

Photonic Technology for 100G Networks; the Computer Science Perspective

Cees de Laat

EU
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Why?



Because we can!

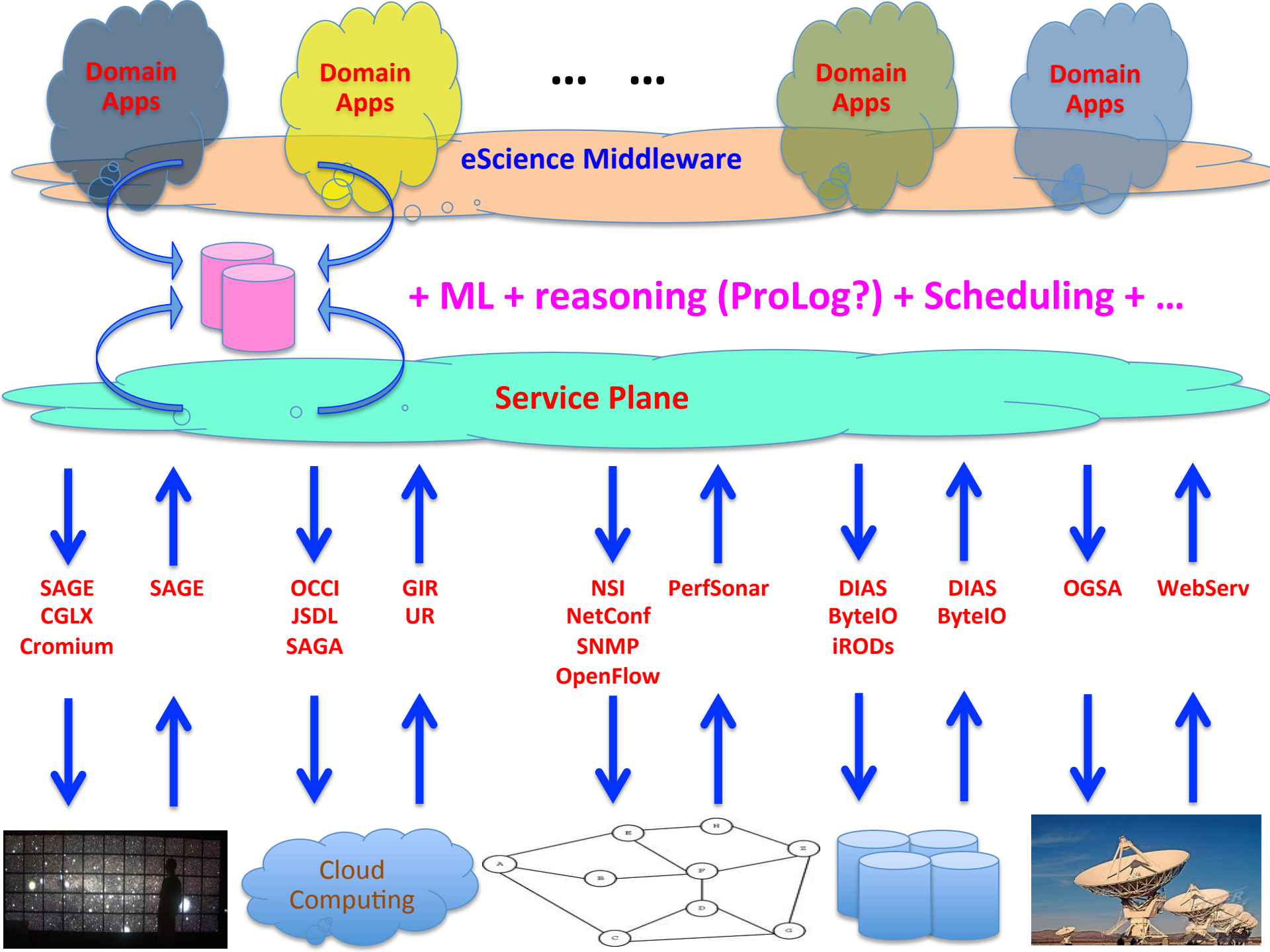


I want to



“Show Big Bug Bunny in 4K on my Tiled Display using green Infrastructure”

- Big Bugs Bunny can be on multiple servers on the Internet.
- Movie may need processing / recoding to get to 4K for Tiled Display.
- Needs deterministic Green infrastructure for Quality of Experience.
- Consumer / Scientist does not want to know the underlying details.
➔ His refrigerator also just works.

