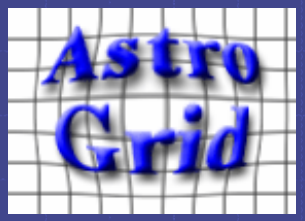


PPARC

A PPARC funded project

Using AstroGrid CEA to access compute grids

Guy Rixon

Grid Workshop

Strasbourg, June 2005

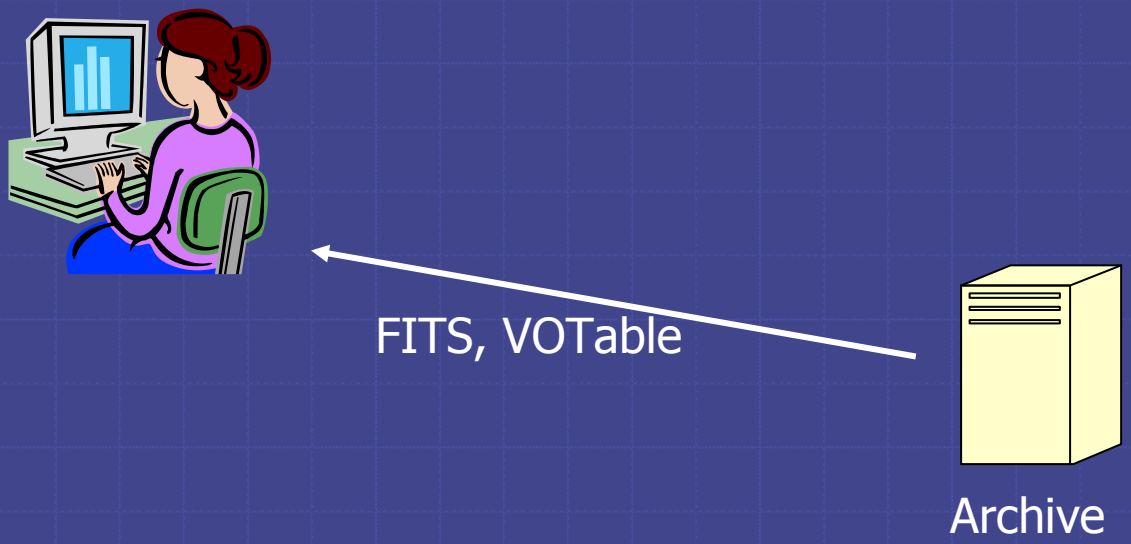
Outline

- What the IVO movement has done that's grid-like.
- What CEA adds to IVO operations
- Why "The Grid" is a hard sell to astronomers
- CEA linked to compute grids

Is the IVO a grid?

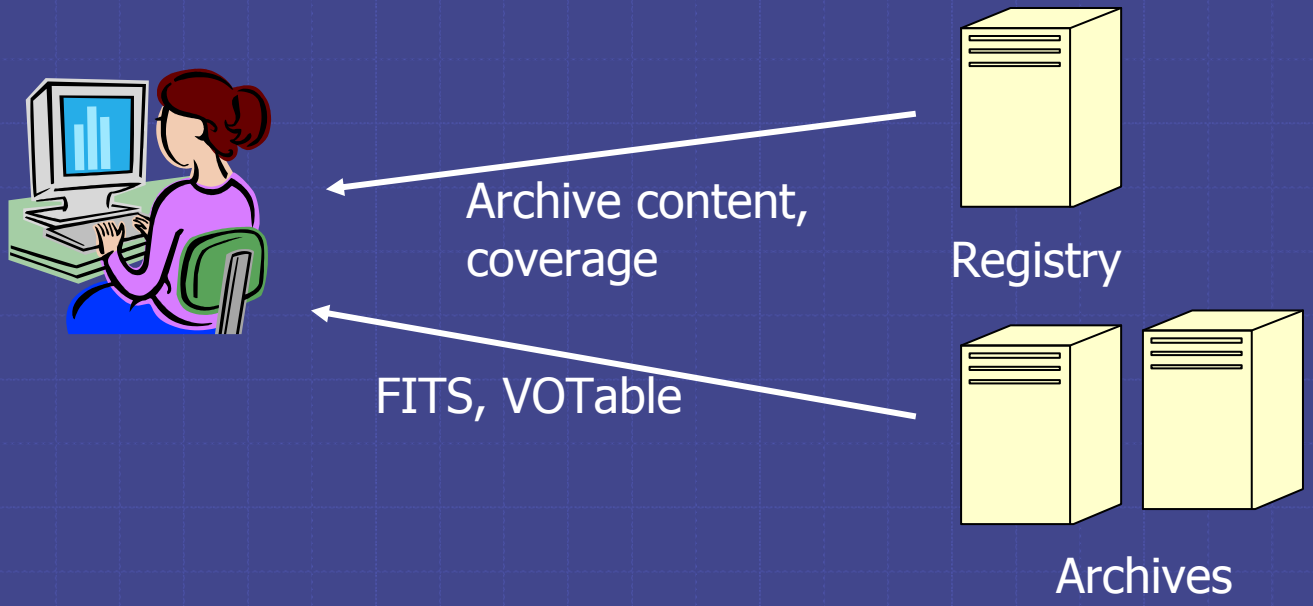
- IVO = International Virtual Observatory
  - The interoperable intersection of regional VOs
  - Global; singular
  - Internal standards managed by IVO Alliance (IVOA)
- IVO is a network of (web) services
- A service network might also work as a grid
- A grid makes available a commodity:
  - CPU cycles (compute grid)
  - Storage (data grid)
  - ??? (value-added grid)
- What's the commodity in IVO?

