Open Science Grid

Introduction to Distributed HTC and overlay systems

Tuesday morning, 9:00am

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Manager High Throughput Computing
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About Me

- 12 Years in Computing Operations
- Working with Grids since 2003
- OSG Operations Coordinator since 2006
- Responsible for 3 Glide-In Services located at IU, UCSD, and CERN
- Have been involved in several grid schools but this is my first overlay session

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Logistical reminder

It is OK to ask questions

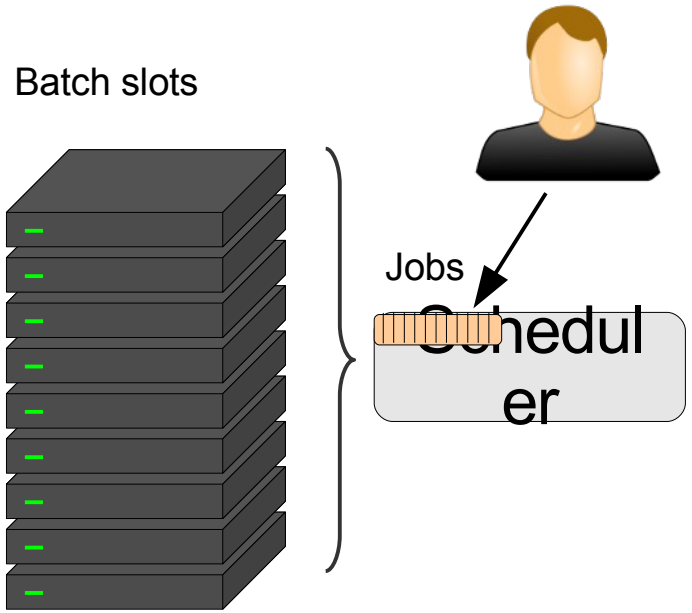
- During the lecture
- During the demos
- During the exercises
- During the breaks

If I don't know the answer,
I will find someone who likely does

High Throughput Computing

Scot yesterday introduced you to HTC

- The concept of getting as many CPU cycles as possible over the long run



- Based on batch job processing
- No interactive access to resources

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HTC in words

As our esteemed PI would put it

HTC is about extending the compute power of my own machine.

I **could** run my work on my own machine, but then it would take a very large number of calendar days/months/years to complete.

To finish the computation in a reasonable time, I have to expand the capacity of my own machine by obtaining and using temporary resources.

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Introducing DHTC

So what is **Distributed** HTC???

HTC is always distributed, right?

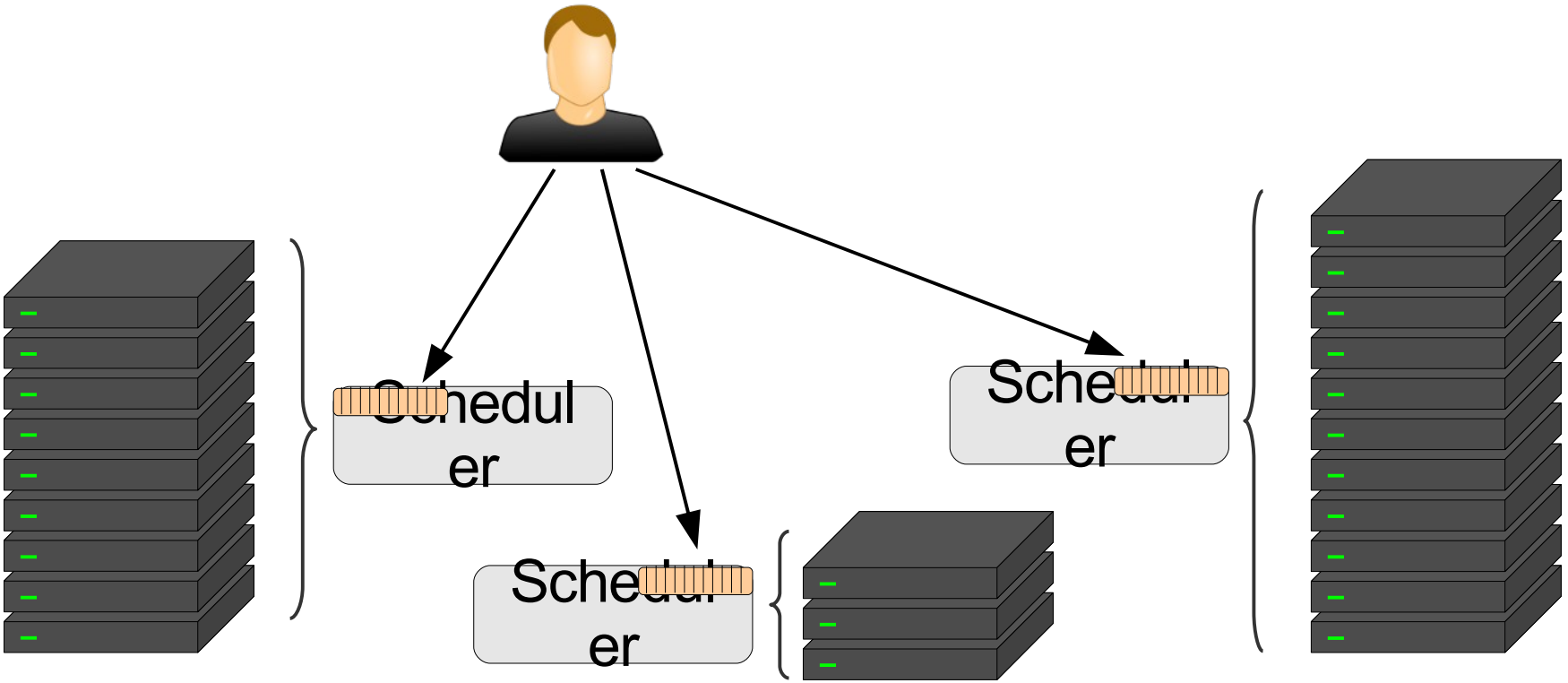
What we mean here is

MASSIVELY distributed

i.e. more than you can afford to host and operate in one place

Anatomy of DHTC

So DHTC is about computing on **more than one** HTC system



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Why DHTC

Many reasons:

