



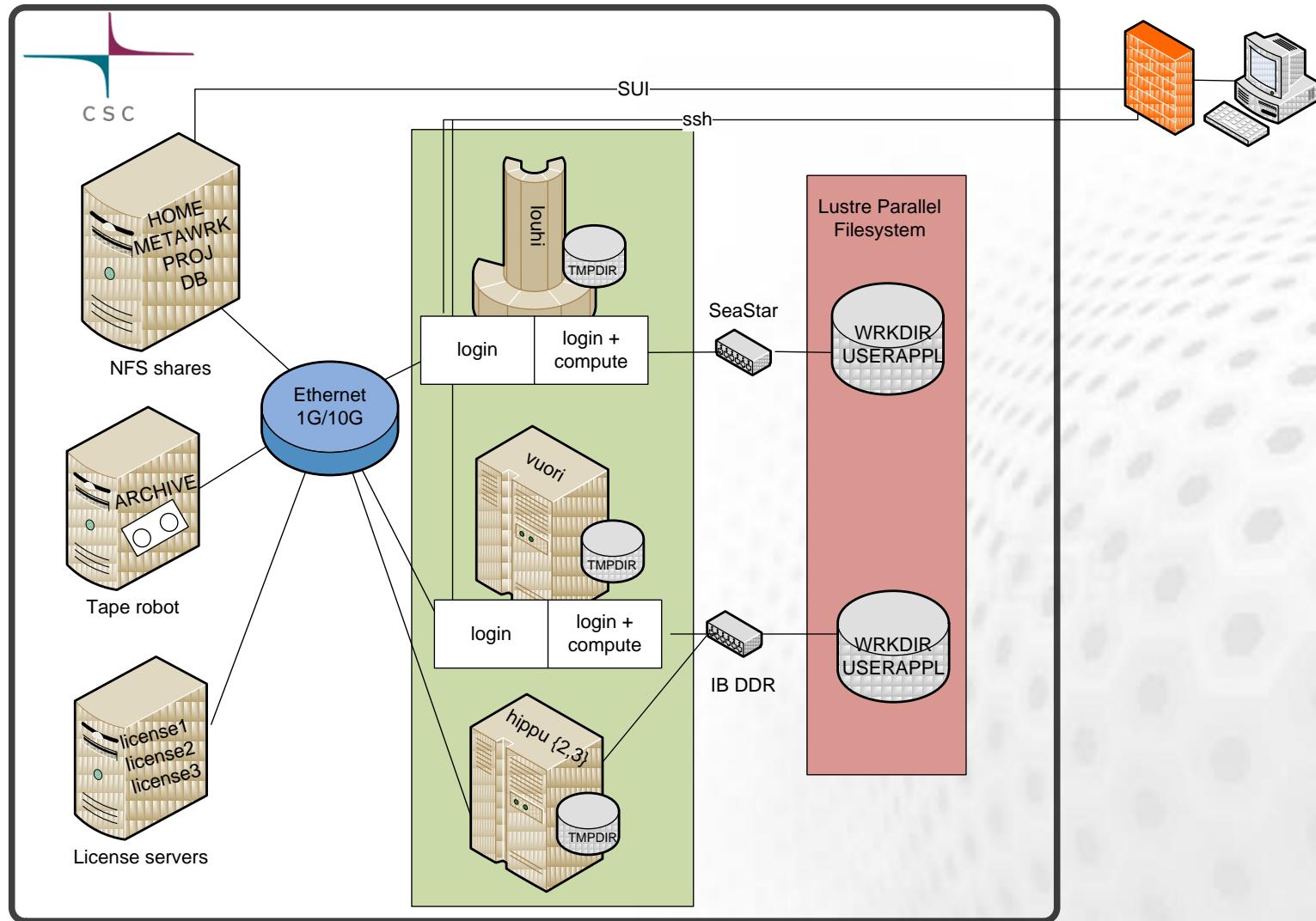
# Introduction to CSC Computing Environment