IVO does data retrieval



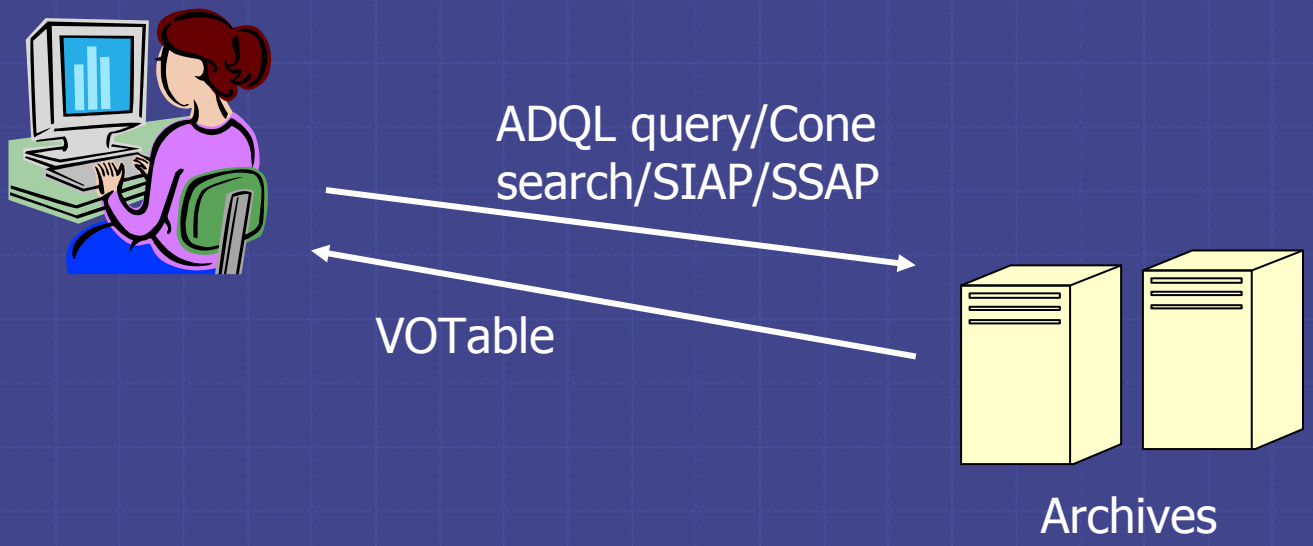
- Commodity: data in standard, self-describing formats

IVO does resource mirroring



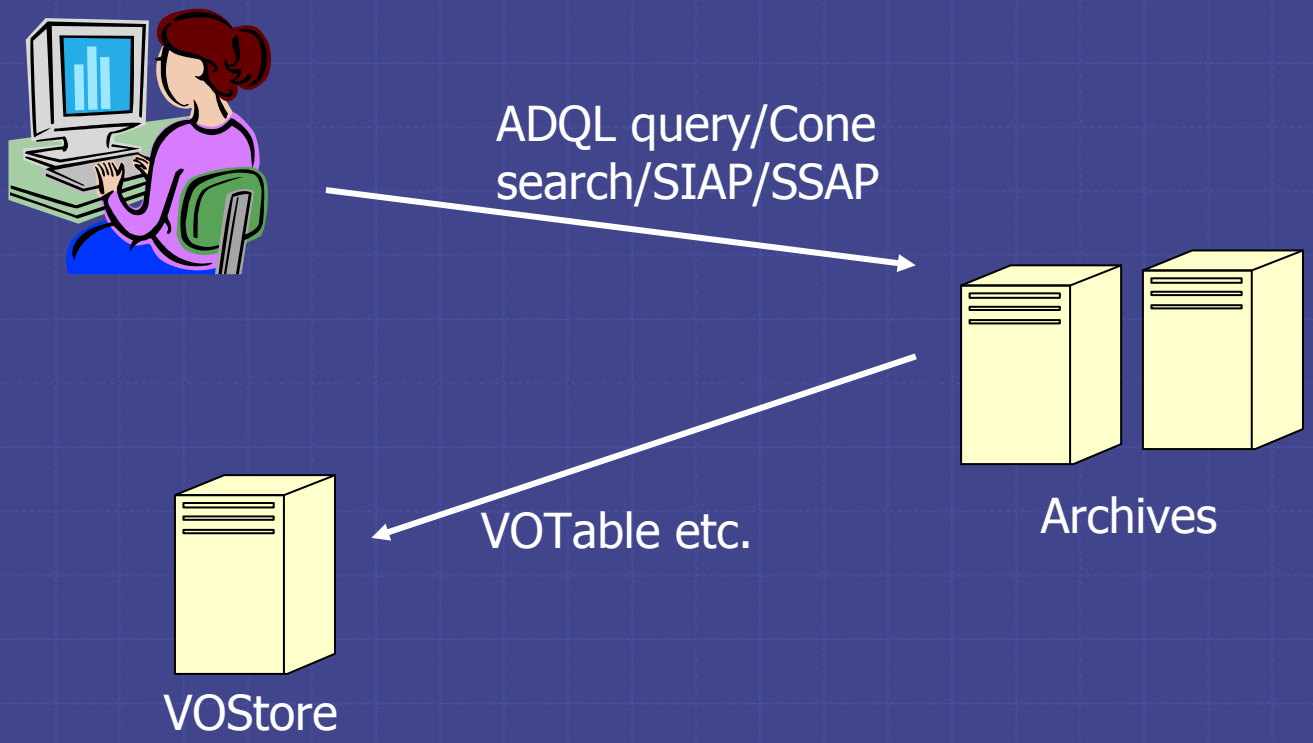
- Commodity: standard description of archives
- Commodity: archives mirroring same data

