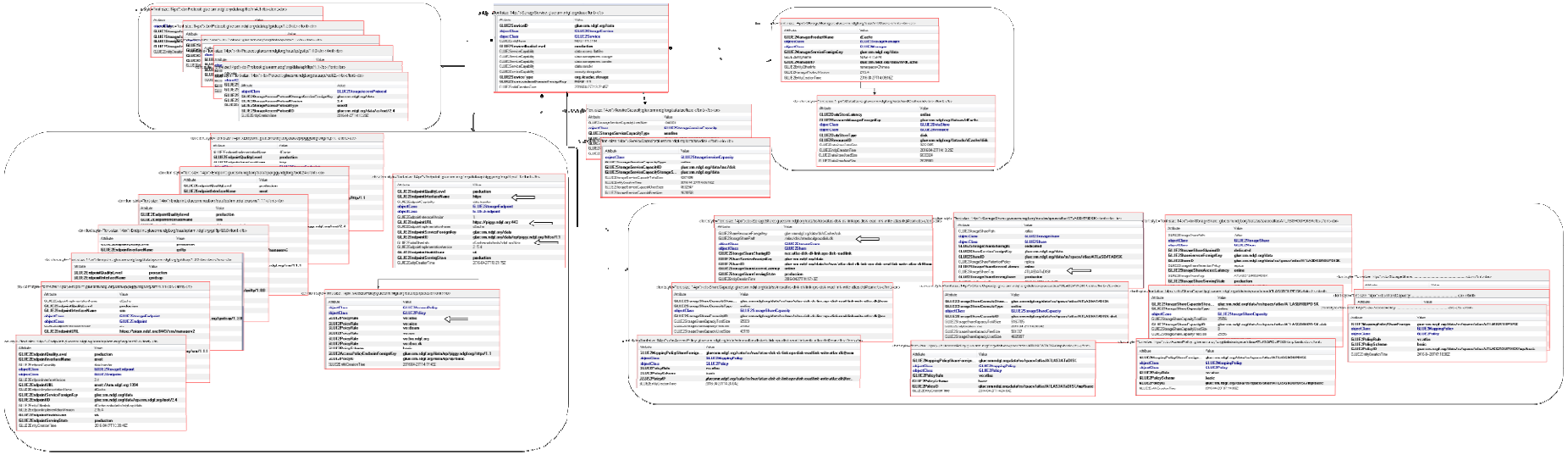
Service Groups this Service Belongs To

Service Endpoints (endpoints?)

Name	URL	Interface Name

Pre-CRIC storage models

... or too much!!