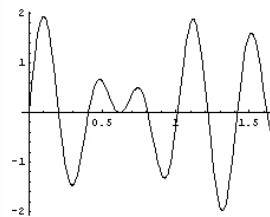


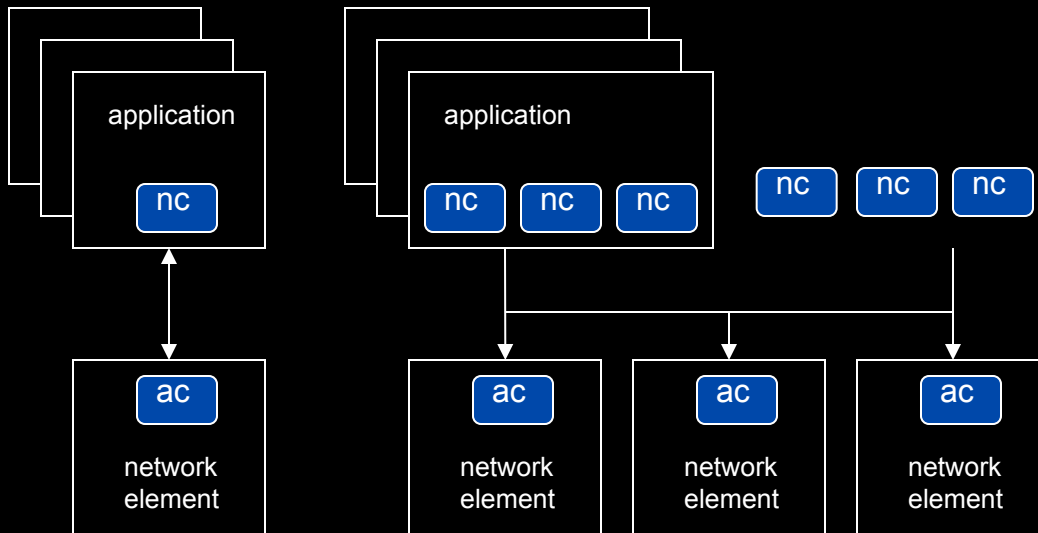
TeraThinking

- What constitutes a Tb/s network?
- CALIT2 has 8000 Gigabit drops ?->? Terabit Lan?
- look at 80 core Intel processor
 - cut it in two, left and right communicate 8 TB/s
- think back to teraflop computing!
 - MPI turns a room full of pc's in a teraflop machine
- massive parallel channels in hosts, NIC's
- TeraApps programming model supported by
 - TFlops -> MPI / Globus
 - TBytes -> OGSA/DAIS
 - TPixels -> SAGE
 - TSensors -> LOFAR, LHC, LOOKING, CineGrid, ...
 - Tbit/s -> ?

User Programmable Virtualized Networks allows the results of decades of computer science to handle the complexities of application specific networking.

- The network is virtualized as a collection of resources
- UPVNs enable network resources to be programmed as part of the application
- Mathematica, a powerful mathematical software system, can interact with real networks using UPVNs

$\text{Eigenvalues}\left[\begin{bmatrix} -1 & 0 & 2 \\ 2 & 9 & 2 \\ 3 & 1 & 4 \end{bmatrix}\right]$ <p>(9.484782381, 4.488378326, -1.973160708)</p>	$\sum_{\beta=1}^{30} \frac{1}{\beta^2}$ <p>1.612150118</p>
$\text{Plot}[\text{Sin}[13 x] + \text{Sin}[18 x], \{x, 0, 2\}]$ 	$\text{BesselJ}[1, 3 + i]$ <p>0.4326156394 - 0.4295057869 i</p>
	$\text{Simplify}[1 + 5 x + 10 x^2 + 10 x^3 + 5 x^4 + x^5]$ <p>(1 + x)⁵</p>
	$\text{mydata} = \{\{0.444539, 0.908491\}, \{1.4486, 1.84577\}, \{1.8734, 1.84577\}, \dots\}$ <p>$\text{Fit}[\text{mydata}, \{1, x, x^2\}, x]$</p> <p>0.2617148495 + 1.007 x - 0.0034235343 x²</p>