IVO does data selection

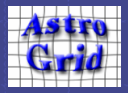


- Commodity: data-selection *applications* available on all archives with standard interfaces.
- NB: a query is a kind of application

IVO does data storage



- Commodity: storage



- What the IVO movement has done that's grid-like
- What CEA adds to IVO operations
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Some limitations of current IVO

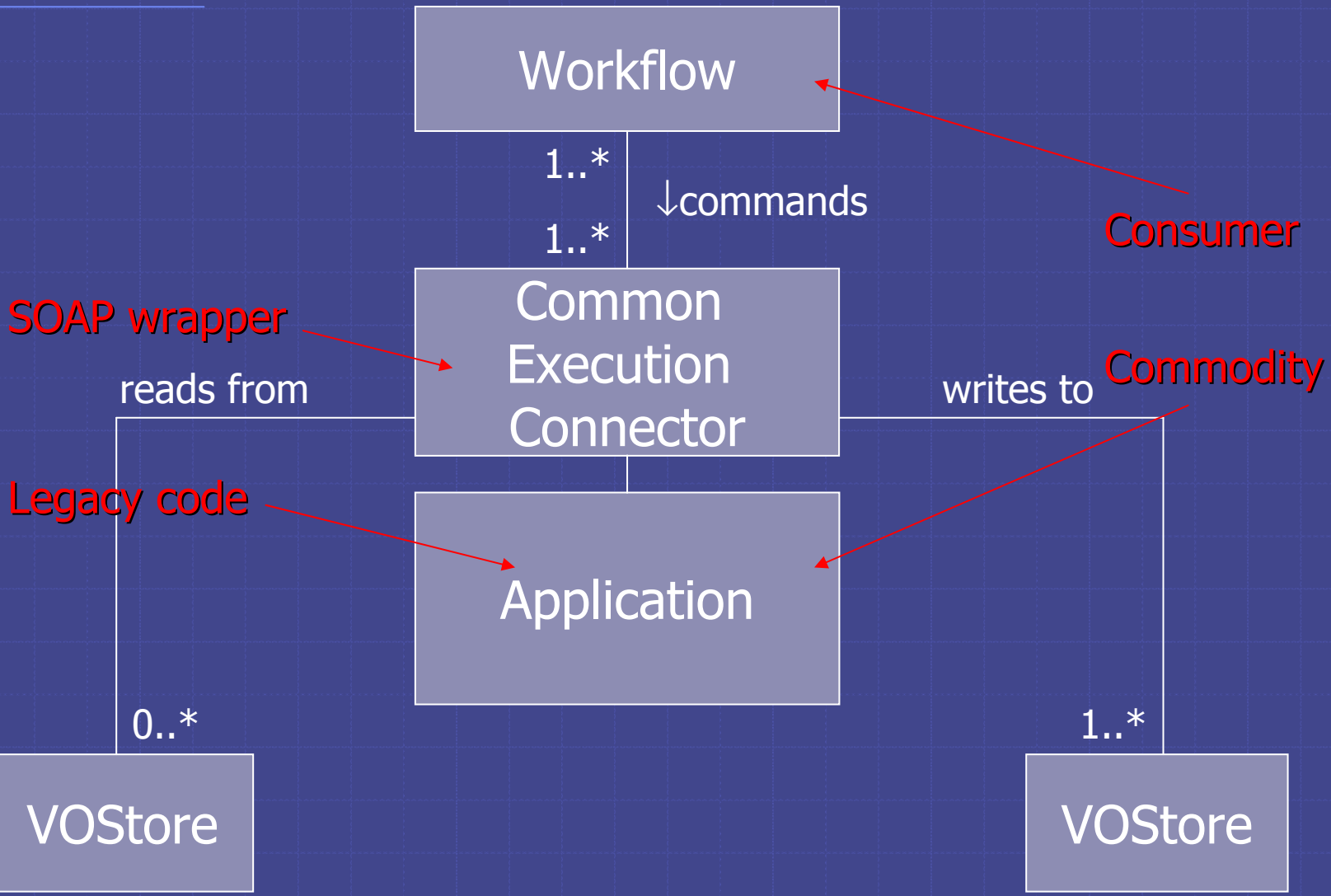
- Standard applications, but one hard-won IVOA standard per interface type
  - ⇒ Few applications supported
- No standard apps independent of data archives
  - ⇒ no way to register applications with data inputs
- Registry describes services, not applications
  - ⇒ hard to find exact mirrors of resources.
- Most standard apps require synchronous calls
  - ⇒ doesn't scale to long-running jobs
- VOStore forthcoming but not yet part of standard apps
  - ⇒ no data grid for most operations

CEA: goals

- To create a uniform interface and model for an application and its parameters.
- To provide extensions with the VO Resource schema that can describe a general application.
- To provide asynchronous operation of an application.
- To allow for the data flow to not necessarily have to follow the call tree.

*Abstracted from Harrison, IVOA Note "**A Proposal for a Common Execution Architecture**"*

CEA: filter-like processes



CEA: new resource types for registry

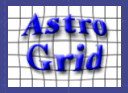
- CeaApplication
  - Describes an application
  - Defines application parameters
  - Groups parameters into interfaces
  - Basis for standardization/mirroring of *apps*
- CeaService
  - Lists registered applications that service can run
  - States service endpoint

CEA: JDL and WSDL contract

- All CEA services are SOAP services
- All have the same WSDL contract
- The standard contract uses a Job-Description Language.
- ⇒ call to application is defined by an XML document passed to CEA service.

CEA is a grid?