# CSC's Computing Environment

How to utilize CSC's servers and services

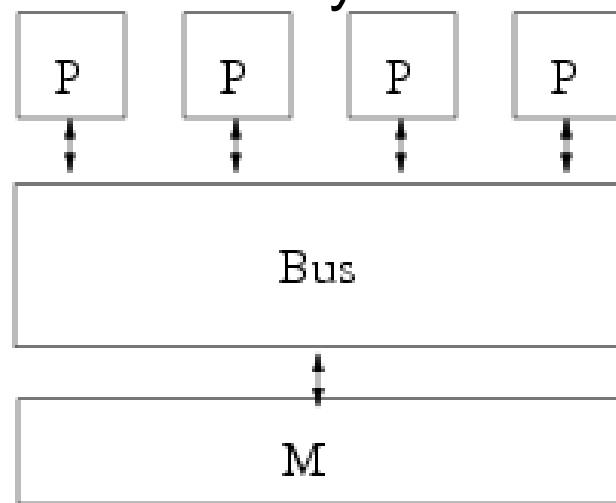
# The complete picture



# On Clusters and Supercomputer

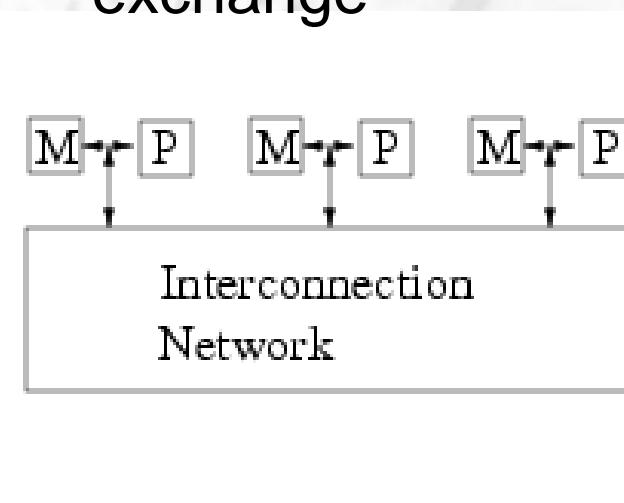
## ➡ Shared Memory Parallel (SMP):

- All processors access (more or less) the same memory



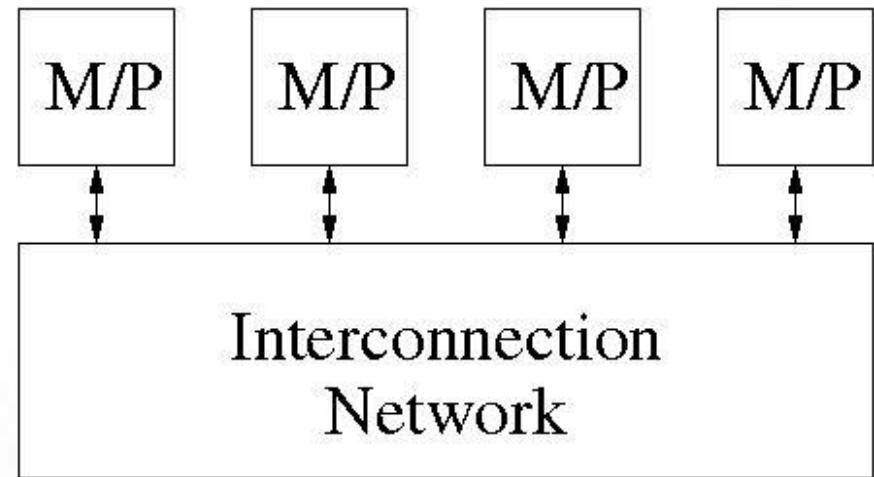
## ➡ Distributed Memory:

