Managed by

Towards Grid Checkpoint Architecture

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What is the checkpointing?

- Checkpointing is a process of preserving a snapshot of application state that will allow continuation of computing from point of time when checkpoint was taken.

- What is it used for?
  - migration
  - fault tolerance
  - load balancing
  - ...

What are the types of checkpoitning?

- System (kernel)
  - language independent
  - source independent
  - hardware dependent
  - operating system dependent
  - hard to impelement distributed checkpointer

What are the types of checkpoitning?

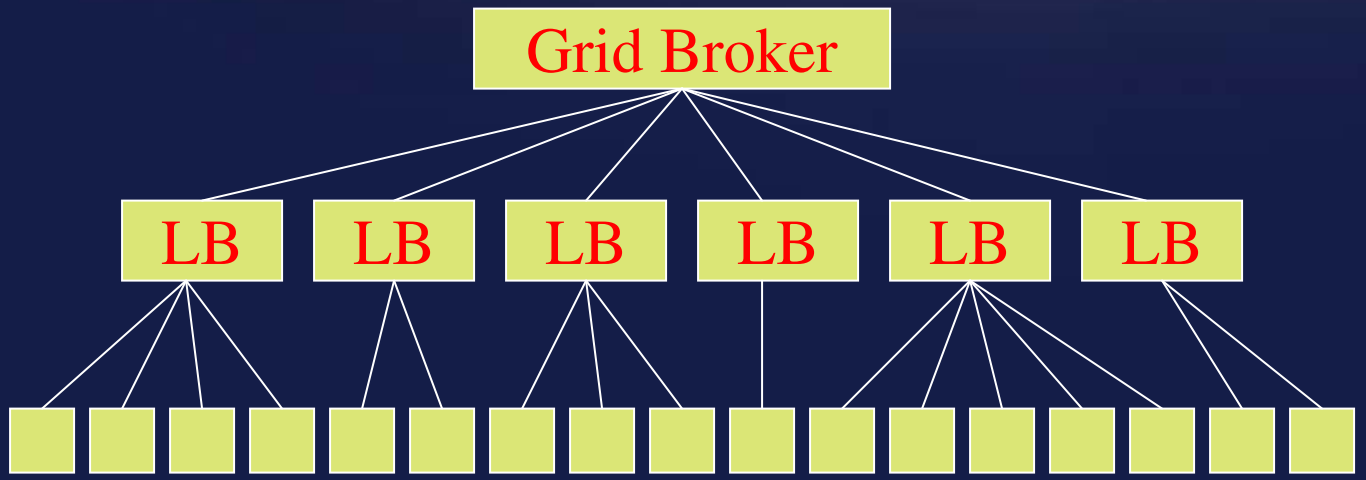
- User (library)
  - language dependent
  - may be source independent
  - hardware dependent
  - operating system dependent
  - distributed checkpointer may be implemented

What are the types of checkpoitning?

- Application (hard-coded into application)
  - language dependent and independent
  - source dependent
  - may be hardware independent
  - operating system independent
  - distributed checkpoint possible

Grid architecture

(from checkpointer point of view)



Why is checkpointing in grid that important?

Grid applications may be huge (running on hundreds of nodes).

- Grid is prone to failures!
- Grid has to be managed!
- Efficiency and resource utilization.

The problem with grid checkpoitning

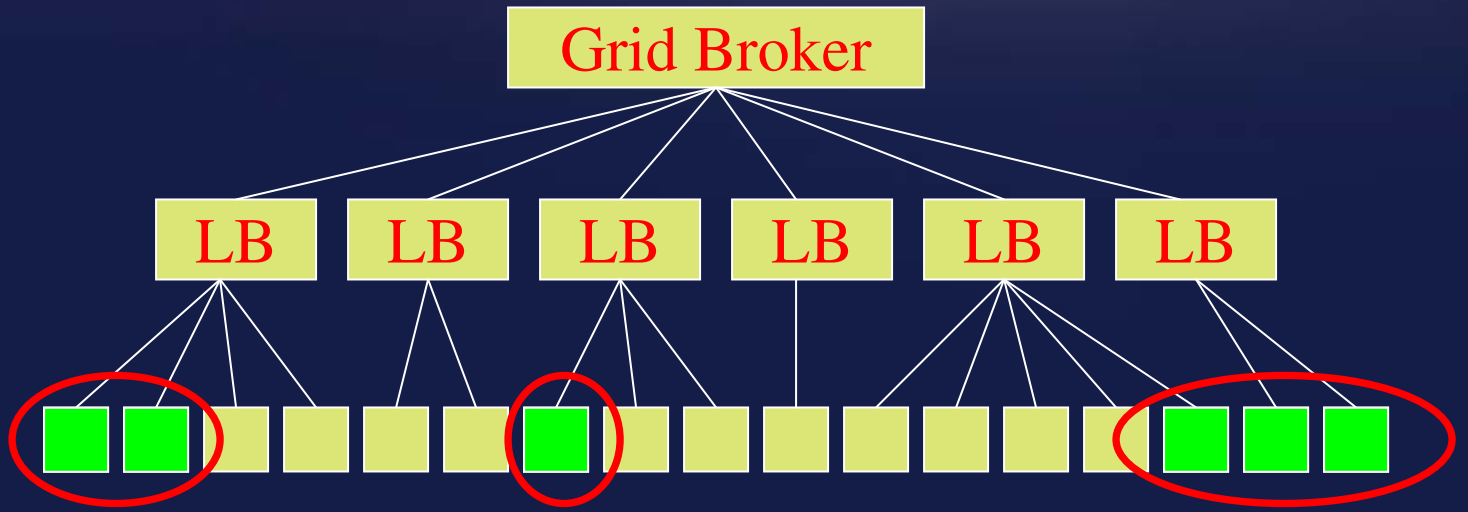
- There is no grid checkpointer!
- Grid is heterogeneous, checkpointers are (in most cases) not!
- No standard on (even local) checkpointers!