- CEA makes the IVO more grid-like
  - Can run "any" application
  - Applications as proper commodities
  - Data grid reconnected to applications
  - Asynchronous execution of long jobs
  - Offers processing power without exposing details
- CEA is *a* grid…but it is not part of "The Grid".
- **"Why aren't AstroGrid using The Grid?"**



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“Why don’t astronomers use The Grid?”

Grid acceptance at IoA Cambridge (observers):

EGEE: ~20,000 CPUs. Little interest.

UK National Grid Service: ~2000 CPUs. Little/no interest.

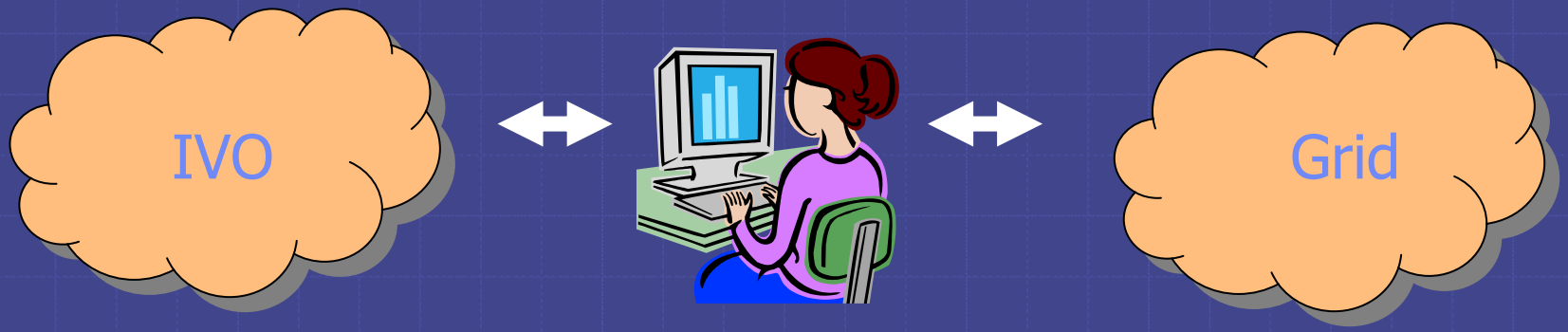
CamGrid: ~650 CPUs. Little/no interest.

Departmental grid: ~50 CPUs. Saturated with jobs

- Observational astronomers don’t make much use of existing, ***external*** grids: why?

What's the use case?

- Rephrase the question: why *should* astronomers use an external compute grid?
  - Run calculations that can't otherwise run at all.
  - Higher throughput of small calculations.
- Refine the question: should the IVO be involved in astronomers' use of grids?
  - Or is the IVO a complementary alternative to "the Grid"?



Nature of obs calculations

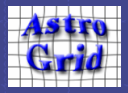
- Observational astronomy has few "big" calculations
  - Atomic calculations usually run on one CPU
  - C.f. theoretical astronomy
- Observational astronomy has many repeated calculations
  - E.g. image processing: embarrassingly parallel
  - Few low-level operations per pixel; not CPU limited.
- Observational astronomy uses RDBMS for many large-data calculations
  - Significant processing inside DB (e.g. SDSS)

Win condition for use of grid

- Consider processing of n similar data-sets
- What is duration t for whole experiment?
  - t_c – time to process one data-set
  - t_d – time to transfer one data-set to processor
  - t_i – time to understand/install/gridify application s/w
- Local computation:
  - $t_l = t_i + n(t_c + t_d)$
  - $t_i \rightarrow 0$ in typical case
  - $t_d \rightarrow 0$ iff data local
- Grid computation (n-way parallel)
  - $t_g = t_i + t_c + nt_d$
- Grid advantage requires:
  - $t_i + nt_d << (n\text{-}1)t_c$ (if data are local)
  - $t_i << (n\text{-}1)t_c$ (if data are remote)

Astronomical win condition for use of grid

- As $n \rightarrow \infty$:
  - Gridworthyness depends on t_d / t_d for local data…
  - …but grid wins automatically for remote data…
  - …and all data are remote in IVO.
- Typical image-processing computation:
  - $t_c \sim 5$ seconds
  - $t_d \sim 3$ seconds
  - 1 day < t_i < 1 week for external grid?
  - $\Rightarrow t_i$ dominates until $n \sim 10{,}000$
  - Most astro experiments aren't that big!