- Practical
  (a site has a limit to how much HW can host)
- Political
  (you only get money for HW if it is hosted at X)
- Economical
  (hosting and operating HW myself is too expensive)
  (someone else can offer you hosted HW for less)

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Why is DHTC different?

- Not a single system anymore
  - How do I partition my jobs?
- Different clusters likely operated by different people
  - Leads to variations in compute environment
- Likely no globally shared file system
- Typically Wide Area Networking
  - Likely lower bandwidth and high RTT

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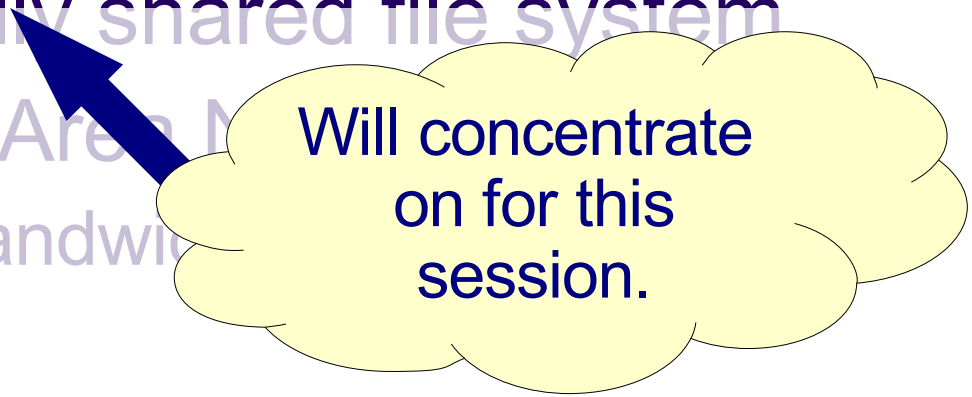

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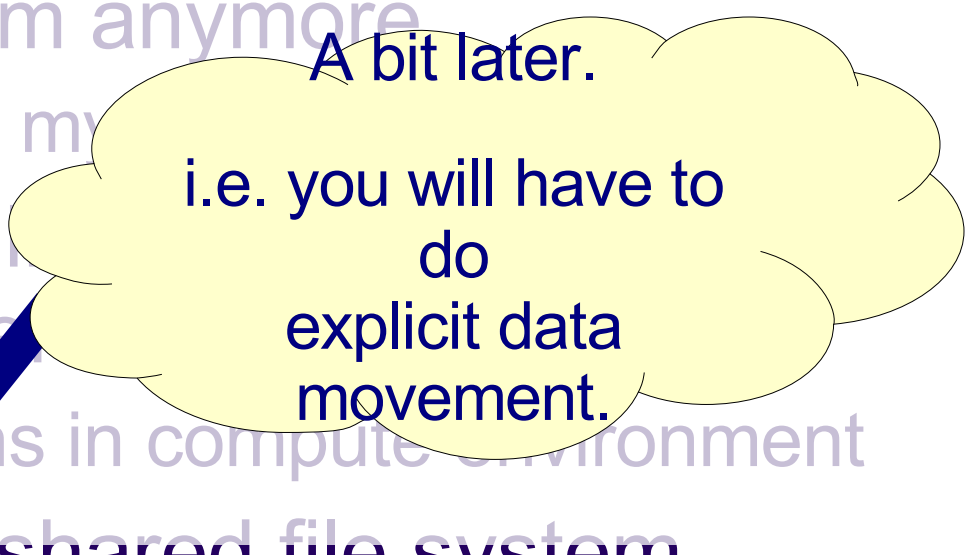
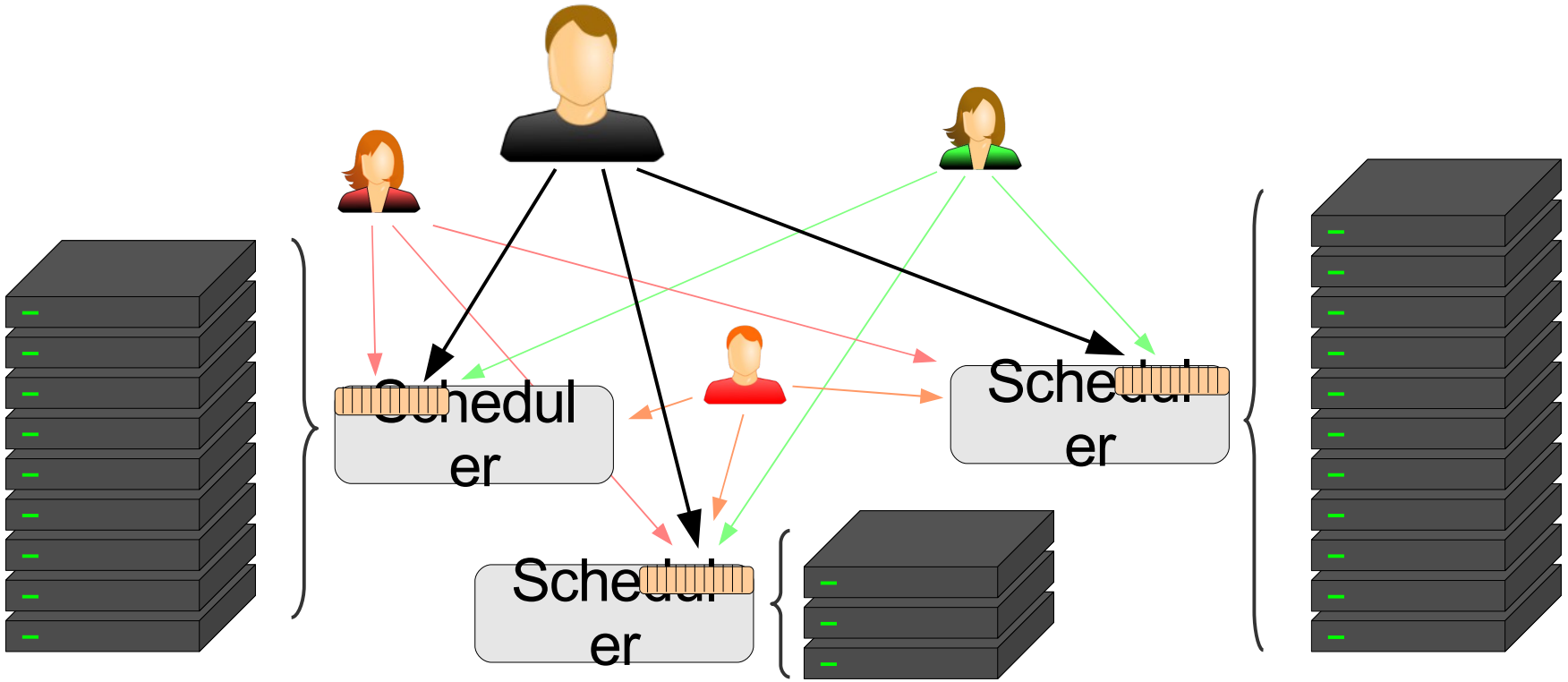