Mathematica enables advanced graph queries, visualizations and real-time network manipulations on UPVNs

Topology matters can be dealt with algorithmically

Results can be persisted using a transaction service built in UPVN

Initialization and BFS discovery of NEs

```
Needs["WebServices`"]
<<DiscreteMath`Combinatorica`
<<DiscreteMath`GraphPlot`
InitNetworkTopologyService["edge.ict.tno.nl"]
```

Available methods:

```
{DiscoverNetworkElements, GetLinkBandwidth, GetAllIpLinks, Remote,
NetworkTokenTransaction}
```

Global`upvnverbose = True;

```
AbsoluteTiming[nes = BFSDiscover["139.63.145.94"];][[1]]
```

```
AbsoluteTiming[result = BFSDiscoverLinks["139.63.145.94", nes];][[1]]
```

Getting neighbours of: 139.63.145.94
 Internal links: {192.168.0.1, 139.63.145.94}
 (...)
 Getting neighbours of: 192.168.2.3

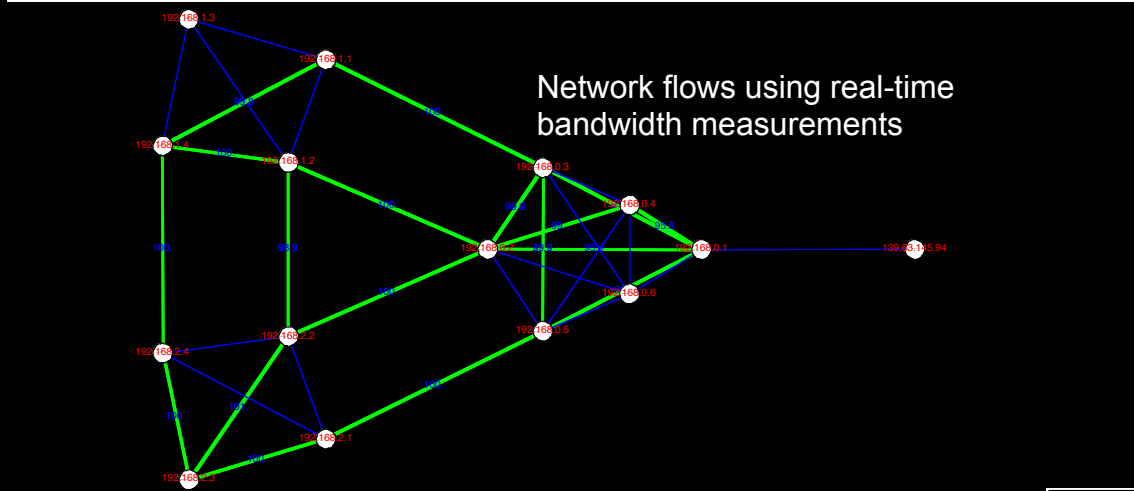
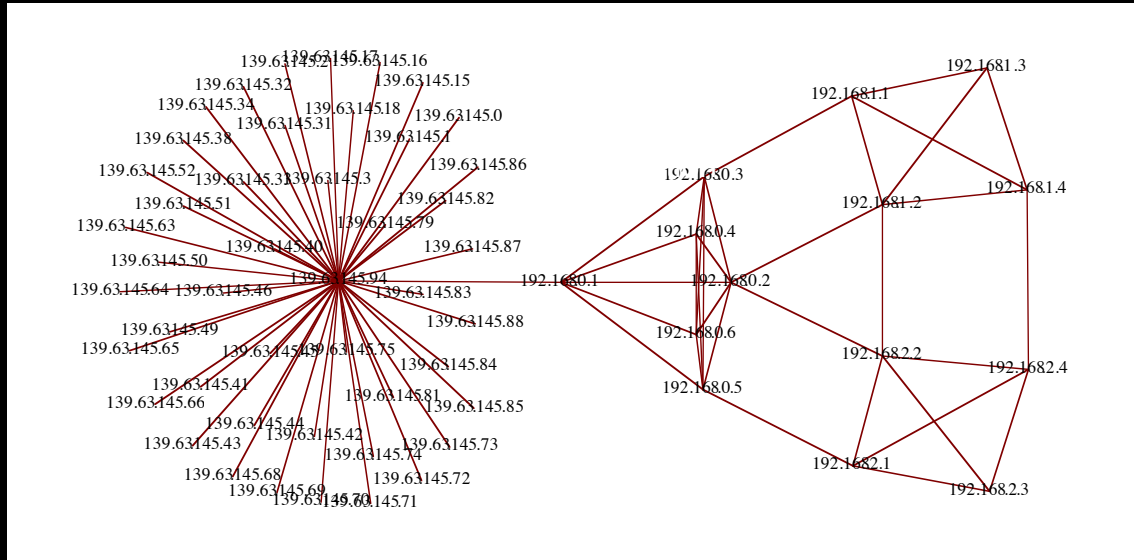
Transaction on shortest path with tokens