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Making t_i go away

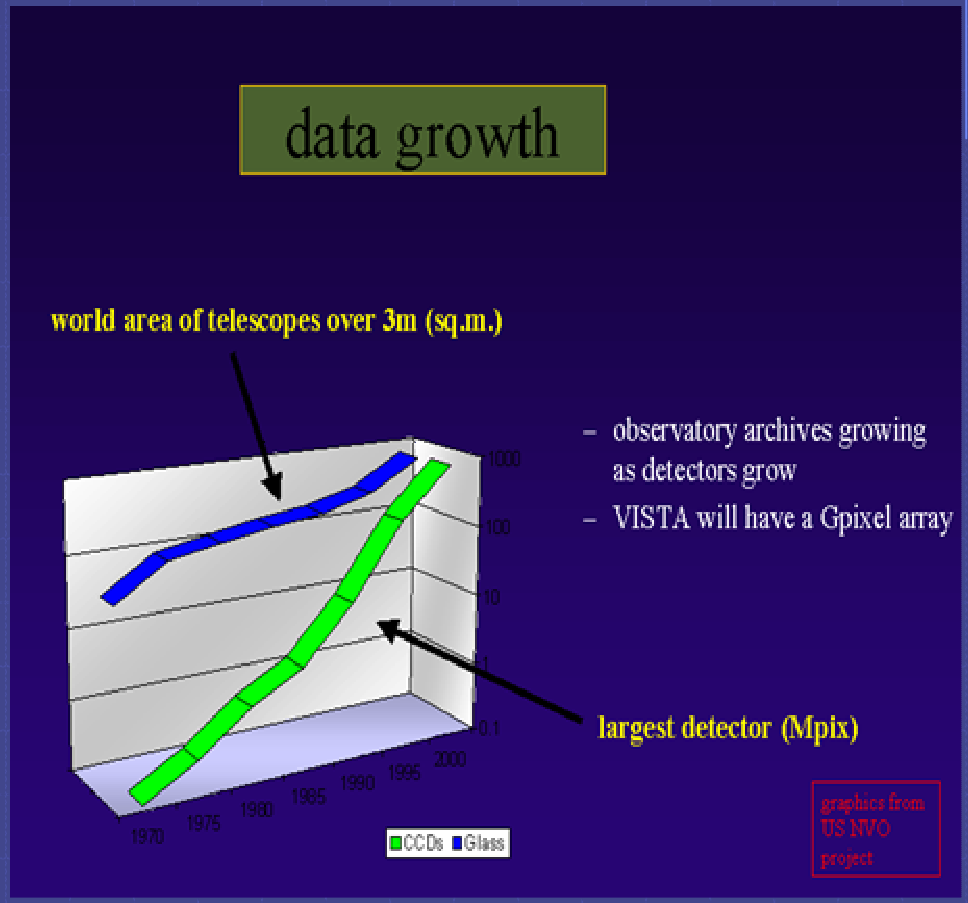
- Astronomers won't use The Grid until we make it easy.
- Need a library of prepared applications
  - Provided as services
  - Different services go to different execution environments (i.e. different grids) …
  - …but external interface is the same for given app.
- CEA already does this
  - Well-known, registered apps
  - Run as sub-processes of SOAP service
  - Local configuration supported but hidden from users.

CEA does grid

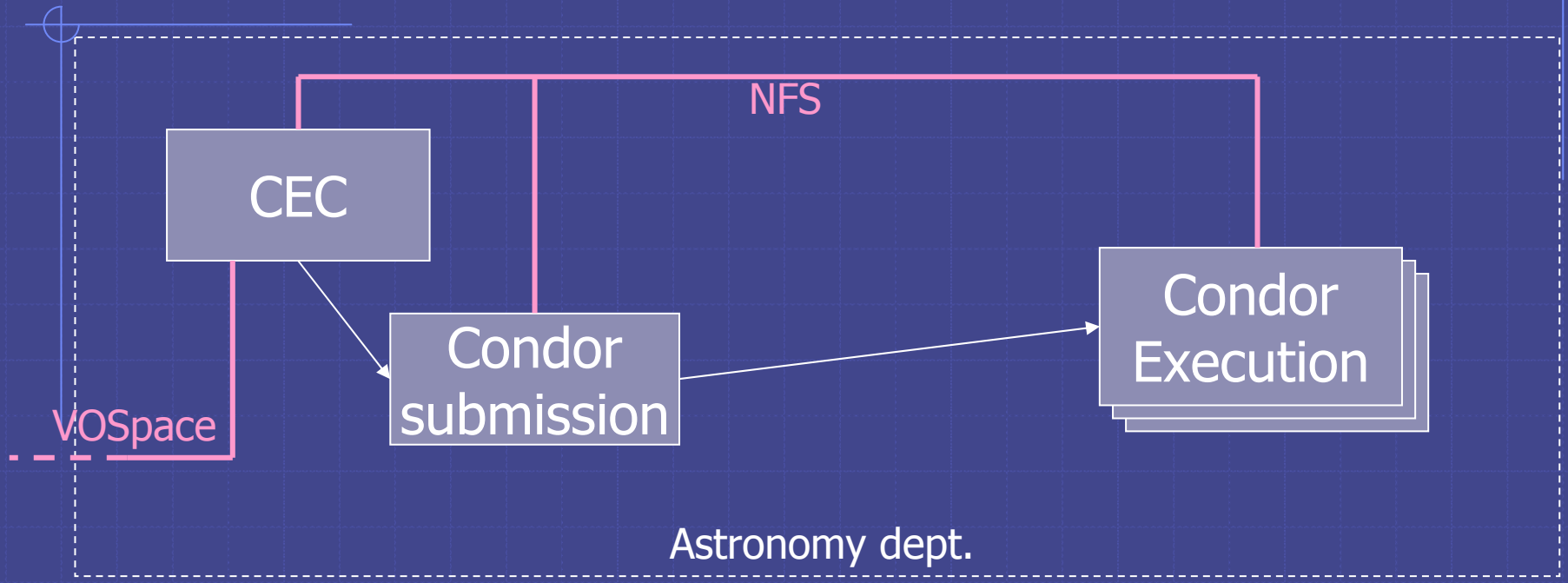
- A CEA service can drive “any” CL application
  - ⇒ it can work client end of grid toolkit
  - ⇒ it can delegate work to external grid

CEA *needs* grid

- Data volume looms
- CEA concentrates demand on few sites
- Service host can't handle all processing
  - ⇒ need at least local grid, e.g. on cluster
- Volunteer sites donate a little h/w
  - Demand can exceed donated resources
  - Need to get more computers.
  - Grid projects have all the h/w funding!
  - ⇒ need external grids