Job partitioning?

Used naively, DHTC requires job partitioning

Very hard to do it right in a multiuser world!



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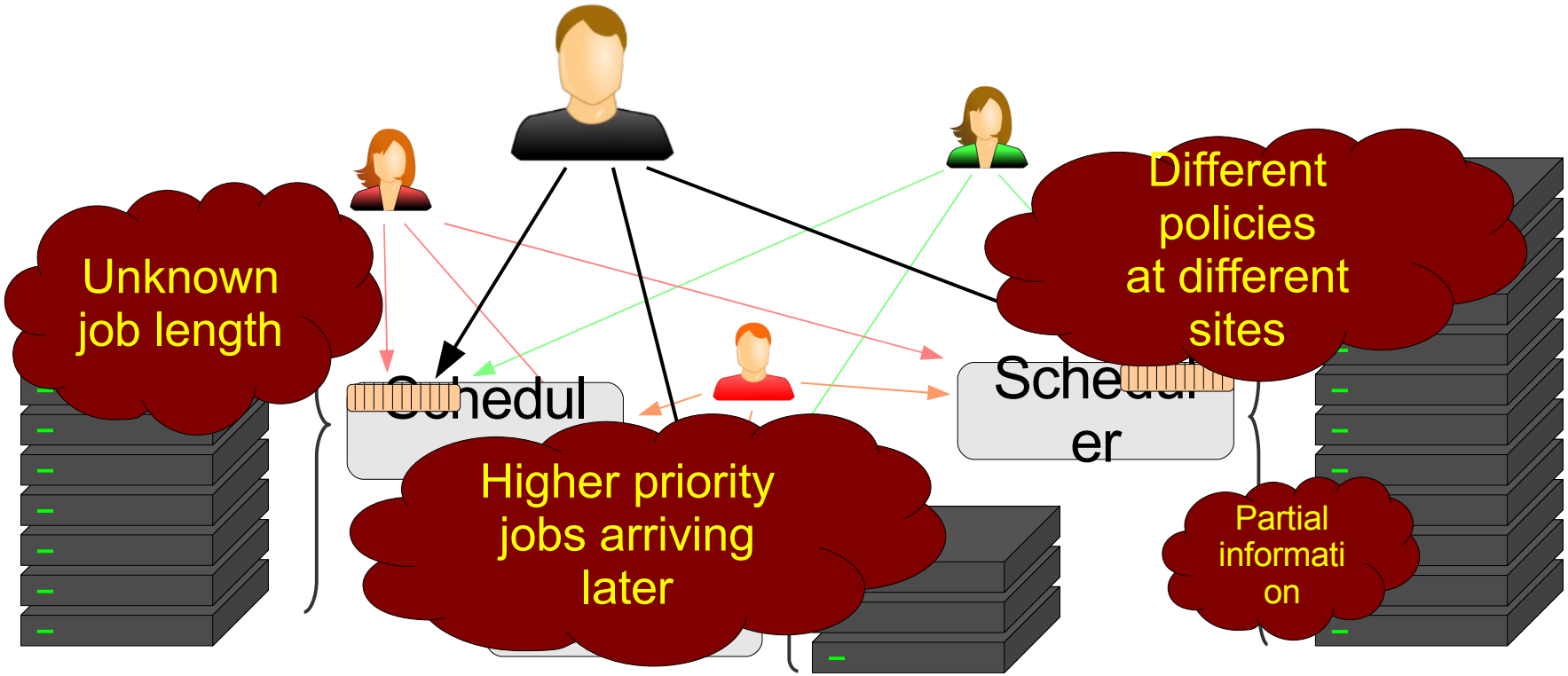