Solution

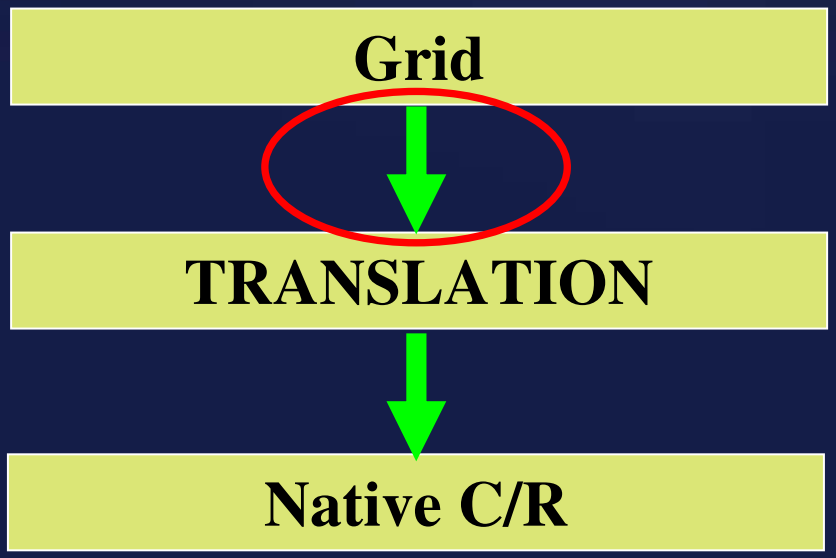
- **Why not to integrate all existing (and future) checkpointers into grid chekpointing service?**

Solution

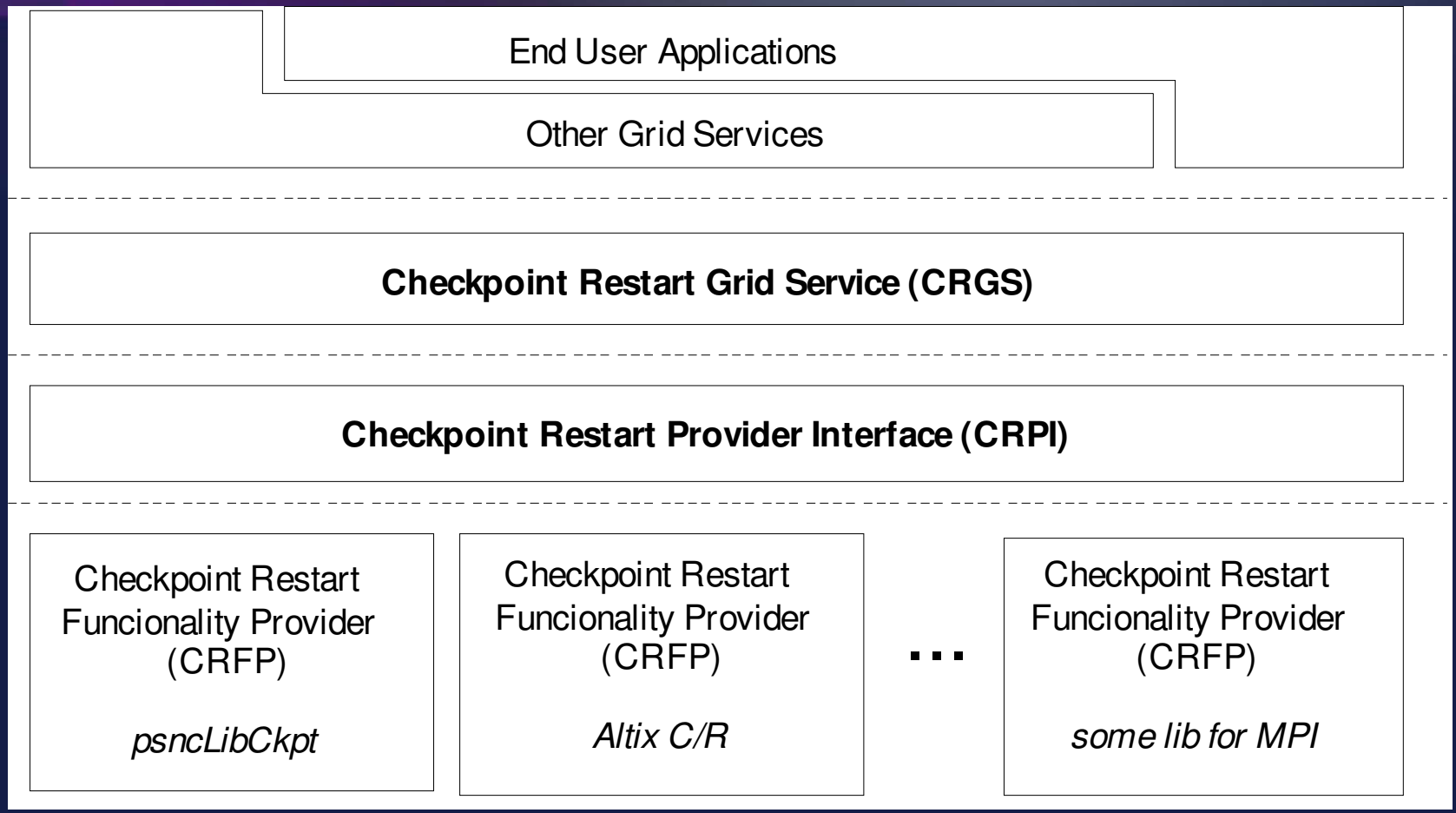
(Heterogeneity problem)