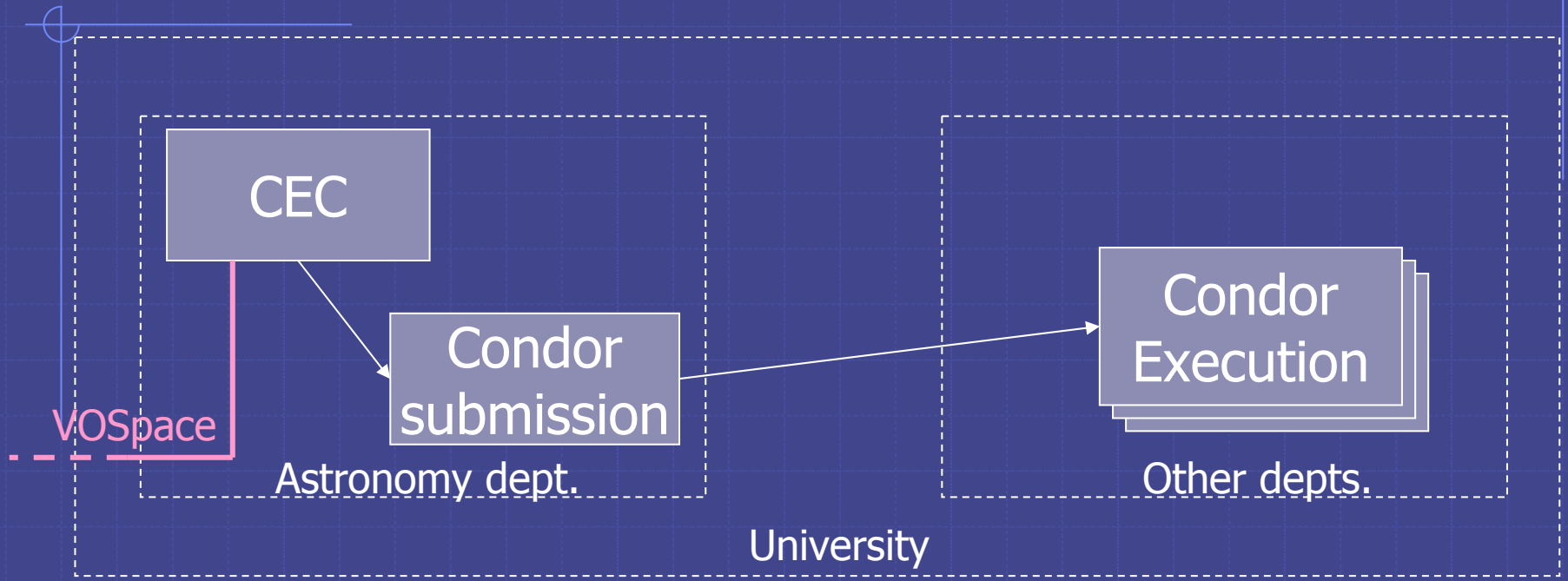


CEA + local condor pool



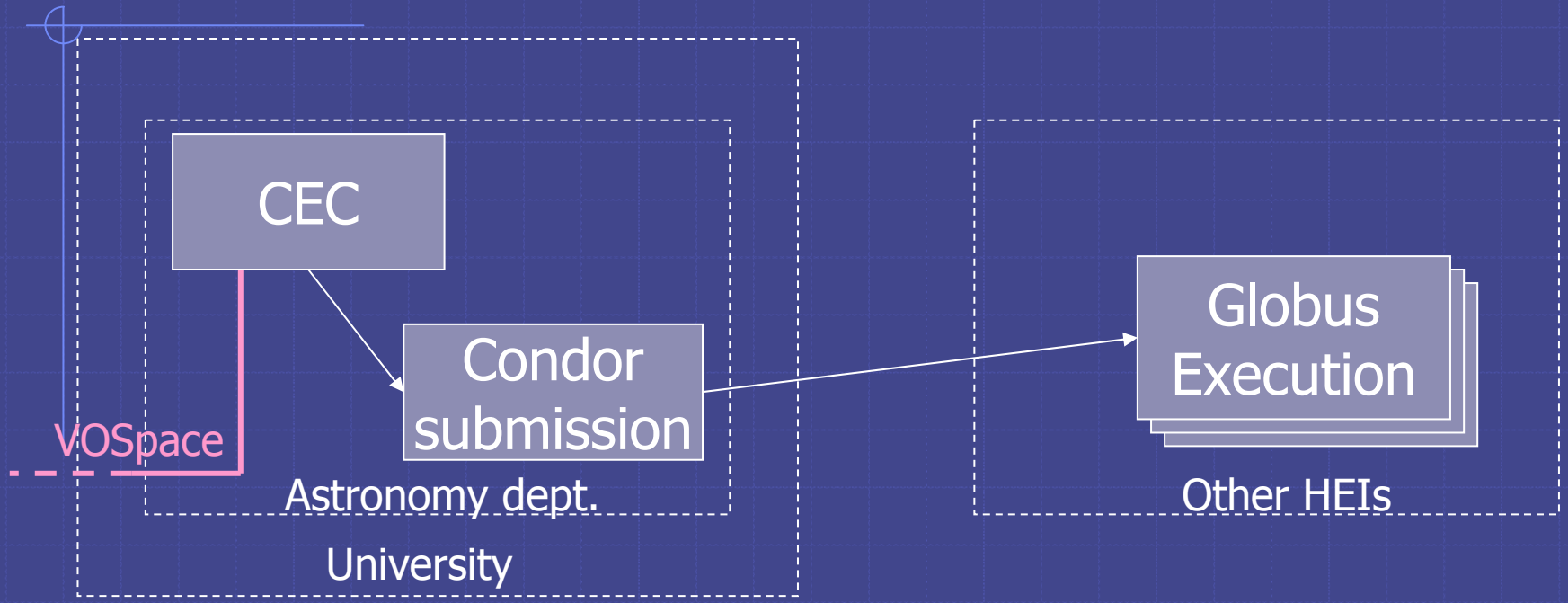
- Pro:
  - No access restrictions
  - No contention
  - Use NFS as internal data-grid
- Con:
  - Astronomers have to provide h/w
- Under test at IoA Cambridge (5 CPUs; *ad hoc* cluster).
- Possible targets at JBO (~200 CPUs), Portsmouth (~15), Leicester (9)