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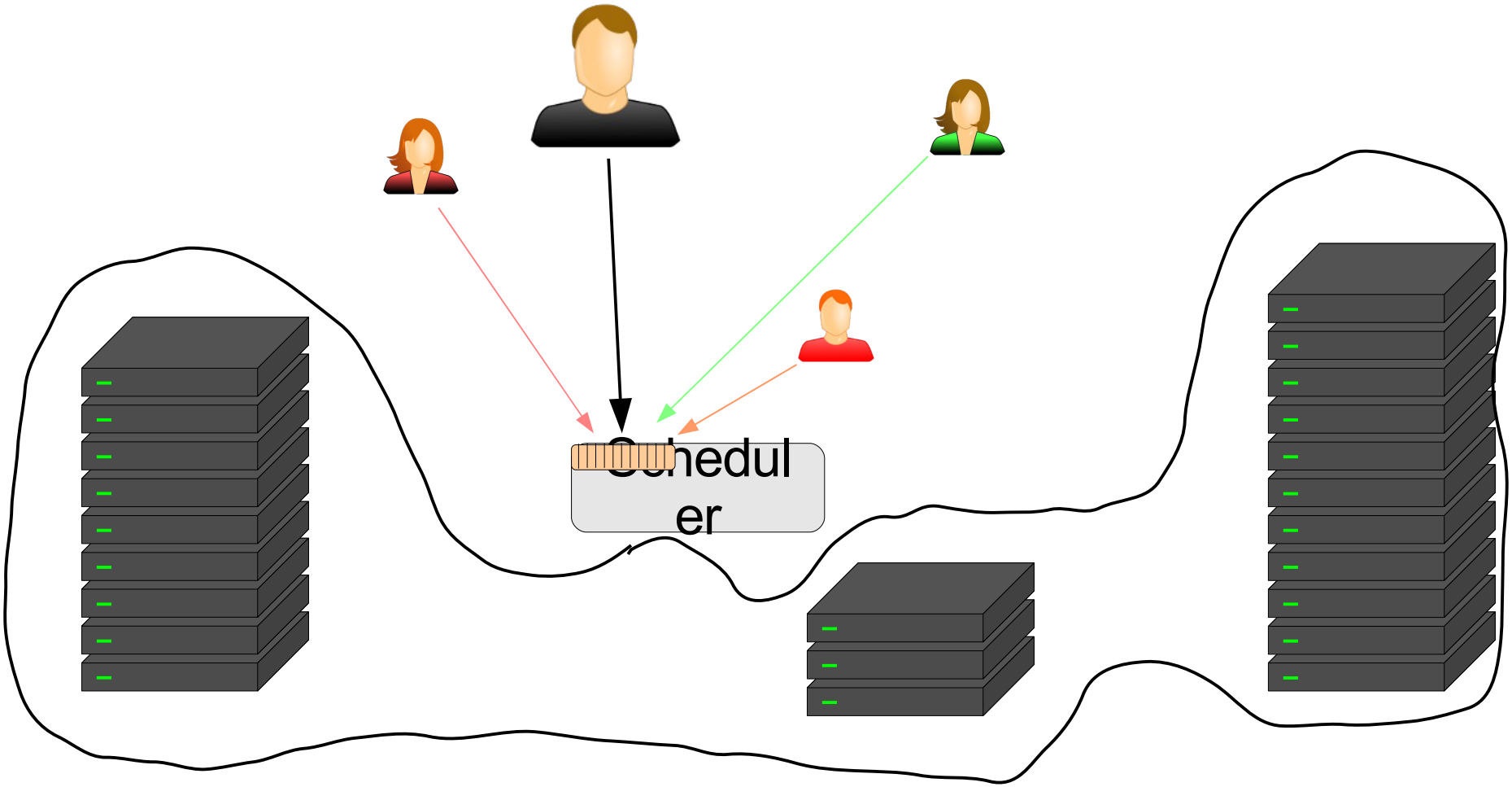
If only we had a global scheduler

This would make life easy again



If only we had a global scheduler

This would make life easy again

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Why we cannot have it?

Existing infrastructure

Local users, local policies

Money & politics

Different technologies

Being able to work
when WAN goes down

...

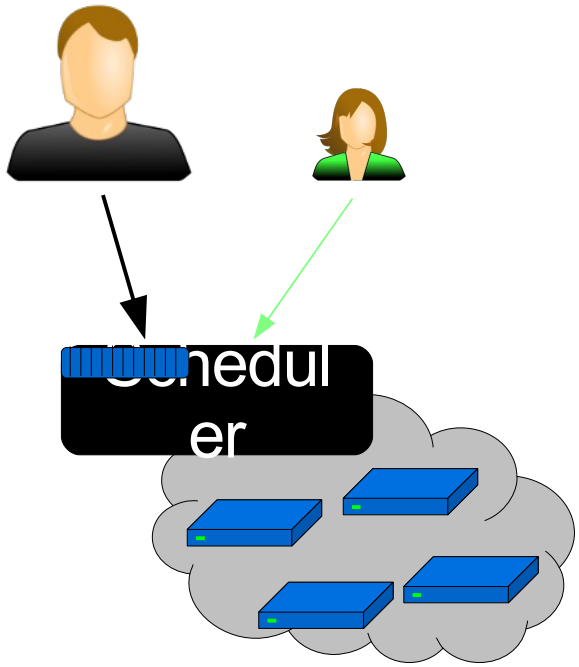
Idea – Create virtual-private HTC

What if we **collected** a set of batch slots and **only then scheduled** jobs on them?