- Reserved memory
- Interconnection network for exchange



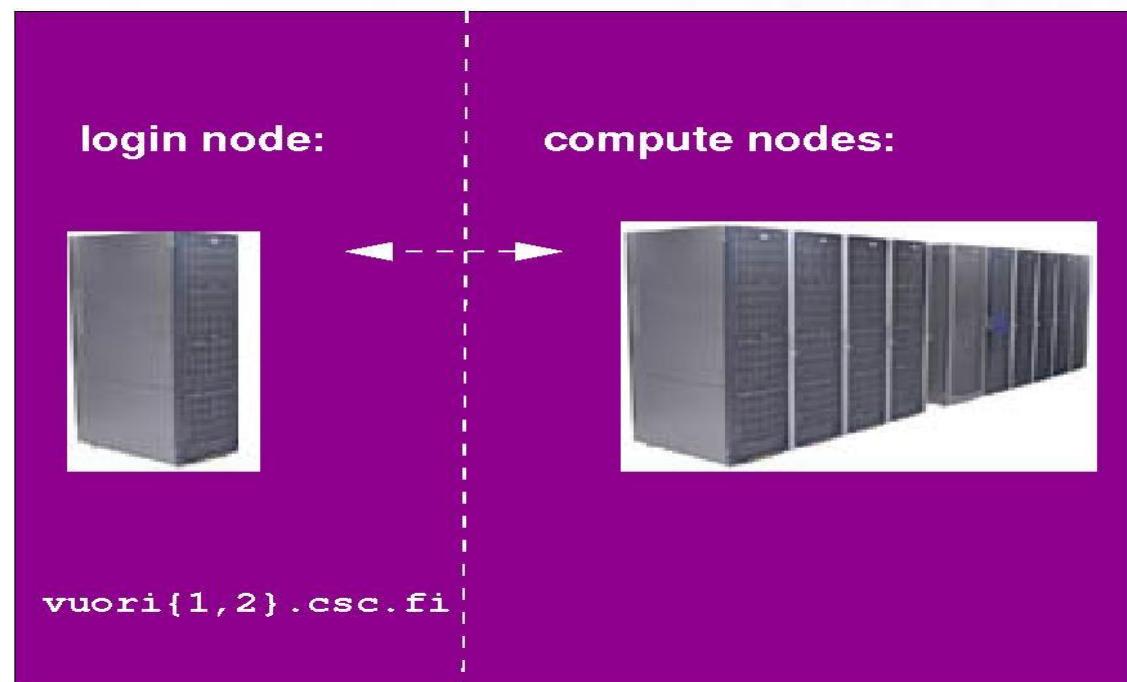
# On Clusters and Supercomputer

- A cluster is a connection of separate units (nodes) via a fast network
  - All larger CSC platforms (louhi, murska, vuori) are clusters in a general sense



# On Clusters and Supercomputer

- CSC's clusters:
  - login nodes:
    - setup and submission of runs
    - very small interactive work
  - compute nodes:
    - number-crunching
    - batch jobs



# On Clusters and Supercomputer

## ➔ Supercomputer:

- Cluster with enhanced interconnection network
- E.g., XT4/5 seastar
- Often also special operating system for compute nodes

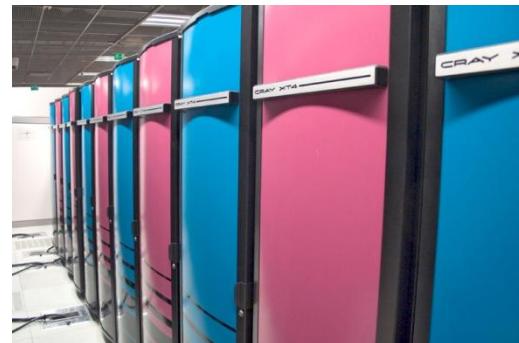


# Computing servers

Application server  
(Shared memory)  
[hippu.csc.fi](http://hippu.csc.fi)



Supercomputer  
[louhi.csc.fi](http://louhi.csc.fi)