CEA + condor flock campus grid



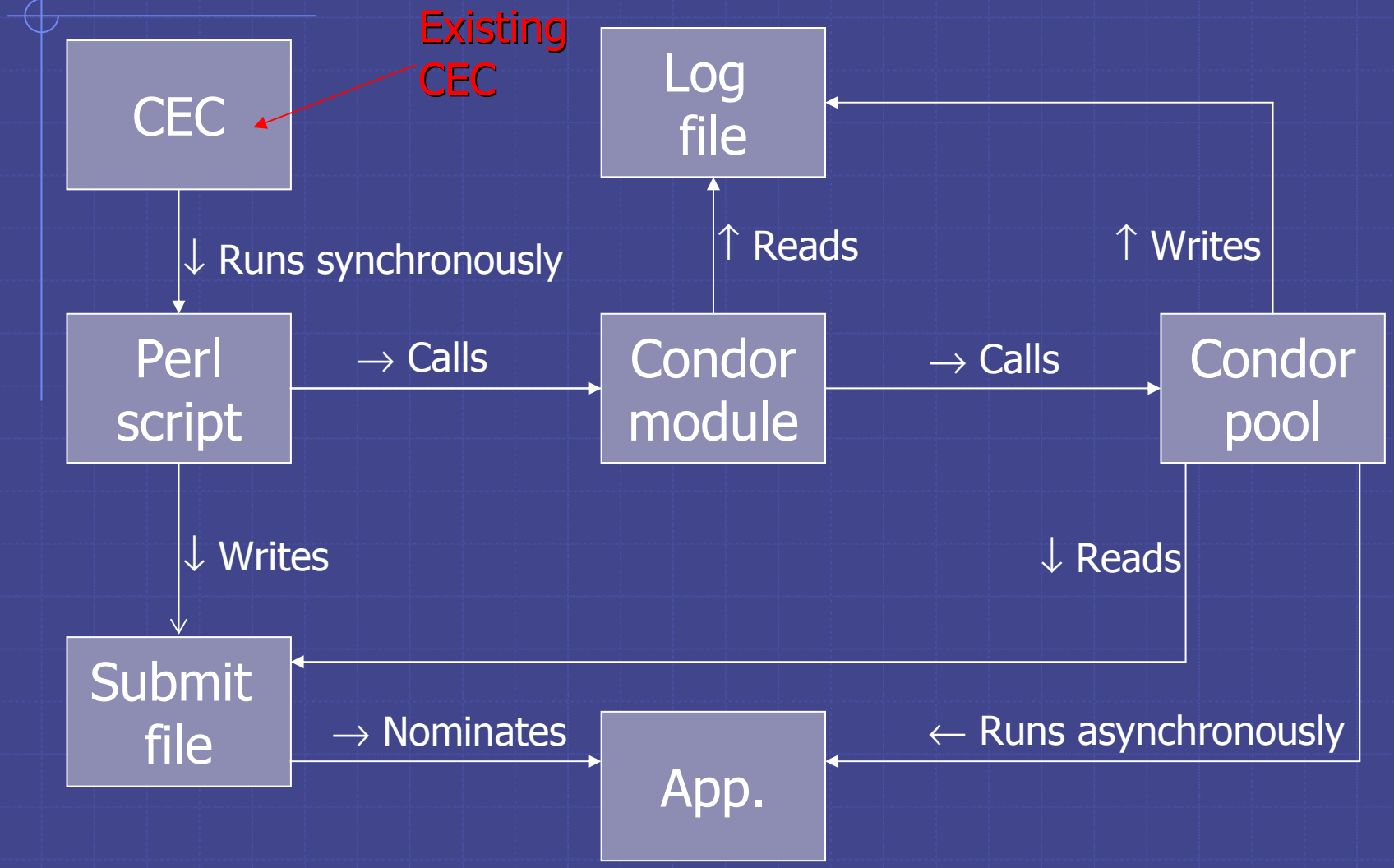
- Pro:
  - More CPUs
- Con:
  - Typically no NFS
  - Access policy
- Experiment planned with CamGrid (~650 CPUs)