- Possibly for a set of users

From the user point of view, **a single, global** scheduler

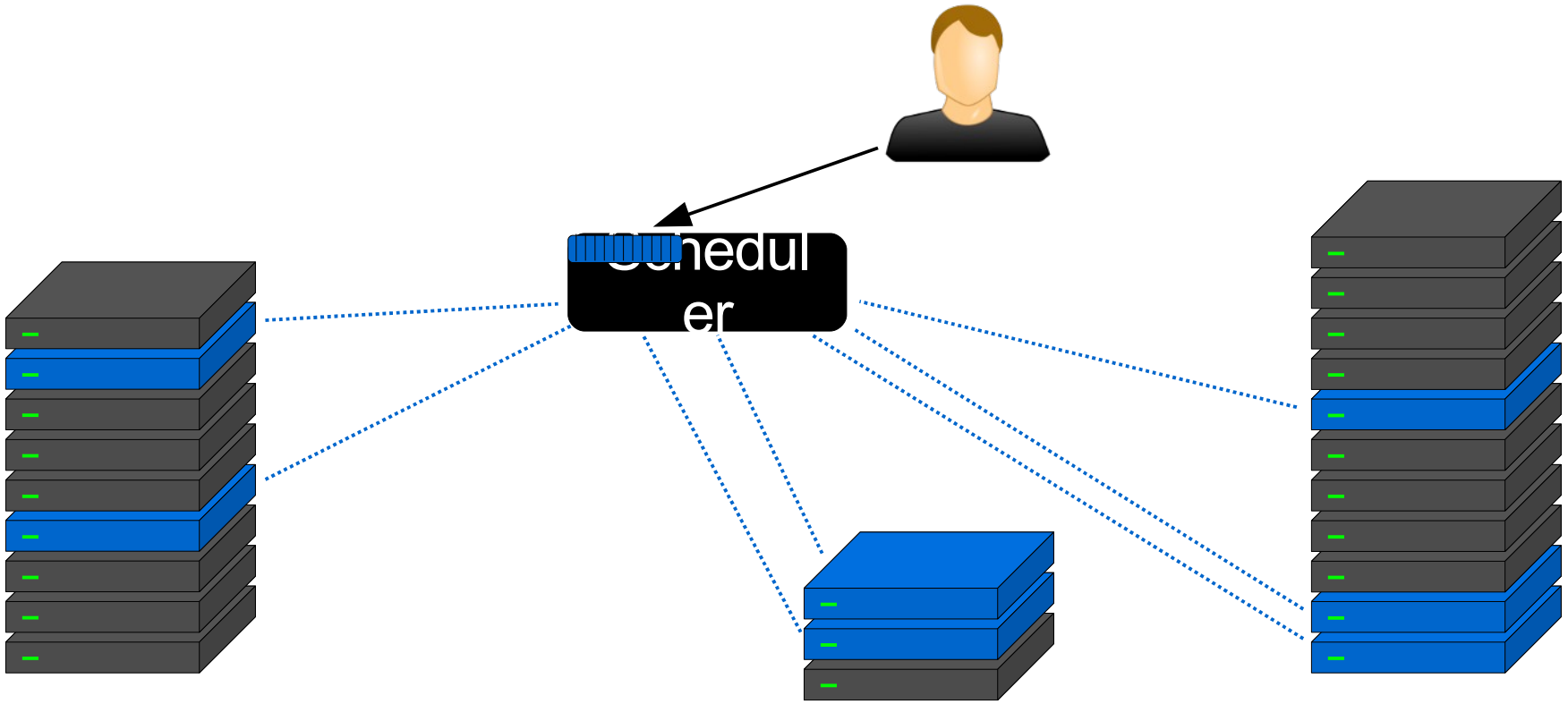
- But the available batch slots change in time