Cray XT4/XT5  
❖ 10864 cores  
❖ 1GB (/ 2GB) memory

Superclusters  
[vuori.csc.fi](http://vuori.csc.fi)



HP ProLiant DL785 G5 server pair  
(hippu1+2)

- ❖ 32+32 cores (AMD)
- ❖ 512+512 GB memory

HP ProLiant DL580 G7 server pair  
(hippu3+4 = hippu)  
❖ 32+32 cores (Intel)  
❖ 1+1 TB memory

HP CP4000 BL Proliant

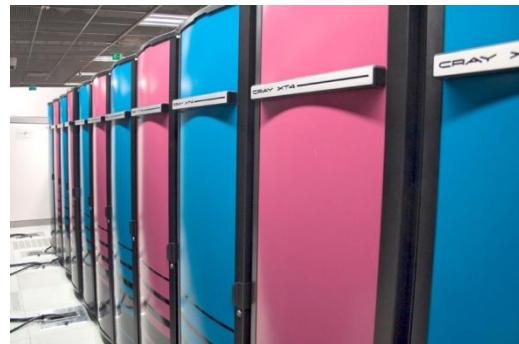
- ❖ 2880 cores
- ❖ 1-8 GB memory/core
- ❖ 24 "fat"-nodes with 8GB/core
- ❖ + 8 GPGPU nodes (Nvidia Tesla)

# Computing servers

Application server  
(Shared memory)  
hippu.csc.fi



Supercomputer  
louhi.csc.fi



Superclusters  
vuori.csc.fi



- Interactive use
- Serial or multi-threaded, but not MPI
- No batch job system (needs some discipline from users)

- Massive parallel jobs
- Needs scalability test of deployed software
- PBS batch job system

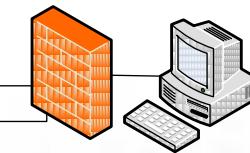
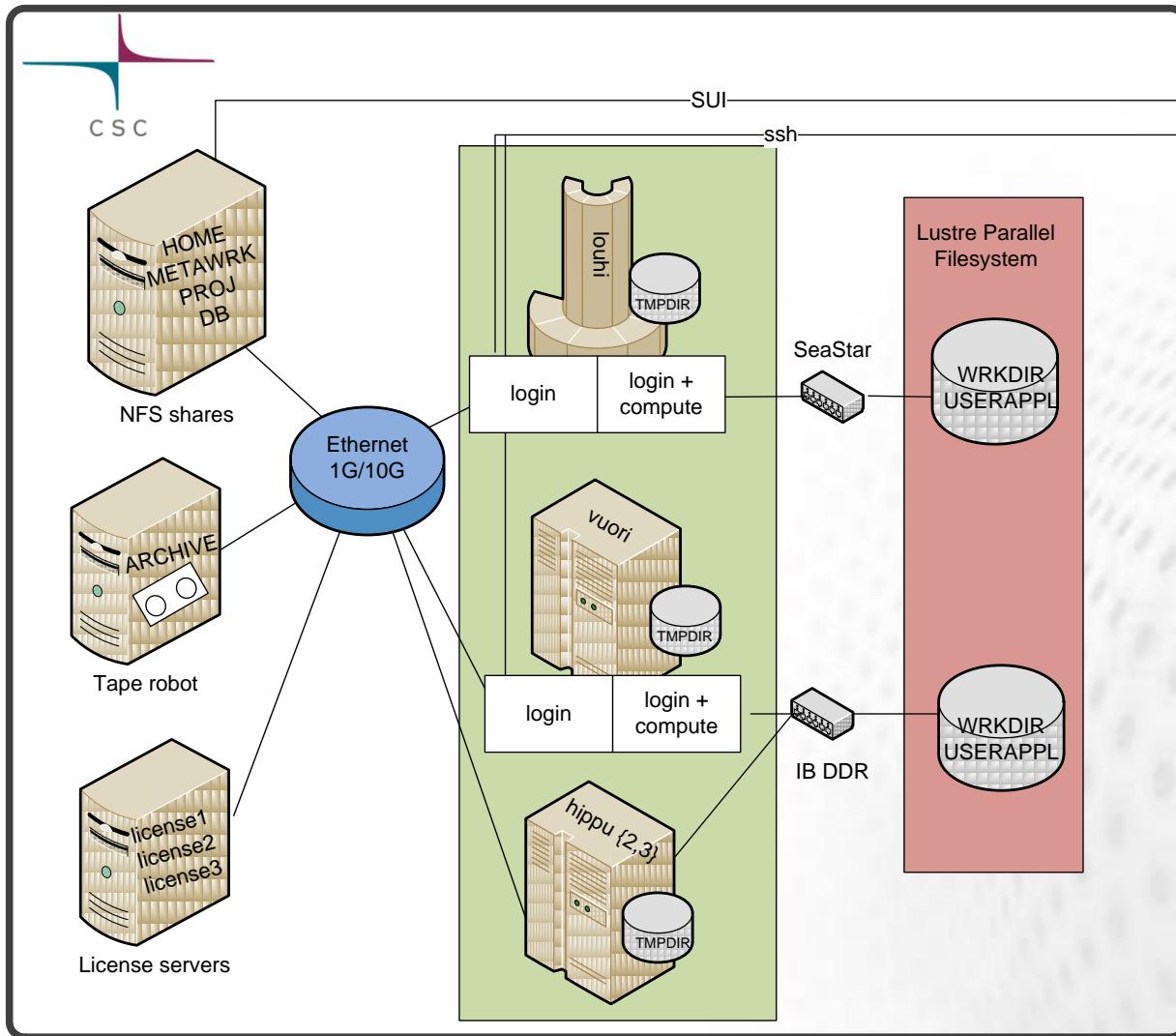
- Serial and array jobs
- Smaller (<128 cores) parallel jobs
- SLURM batch jobs system