CEA + Condor-G + Globus grid

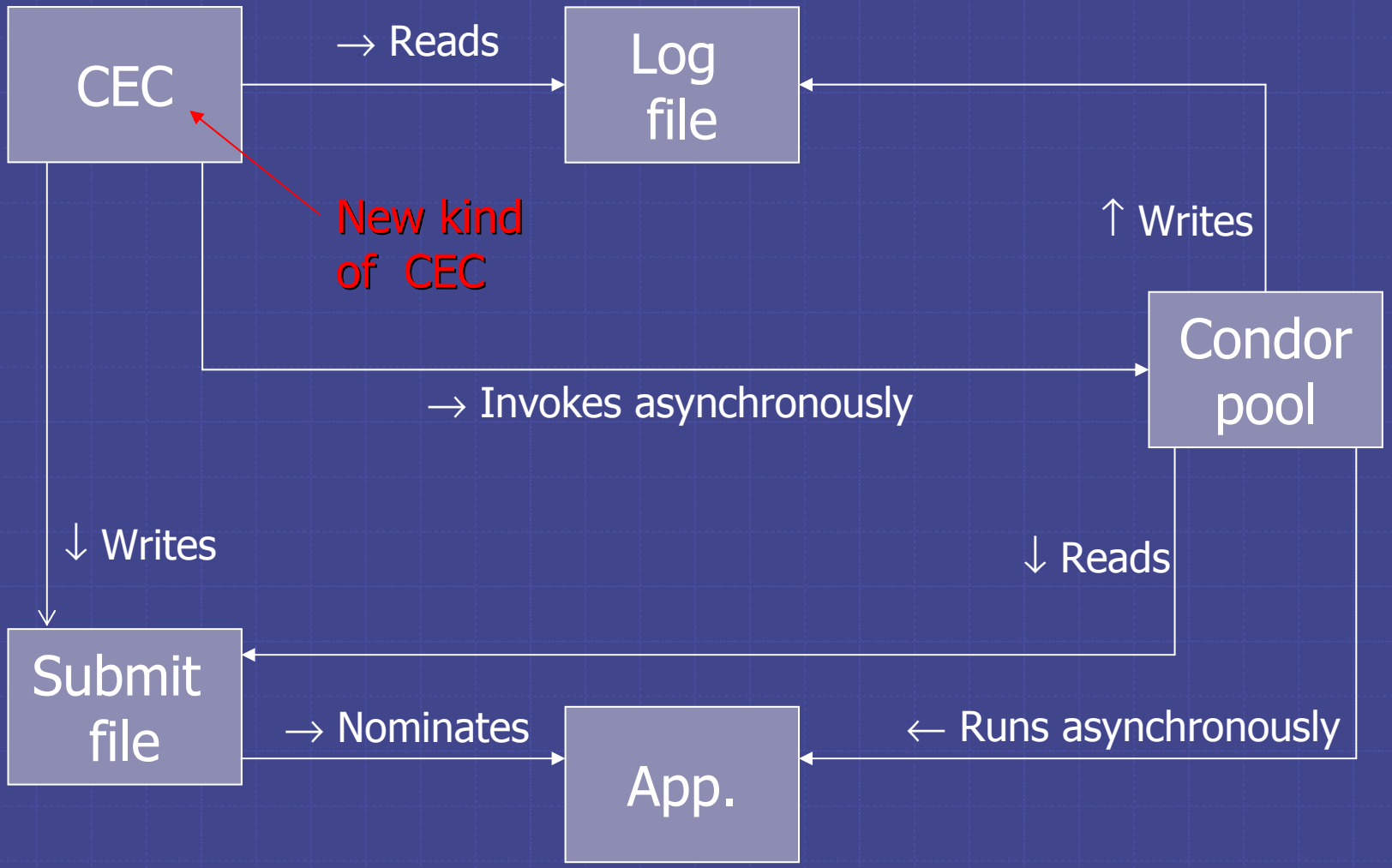


- Pro:
  - Vastly more CPUs available
- Con:
  - Latency
  - Credential complications
  - Still no data-grid below CEC.
- Astronomer-friendly way in to NGS, EGEE?

CEC ⇔ Condor: current experiment

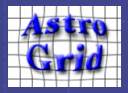


CEC ⇔ Condor: planned



Deployments, current

- Local tests at IoA Cambridge
  - Dedicated Condor pool, ~5 CPUs
  - Working
- Tests at Leicester Physics & Astronomy
  - Dedicated Condor pool, 9 CPUs; test only
  - Under construction
- Tests on CamGrid
  - Shared Condor flock, Campus grid, ~600 CPUs
  - Planned
- Production grid, Portsmouth
  - Dedicated Condor pool, ~15 CPUs?
  - Possible?



Which applications work on the grid?

- Good:
  - C programme, statically linked
  - Few configuration files
  - No dependency on OS
  - Can be relinked for standard Condor universe
- Tricky:
  - Interpreted/uses VM (e.g. Python, Java)
  - Dynamic linking
  - Interdependent programmes (e.g. IRAF)
  - Binary-only release

Apps from AstroGrid prototypes (1)

- AstroGrid has prepared these apps to run on non-grid CECs:
  - eSDO MSSL database (NG: local DB)
  - Super COSMOS catalogues (NG: local DB)
  - Solar FITS querier (NG: local DB)
  - 6dF catalogues (NG: local DB)
  - 2MASS catalogues (NG: local DB)
  - USNOB catalogues (NG: local DB)
  - INT-WFS images (NG: local DB)
  - FIRST object catalogue (NG: local DB)
  - INT-WFS observation catalogue (NG: local DB)
  - INT-WFS object catalogue (NG: local DB)

Apps from AstroGrid prototypes (2)

- BPZ (Difficult: Python)
- HyperZ (Difficult: library of template SEDs)
- Galaxev (tricky: library of templates?)
- Pegase (tricky: library of templates?)
- Generic movie maker (possible?)
- ANNz (possible?)
- Sextractor (OK)

Challenges

- More "easy" apps for Condor to run
  - An IVO(A) library of prepared apps?
- "Drive-by installation" for complex apps
- Enable Java, Python apps
  - Either Condor's "Java universe" or drive-by installations
- Enable/exploit checkpointing, migration
  - Needs Condor's "standard universe"
- Submission to restricted parts of grid
  - Needs working security framwork
- Distinguish restricted services
  - Needs registry support
- Use Sun Grid Engine as well as Condor?
  - Needs a use case to justify this.
- Use Condor-G for wider grid
  - Needs prayer?

Summary

- The IVO has a number of grid-like features
- AstroGrid CEA enhances, strengthens these
- CEA is now becoming a gateway to external compute grids
- Lots more development needed to get full benefits…
- …but some of it works now!
- More information:
  - http://www.astrogrid.org/
  - http://software.astrogrid.org/
  - Guy Rixon: gtr@ast.cam.ac.uk