Solution
(no standards)



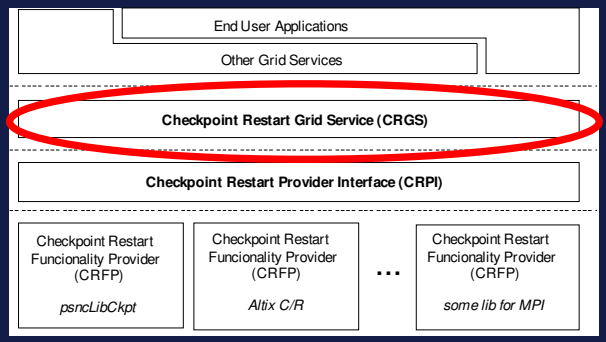
Grid Checkpointing Architecture (GCA)



Components description

Checkpoint Restart Grid Service (CRGS)

- Exposes the checkpointing functionality to the whole Grid. Most probably this layer will be further decomposed on a few smaller interacting components.
- Cooperates with external services in order to provide the coherent checkpointing mechanism within the Grid environment.
- Delegates some requests to the lower layers (till to actual low-lever checkpointing systems).
- The external services that are considered to be involved in checkpointing workflow have to be aware of this cooperation. They must provide the CRGS with appropriate services and on the other hand CRGS must provide them with appropriate functionality as well.
- Among other things it register the ontology of underlying checkpointing systems with the information services.



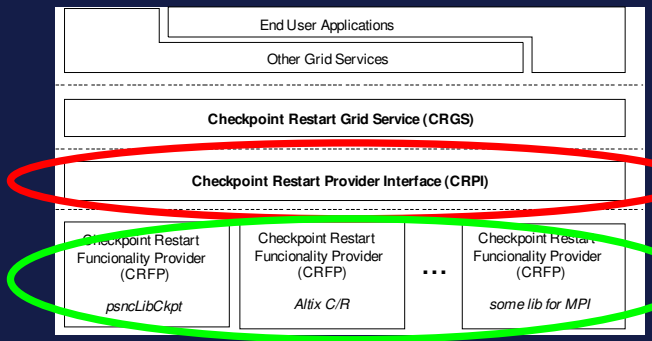
Components description

Checkpoint Restart Provider Interface (CRPI)

- This layer defines set of interfaces, rules and conventions that have to be fulfilled so that incorporate any checkpointing system into the CRGS.

Checkpoint Restart Functionality Provider (CRFP)

- It is actual adaptation of any checkpointing system to the CRGS. The implementation of the CRFP have to comply with CRPI.