## GRID- the other option

- ➔ FGI - The Finnish Grid Infrastructure
- ➔ is a consortium of 9 Finnish Universities and CSC
- ➔ Infrastructure consists of numerous computing nodes at each site
- ➔ Accessed via GRID technologies and locally
- ➔ GRID = common access to distributed computing resources
- ➔ More information: [FGI webpages](#)



# Filesystems



- ➡ Common filesystems  
NFS mounted
- ➡ Local filesystems
- ➡ Fast parallel filesystems

# Filesystems: NFS mounts

- ➊ **HOME**: quota 1GB, backup, permanent, common visibility (not compute nodes)
  - Most important files, like source code and scripts
- ➋ **project**: quota (size on request), backup, permanent, common visibility (not compute nodes)
  - To be applied for; project specific files, usually shared in between a group (remember UNIX intro)
- ➌ **METAWRK**: quota 200 GB, no backup, 30 days, common visibility (not compute nodes)
  - Easy exchange of data between platforms

## Filesystems: NFS mounts

- ➊ **ARCHIVE:** 550 GB or 10k files (max. file size 350GB), redundant 2 copies, permanent, common visibility (not compute nodes)
  - Tape robot with large hard-disk for archiving large datasets (mostly data)
  - As long as disk access, OK, but if tape, extremely slow