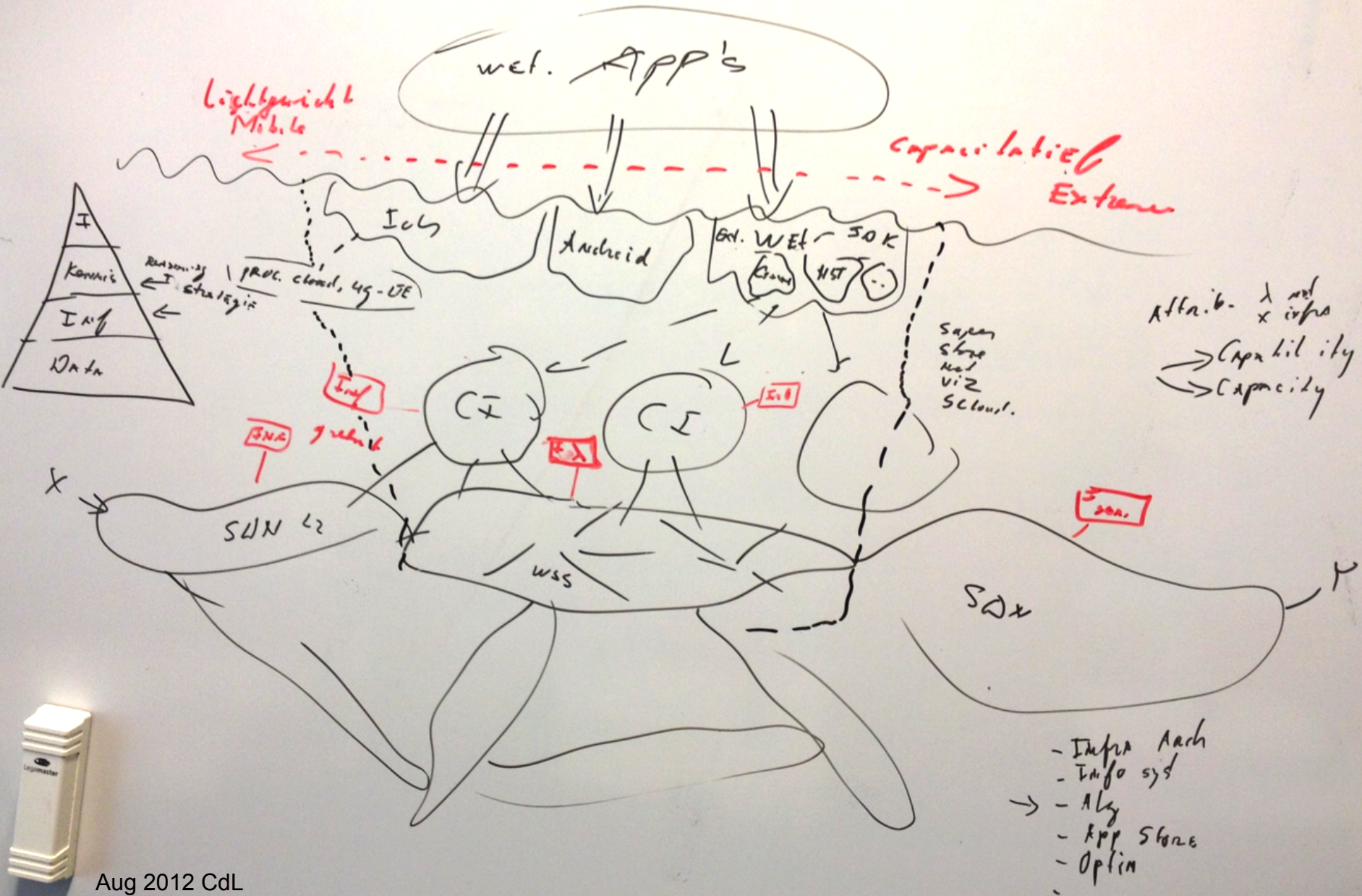
Internal links: {192.168.2.3}

```
nodePath = ConvertIndicesToNodes[
ShortestPath[
g,
Node2Index[nids, "192.168.3.4"],
Node2Index[nids, "139.63.77.49"],
nids];
Print["Path: ", nodePath];
If[NetworkTokenTransaction[nodePath, "green"]==True,
Print["Committed"], Print["Transaction failed"]];
```