Other grid checkpointing projects

GridCPR Architecture by GGF

„One of goals of the Grid Checkpointing and Recovery Working Group (GridCPR WG) is to define a user-level API and associated layer of services that will permit checkpointed jobs to be recovered and continued on the same or on remote Grid resources"

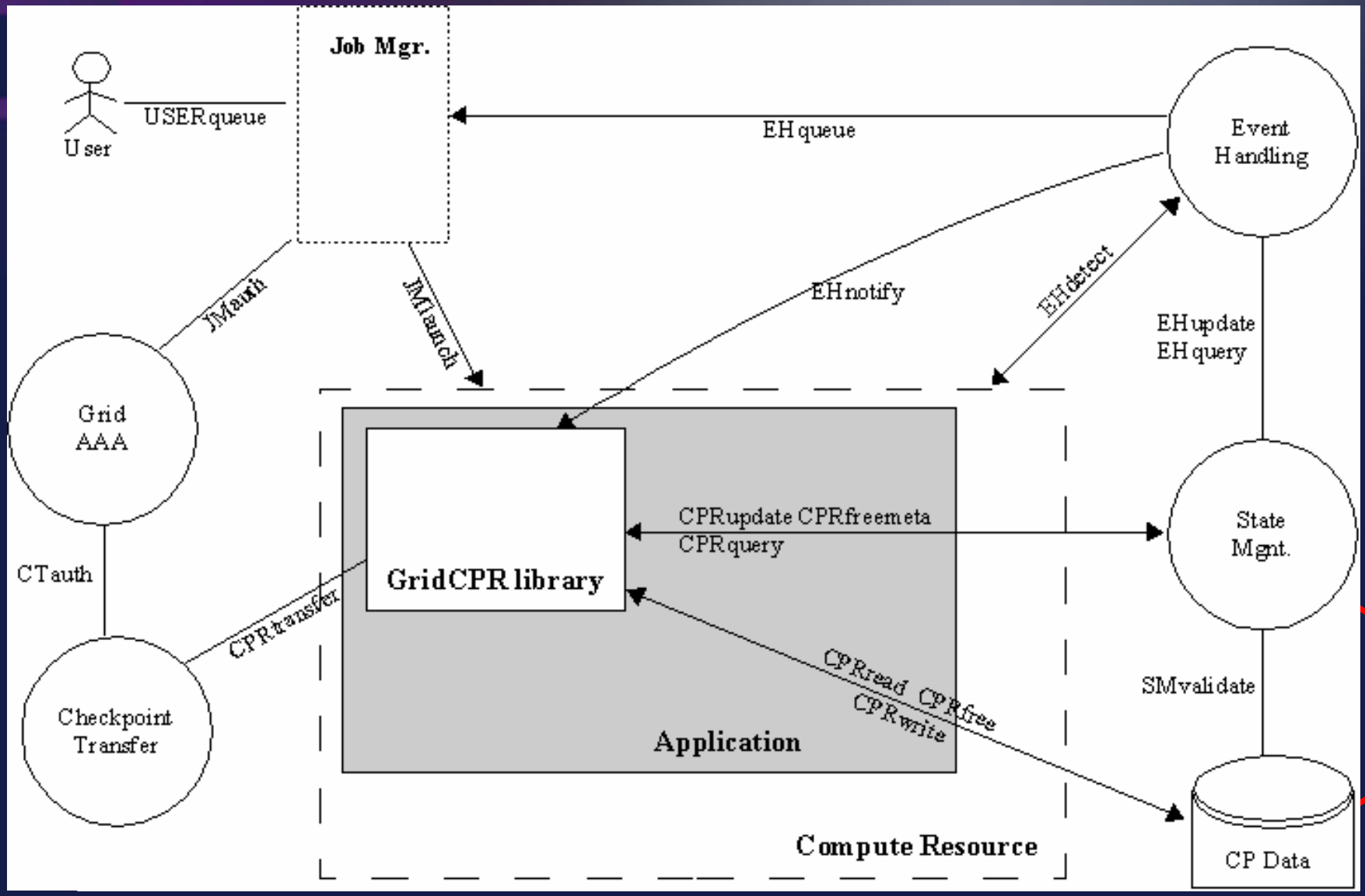
„The current scope of GridCPR WG as described in its charter charter includes Grid applications that implement **ALC**"

„Use-cases based on **SLC** were judged to be outside the WG's current scope …."

GGF's GCA is a library checkpointing which uses Grid services.

ALC – Application Level Checkpointing

SLC – System Level Checkpointing


Job Mgr.
User
USERqueue
EHqueue
Event Handling
JMauth
JMlaunch
EHnotify
EHdetect
EHupdate
EHquery
Grid AAA
GridCPR library
CPRupdate CPRfreemeta
CPRquery
State Mgnt.
CTauth
CPRtransfer
CPRread CPRfree
CPRwrite
SMvalidate
Checkpoint Transfer
Application
Compute Resource
CP Data

CoreGRID C/R service summary

- **Major qualities:**
  - **simple**
  - **flexible**
  - **open**

- **Revised version is „under construction”!**
  - **refined architecure**
  - **description of api**

THANK YOU!