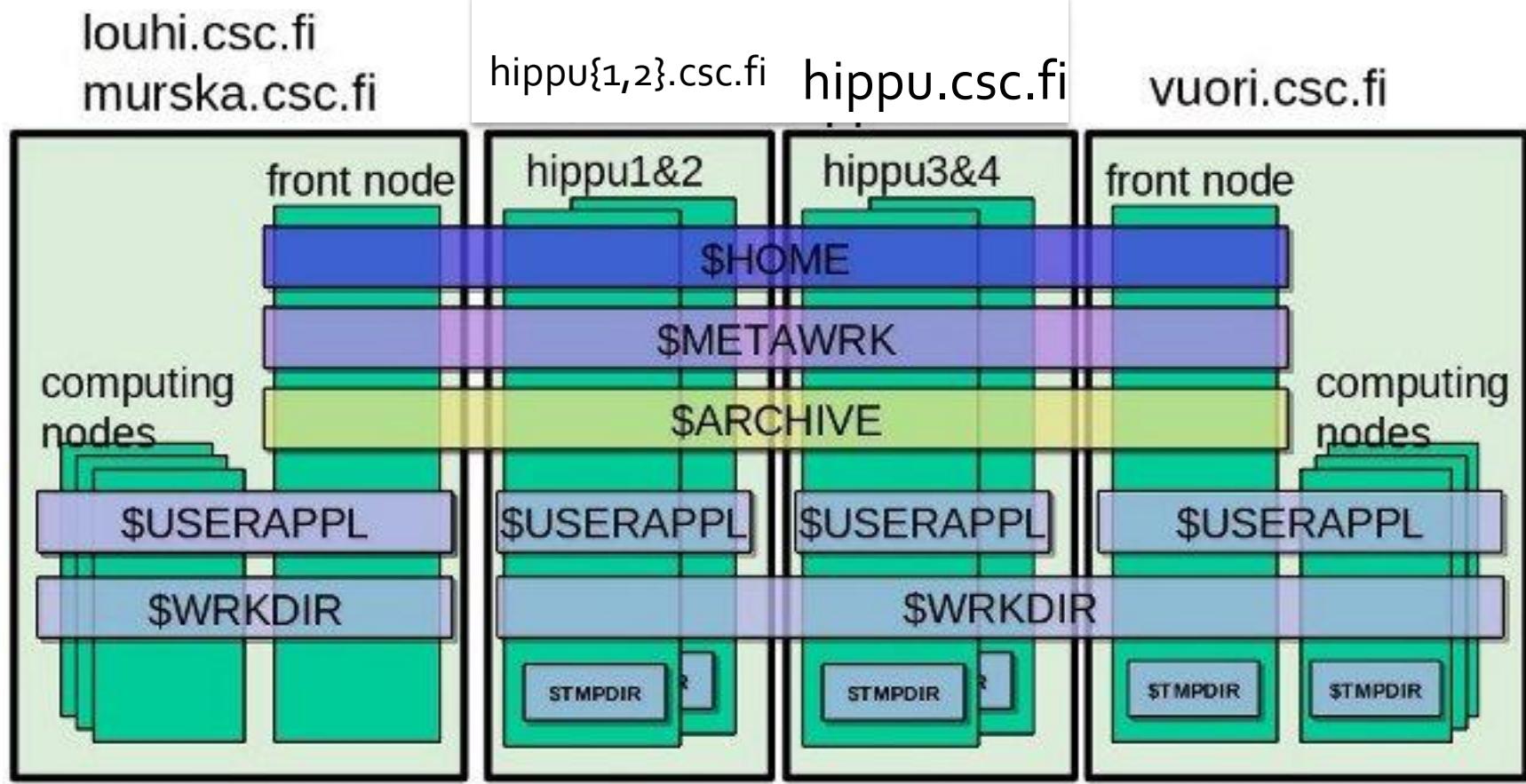
# Filesystems: machine specific FS

- ➊ **WRKDIR**: no quota, no backup, 7 days, login and compute nodes
  - Parallel FS mounted by fast connection (InfiniBand or SeaStar)
  - Clusters need to have input data for runs there, as compute nodes cannot access \$HOME or \$PROJ
  - The variable \$HOME as well as \$WRKDIR on compute nodes refer to these
  - Temporary data files for applications

# Filesystems: machine specific FS

- ➊ **TMPDIR**: no quota, no backup, 1 day, login and compute nodes
  - Run-time storage for very short live data
- ➋ **USERAPPL**: no quota (but limited), backup, permanent, server specific on login and compute nodes
  - Used to install user's own executables (e.g., simulation code)