A leasing model

Imagine leasing some of the batch slots

Once you have them, you decide what to do with them

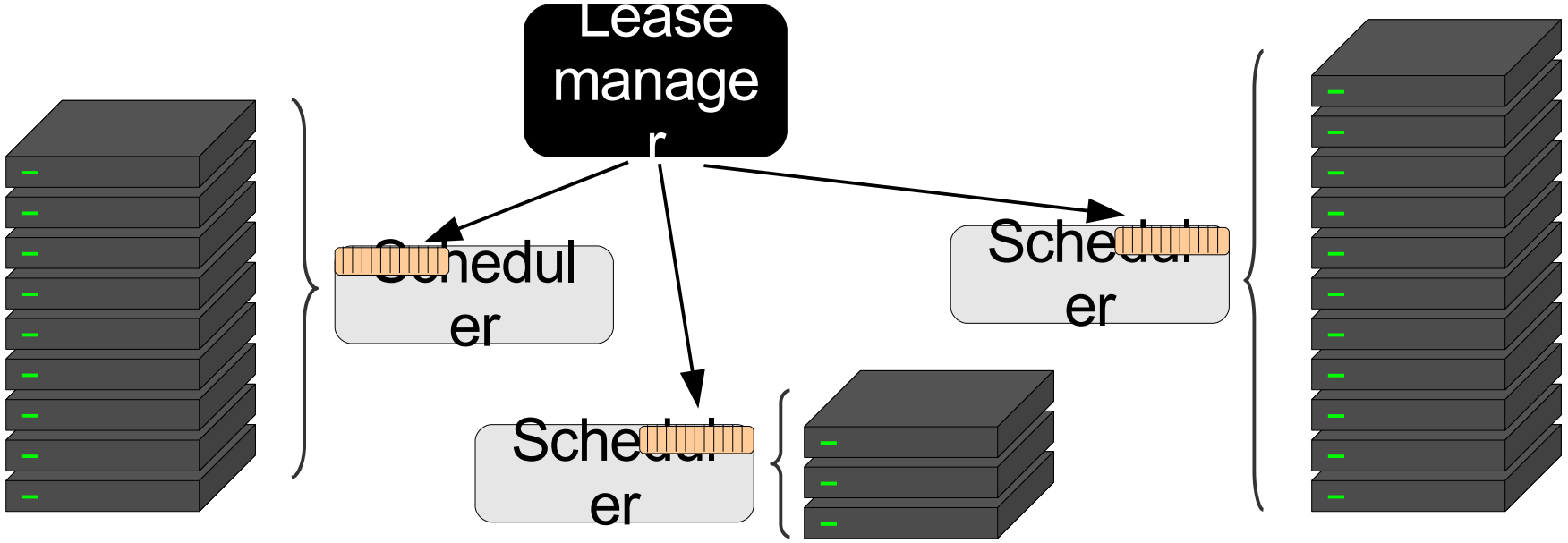


Batch leasing

Sites still own the resources

So we have to play by sites' rules

Must use the sites' schedulers to request the lease



Batch leasing

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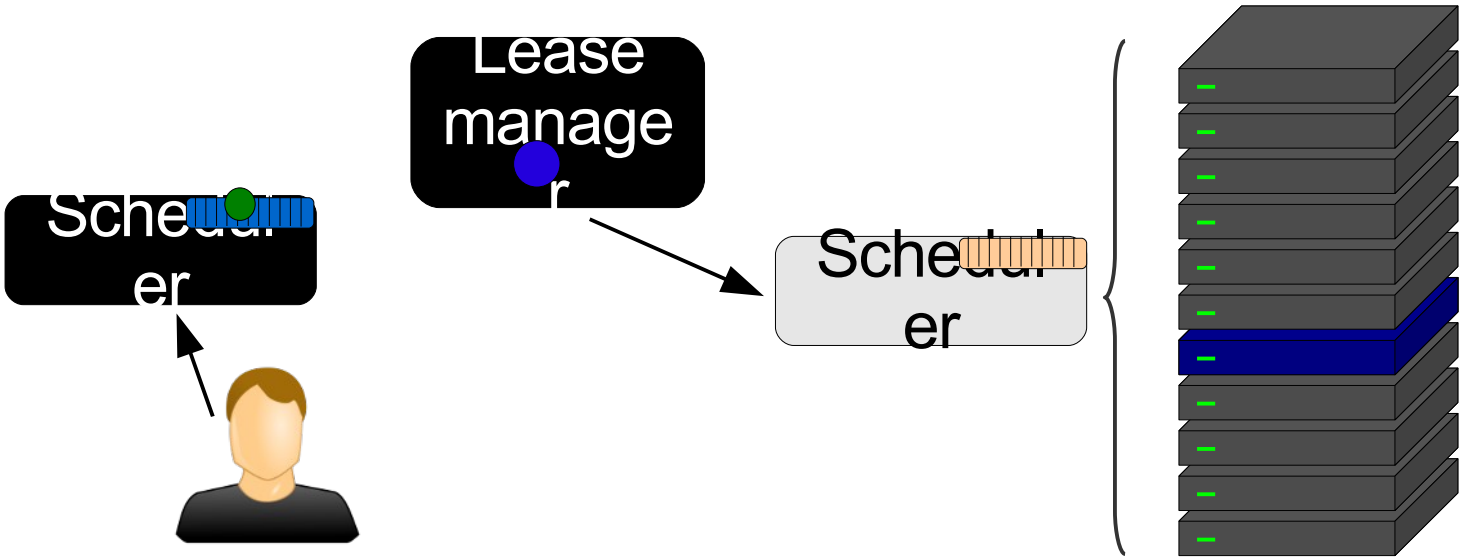
Overlay or Pilot systems