Path:
 {192.168.3.4, 192.168.3.1, 139.63.77.30, 139.63.77.49}

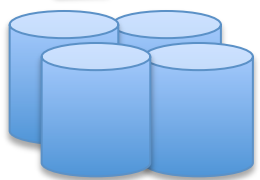
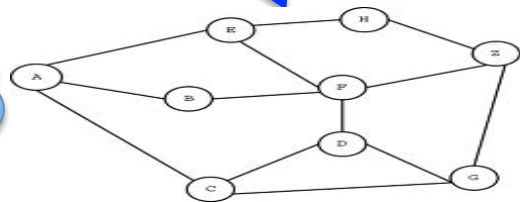
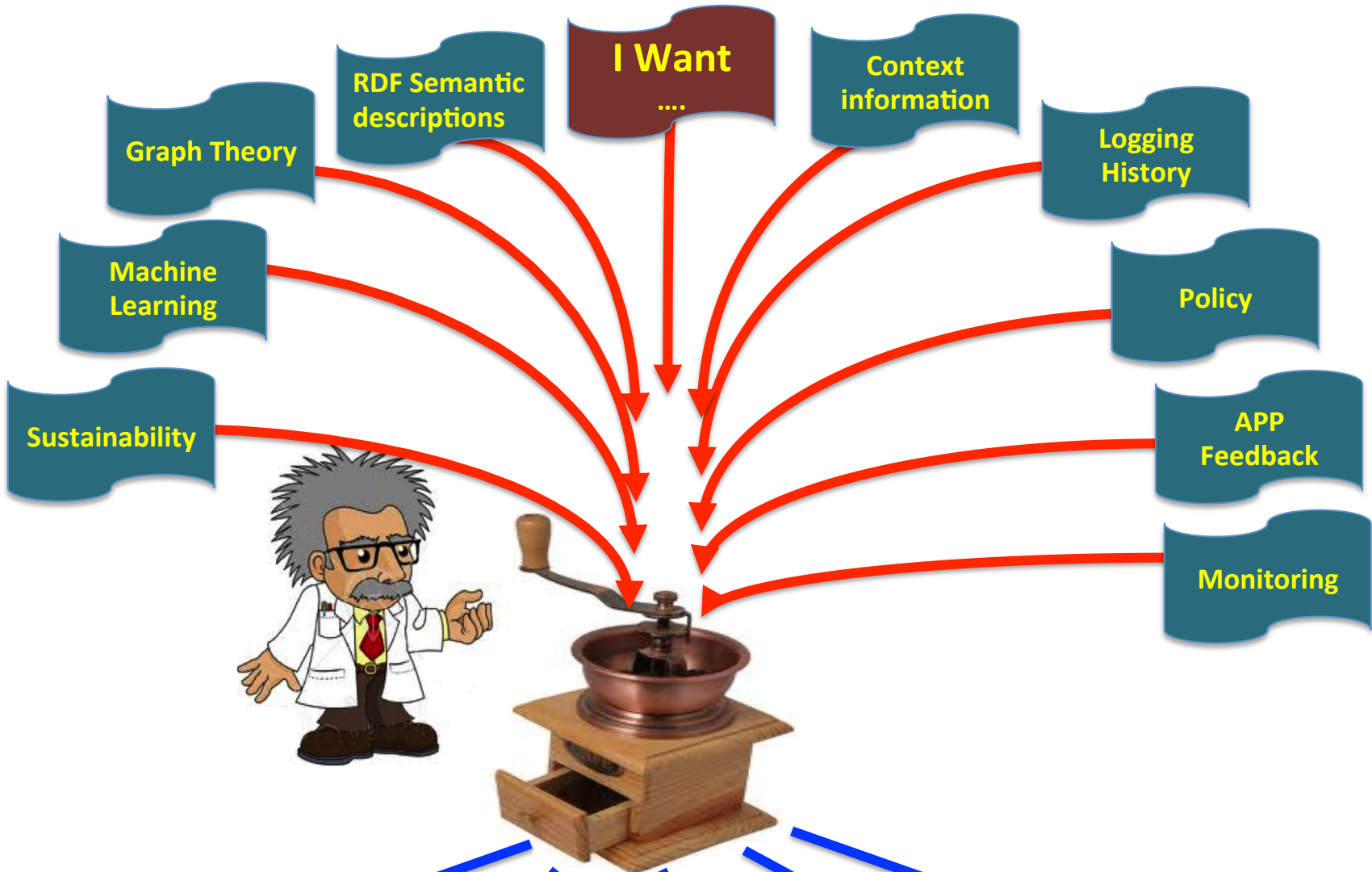
Committed