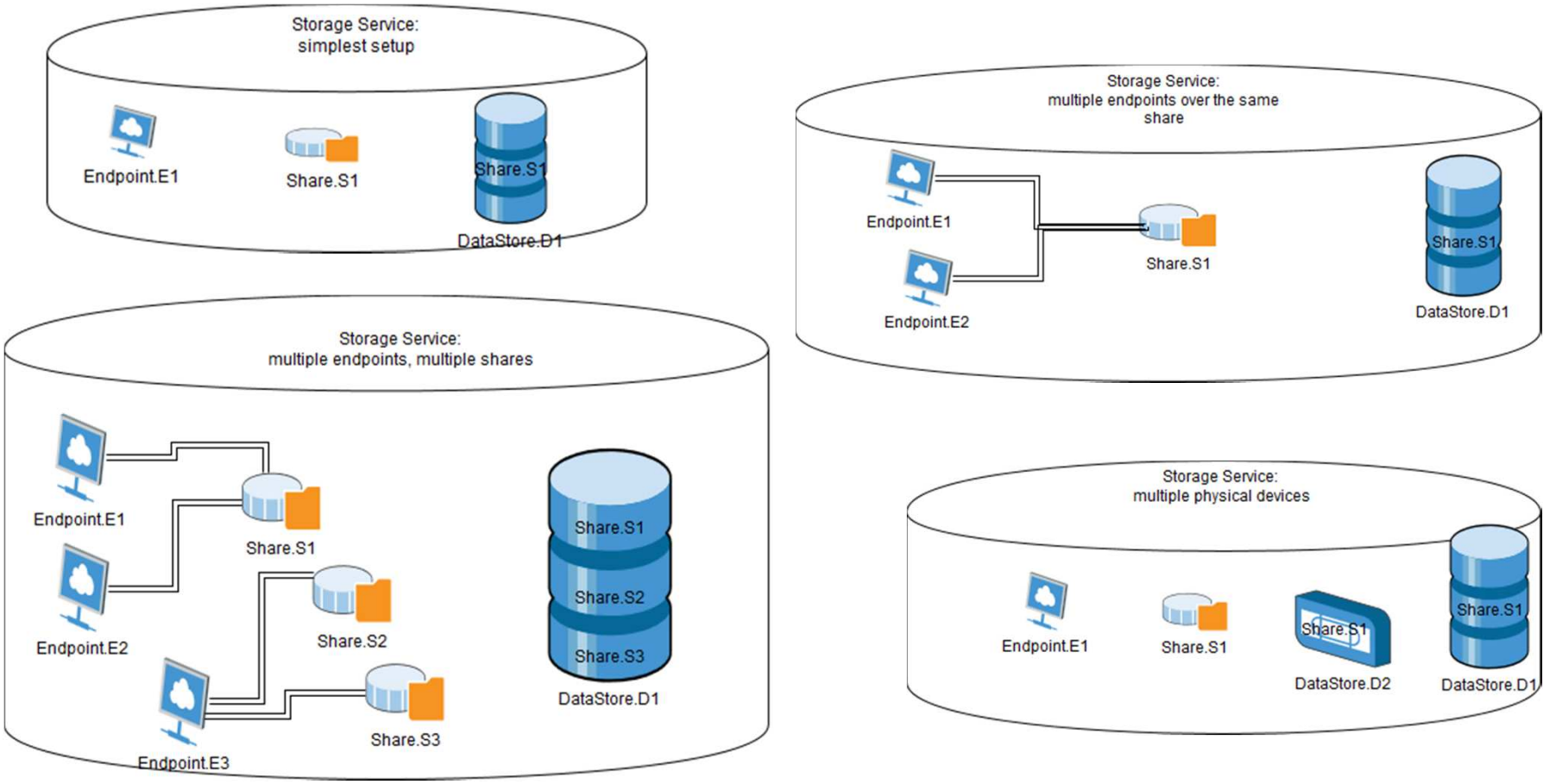
The complete set of GLUE2 records taken from LDAP-BDII describing the NDGF-T1 storage system

https://twiki.cern.ch/twiki/pub/AtlasComputing/AtlasGridInformationSystemStorageDeclaration/NDGF-T1-GLUE2.svg

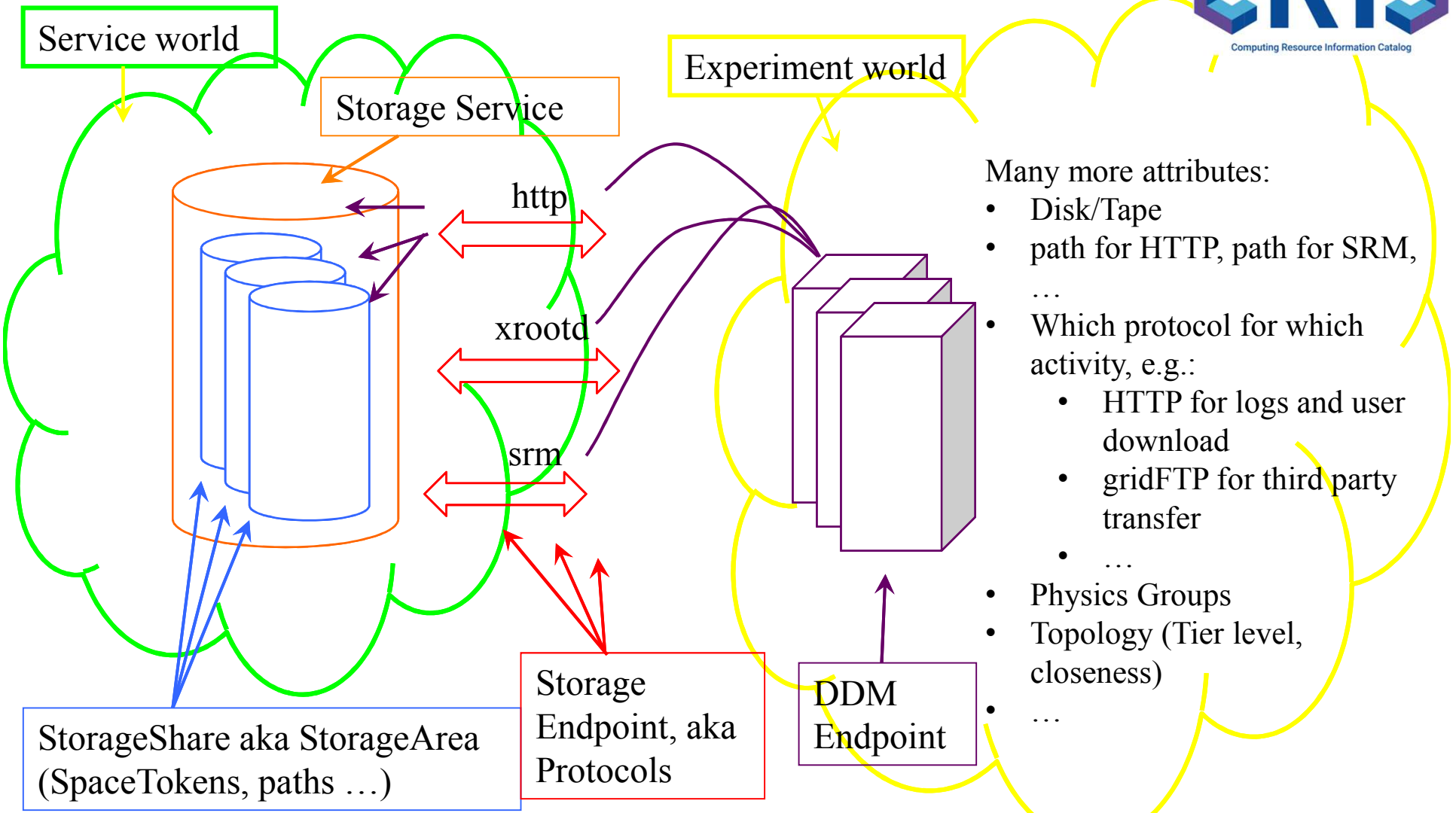
CRIC storage representation details: the set of objects