Also known as **resource provisioning**

We submit **pilot jobs** to sites

Each pilot job holds the lease on the batch slot

- Creating an **overlay HTC system**
- Overlay == 2nd level



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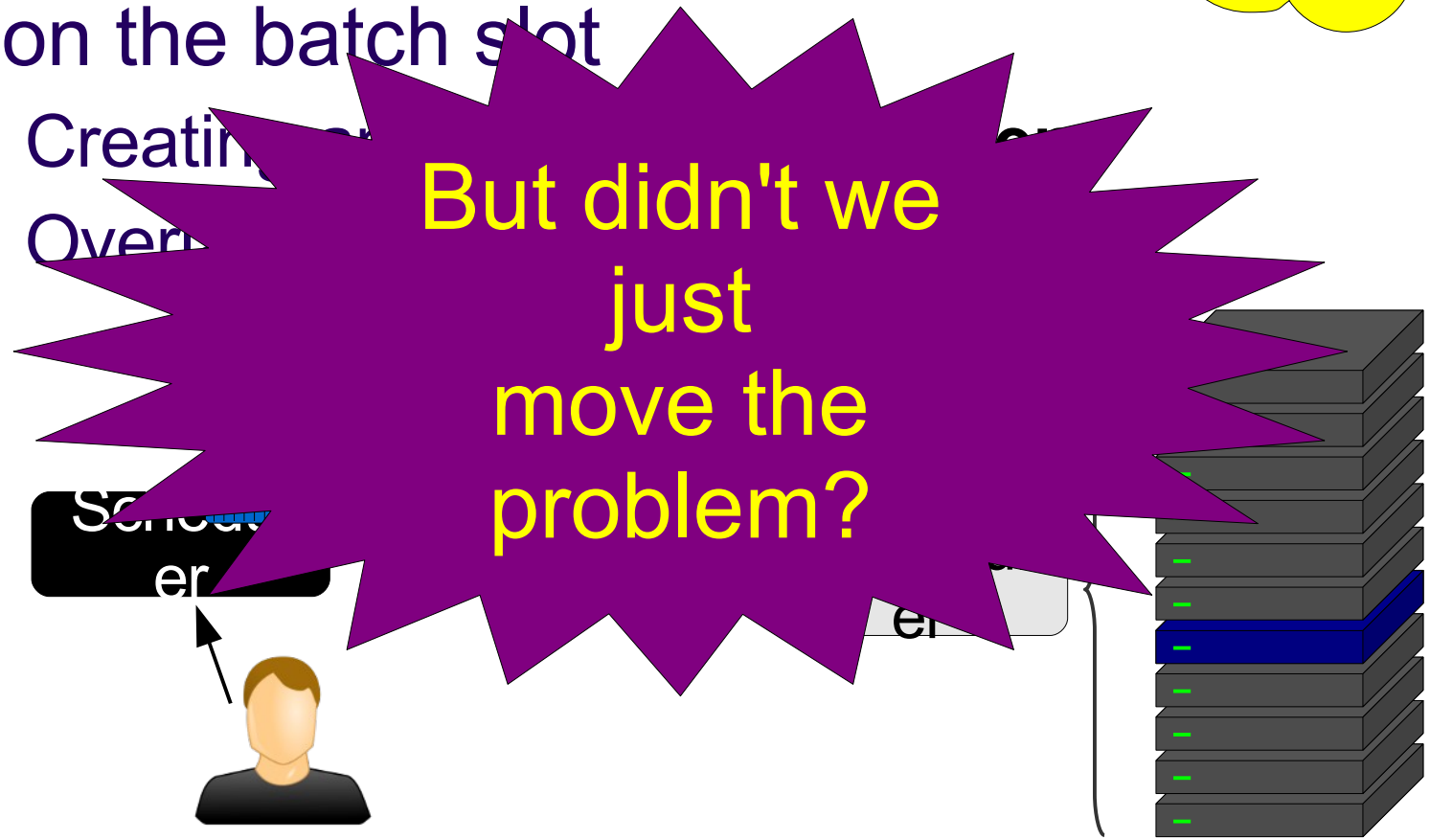

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Provisioning not as hard

Main problem in **user job** partitioning

- **All jobs are important!**
  - Typical user interested in when the **last job** finishes

In pilot job provisioning

- **All jobs are the same**
  - User interested in the **total number** of resources provisioned

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Fighting heterogeneity

- Pilot jobs can tweak the environment before starting user jobs
  - So users see a much more homogeneous system
- Cannot do miracles, of course
  - Usually limited to unprivileged-user tweaks (e.g. cannot replace the kernel)
  - But this is enough most of the time

Fighting heterogeneity

Pilot jobs can tweak the environment before s

So u

Ca

But t

Only a few pilot system administrators need to worry about heterogeneity

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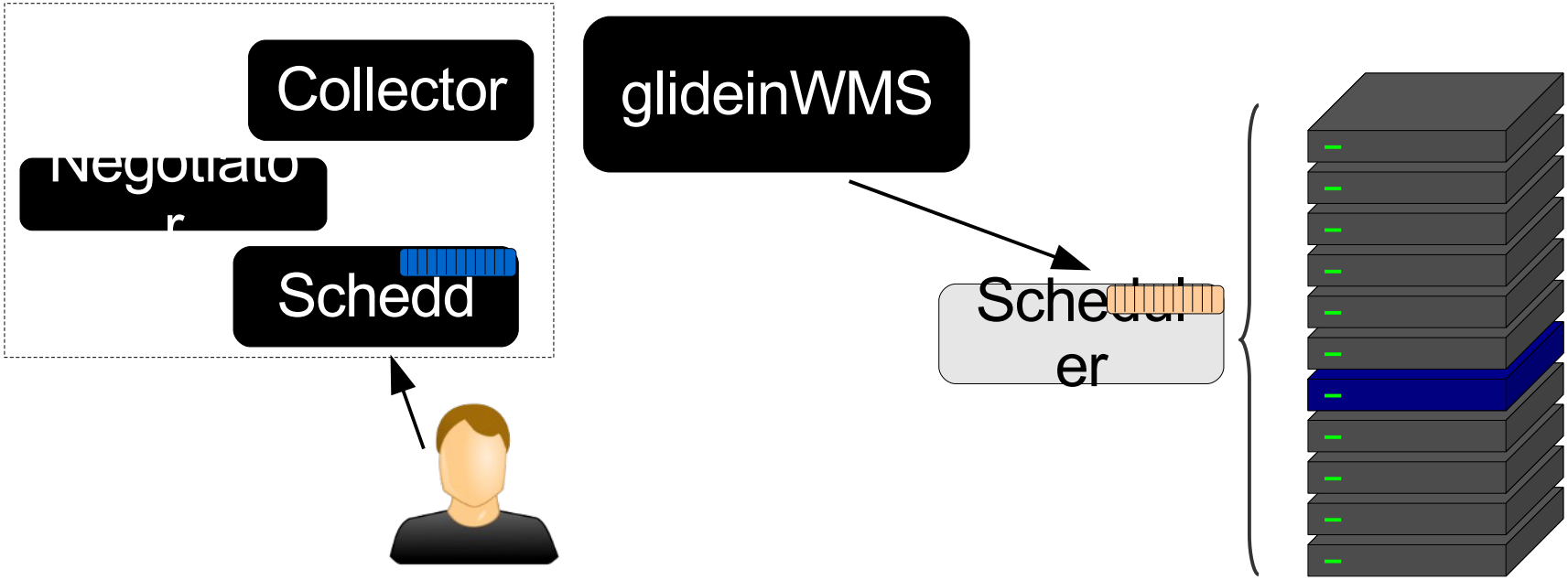
Pilot systems