- Infra Arch
- Info sys
- Alg
- App Store
- Optim

Aug 2012 CdL



ECO-Scheduling

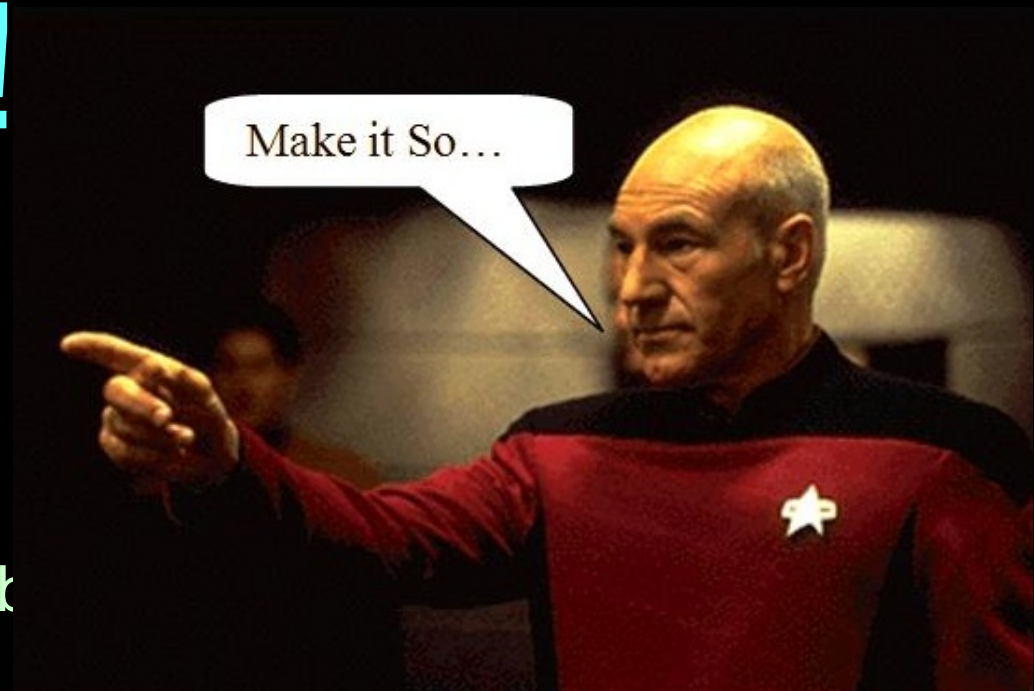


Conclusion

I want a MIS system!

Make it so!

Catchphrase first used in "Encounter At Farpoint" (28 September 1987) by Gene Roddenberry, and thereafter used in many episodes and films, instructing a crew member to execute an order.



Speakers

- Hiroshi Onaka, Fujitsu
- Kim Roberts, Ciena
- Inder Monga, ESnet