- StorageService: represents the entire storage system that makes its Shares, defined within a DataStore, available via Endpoints. Static information.
  - Attributes:name, id,servicetype, implementation, capabilities, qualitylevel, storagecapacity ...
- StorageShare: represents a logical storage area, a part of the storage capacity, allocated on DataStore(s) for a specific user group or use case. May contain dynamic information (e.g. space usage)
  - Attributes: name, id,policyrules, path, assignedendpoints, servingstate, accessmode, maximumlatency, retentionpolicy, defaultlifetime, maximumlifetime, expirationmode, totalsize, usedsize, numberoffiles, message
- StorageEndpoint: represents the network interface to the storage system that maybe contacted to manage and access data stored in the StorageShare(s) of DataStore(s). May contain dynamic information (e.g. healthstate or servingstate)
  - Attributes: name, id, endpointurl, assignedshares, interfacetype, interfaceversion, capabilities, qualitylevel, servingstate, healthstate, message
- DataStore: describes a homogeneous instance of a physical storage extent (e.g. a tape or a disk server). Static information.
  - Attributes: name, id, datastoretype, latency, totalsize, vendor, message

CRIC representation details: storage object relations



CRIC representation details: Storage Endpoint diagram



and a corresponding storage JSON document (partial):

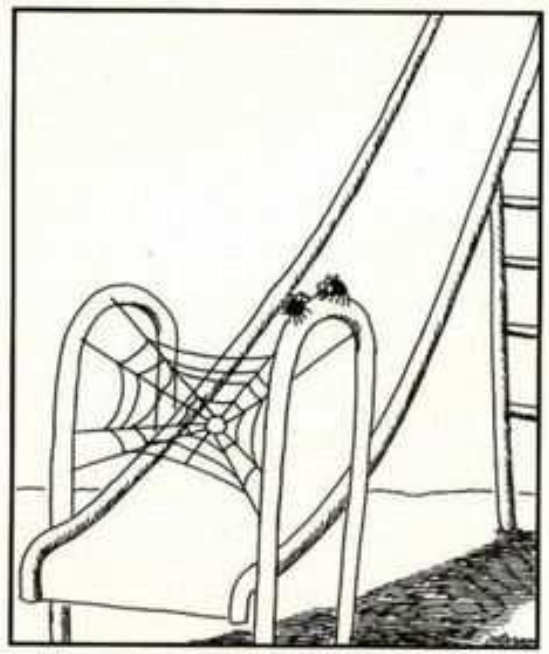

```
{"storageservice": {
                "name": "FZK-ATLAS",
                "id": "global unique",
                "servicetype": "one of the agreed service types",
                "implementation": "dcache-2.13.51",
                "capabilities": [feature1, feature2, feature3],
                "qualitylevel": "production",
                "storagecapacity": {},
                "storageendpoints": [
                {"name": "atlassrm",
                "id": "global unique",
                "endpointurl": "httpg://srm-fzk.gridka.de:8443/srm/managerv2",
                "interfacetype": "srm",
                "interfaceversion": "2.2",
                "capabilities": ["data.mgt.transfer", "data.mgt.storage"],
                "qualitylevel": "production",
                "servingstate": "production",
                "healthstate": "ok",
                "assignedshares": ["all"],
                },
                {"name": "atlasgsiftp",
                "id": "global unique",
                "endpointurl": "gsiftp://f01-060-114-e.gridka.de:2811",
                ...
                },
                {...}
                ],
```

```
"storageshares": [
                {"name": "ATLASDATADISK",
                "id": "global unique",
                "policyrules": ["defaultpermission", "acl1", "acl2"],
                "servingstate": "open",
                "accessmode": ["read/0", "delete/2"],
                "totalsize": 26789588699,
                "usedsize": 123564878,
                "numberoffiles": -1
                "path": ["/../atlasdatadisk/", "/../atlasdata/"],
                "assignedendpoints": ["all"],
                ...
                },
                {"name": "ATLASSCRATCHDISK",
                "id": FZK-ATLAS.S2,
                "path": ["/storage/data/scratch/"],
                "assignedendpoints": ["atlassrm"],
                ...
                },
                {"name": "ATLASGROUPDISK",
                "id": FZK-ATLAS.S3,
                "path": ["/storage/data/atlasgroup/"],
                "assignedendpoints": ["atlasgsiftp"],
                ...
                },
                {...}
                ],
```


https://twiki.cern.ch/twiki/pub/AtlasComputing/AtlasGridInformationSystemStorageDeclaration/storage_service.json

Summary & outlook

- WLCG would benefit from a common information model
- The existing models (e.g. GLUE) were found not being suitable
- CRIC, the infosys component of WLCG, offers a better solution
- The work is ongoing as an iterative process
  - In addition to storages, other core CRIC objects such as compute service & site being modelled
  - Mixture of bottom-to-top & top-to-bottom approach
- Based on the early feedbacks, there is a hope this time the info modelling is being done properly (at least for WLCG)


"If we pull this off, we'll eat like kings."

It is by far not a trivial exercise to catch this lunch.....

credits:

- cartoons are taken from „The Far side" by Gary Larson
- CRIC pictures are from CRIC team presentations

backup

simplified JSON for compute resource

```
{"AdminDomain": [
        "Name": "ATLAS Site 1",
        "Owner": "University of Stockholm"
        "Location.Country": "Sweden",
        "Location.Place": "Stockholm",
        "Location.Latitude": "35",
        "Contact": "email or web address",
        {"ComputingService": [
                "Name": "Monolith",
                "Type": "Traditional batch cluster",
                "Qualitylevel": "Production",
                "Capability": "automatic data staging"
                ...
                ],
                {"ComputingEndpoint": [
                        "URL": "https:url_to_the_ce",
                        "InterfaceName": "ARC-CE",
                        "InterfaceVersion": "5.0.3"
                ]},
                {"ComputingShare": [
                        "Name": "ATLAS Prod",
                        "MappingQueue": "longdedic",
                        "SchedulingPolicy": "preemptable",
                        "MaxWalltime": "16000",
                        "MaxMainMemory": "12"
                ]},
                {"ExecutionEnvironment": [
                        "Name": "Fat memory node",
                        "PhysicalCPUs": "2",
                        "LogicalCPUs": "12",  //  this corresponds to the cores
                        "TotalInstances": "5",  // number of WNs of this type
                        "MainMemorySize": "24GB",
                        "CPUVendor": "Intel",
                        "ConnectivityIn": "True",
                        ...
                ]},
                {"ExecutionEnvironment": [
                        "Name": "WN Type2",
                        "PhysicalCPUs": "1",
                        "LogicalCPUs": "4",  //  this corresponds to the number of cores
                        "TotalInstances": "300",  // number of WNs of this type
                        "MainMemorySize": "12GB",
                        "CPUVendor": "Intel",
                        "ConnectivityOut": "False"
                        "Scratchdisksize": "800"  //not a GLUE2 attribute
                        ...
                ]}
        }
]
}
```