- Many possible implementations
- We will concentrate on **glideinWMS**
  - Based on Condor
  - The one used by most user communities on OSG
- Others available
  - PANDA, DIRAC, ALIEN, ...

glideinWMS

A Condor based overlay system

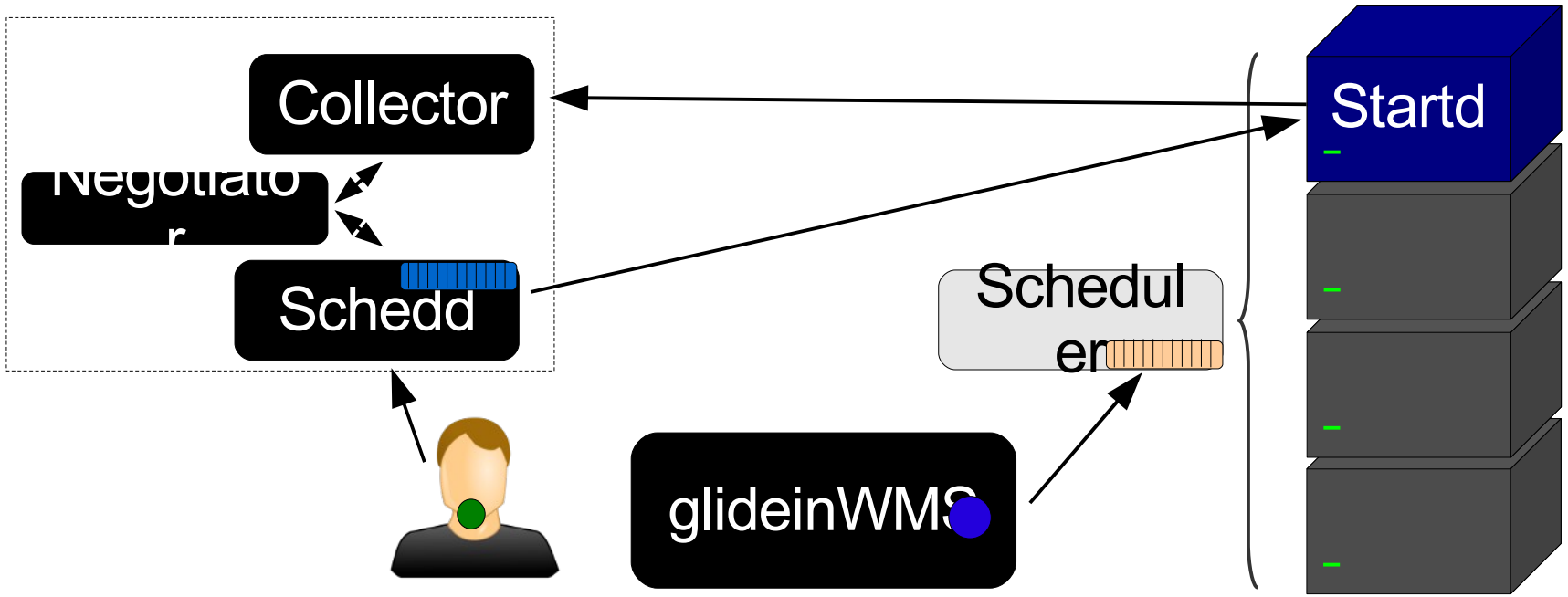
- i.e. looks like a regular Condor system to the users
- Adds a resource provisioning service
  (i.e. the lease manager)



Condor pilots

Condor pilot == A glidein

A properly configured Condor Startd



Two level matchmaking

The system now has
two matchmaking points

- The **glideinWMS** decides
  when and where to send glideins
- The **Condor negotiator** decides
  which job runs on which glidein

The two must treat jobs the same way

- Or we end up with either unused glideins
  or jobs that never start

Moving policy in glideinWMS

In glideinWMS, **user jobs never have requirements**

All policy is implemented by system administrators

Users **just provide parameters**

Example policy

```
(DESIRED_SITES=?=”any”) || stringListMember(GLIDEIN_Site,DESIRED_SITES)
```

Example job JDL

```
+DESIRED_SITES = “UCSD,Wisconsin”
queue
```

Example job JDL

```
+DESIRED_SITES = “any”
queue
```

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Know your system

- The matchmaking is thus less flexible
  - You can only work within the frame of the system policy
- But arguably easier to use
  - No complex boolean expressions to write
- Be sure to ask for the system policy of your system

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Down to practice

This is all for the theoretical part

Next we have the hands-on session

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Questions?

Questions? Comments?

Feel free to ask me questions later:

Rob Quick <rquick@iu.edu>

Next lecture – The Grid and glideinWMS architecture