# Filesystems



# Filesystems: Checking your quota

- Disk quotas:
  - Command `quota` gives the used and available diskspace

```
zwinger@vuori2:~> quota
[_$ARCHIVE_usage_____]
      Online          Offline
      Used    Avail     Used    Avail
Files 122   10000      122   10000
Blocks   0.00G 0.45T  33.29G   0.45T
Grace period 1w
[_Projects_usage_____]
Size Used Avail on
25G 24G 1.3G /fs/proj1/elmer
10G 1.0G 9.0G /fs/proj1/ice2sea
[_$METAWRK_usage_____]
Size Used Avail on
200.0G 17713M 182.7G /fs/metawrk/zwinger
[_$HOME_usage_____]
Size Used Avail on
1024M 305M 719M /home/csc/zwinger
```

# Checking your CPU cycles

- CPU time:  
saldo  
command
- -p *projctID*  
gives statistics  
for particular  
project
- Similar feature  
in [Scientist's](#)  
[Interface](#)

```
zwinger@vuori2:~> saldo
-----
Saldo for year 2010 month 9
Report updated 9.9.2010 12:15
-----
Project tlp0060 Ice2sea (EU project) Thomas Zwinger
start 04.12.2009    end: 04.12.2011    budget: 30.07.2010
CSC budget: 80000    used: 31243.91    remain: 48756.09
-----
      Cpu usage      Cpu secs   Bu
-----
csc001 zwinger        3324  0.92 hippu
      zwinger        0  0.00 hotpage
      zwinger        1  0.00 murska
      zwinger    600442 166.79 vuori
      zwinger  Tot  603768 167.7
```

# CSC Server: software

**CSC provides the most extensive selection of software applications in Finland**

- 200 different ready-made programs available for research use in Finland

GAMS                    CHARMM  
GCG  
FIDAP  
  
Funcs                  ABAQUS/CAE  
  
IMSL                  matlab  
  
SAS                  MSI

Software licenses for different fields of science, such as:

1. chemistry
2. geosciences
3. biosciences
4. physics
5. statistics
6. CFD
7. structural analysis
8. mathematics
9. scientific visualization

# CSC Server: software

- ➲ hundreds of scientific software packages available for Finnish research use
- ➲ [www.csc.fi/english/research/software](http://www.csc.fi/english/research/software)
- ➲ different types of licenses:
  - A academic use
  - C academic + commercial use
  - G governmental use
  - P public domain + free software
  - R academic + commercial use with a royalty fee
- ➲ paid and restrictive licenses are handled by a license server

# CSC Server: software licenses

license2.csc.fi license1.csc.fi license3.csc.fi



## License server

- 3 redundant (FlexLM) license manager
- single FlexLm license manager
- reserved ports for server and daemon



CSC internal network



## Application server

- software
- license information in LM\_LICENSE\_FILE
- UNIX user groups

# CSC Server: software licenses

## ➔ License policy at CSC:

- Often user has to sign a general license agreement
- Sometimes users have to be signed up for a certain UNIX user group
- User has to comply with which she/he signed (e.g., publications, commercial use, ...)
- Be a nice colleague and free unneeded licenses
- Often limitations on licenses introduced

# CSC Server: software setup

- ➔ Setup of software on the fly
- ➔ **module** command on all systems
- ➔ Listing of available modules:

```
hippu1> module avail
```

- ➔ Listing of loaded modules:

```
hippu1> module list
```

- ➔ Loading a module (e.g., Elmer – a finite element program):

```
hippu1> module load elmer/latest
```

# CSC Server: software setup

- ➊ Unloading a module:

```
hippu1> module unload elmer/latest
```

- ➋ Switching between mutually excluding modules:

```
vuori> module switch PrgEnv-
          pgi/10.2-0 PrgEnv-gnu/4.4.3
```

Test: try to simply load PrgEnv-gnu/4.4.3 instead