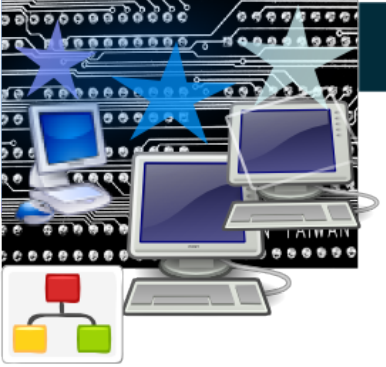

From Grids to Clouds to PaaS: new research challenges – AOC Team –

Christophe Cérin[1]

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Inria - universités tunisiennes workshop

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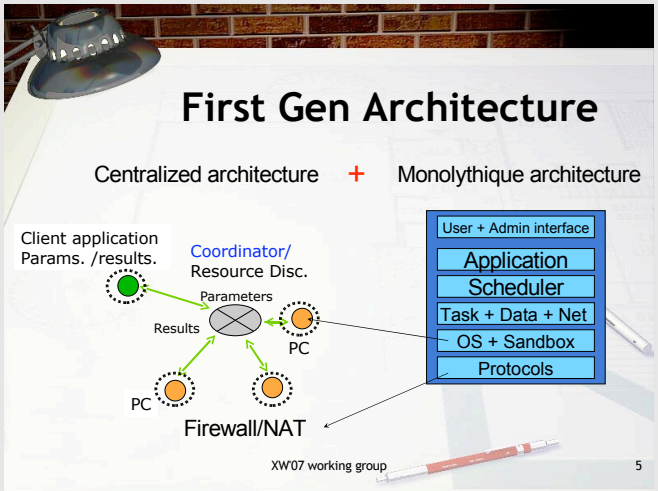
Objectives

1. Motivate research projets in Grids & Clouds ;
2. Starting from recent advances in Desktop Grid Middleware:
   - BonjourGrid (orchestration of multiple instances of DG middleware) and PastryGrid (fully distributed execution of applications)
   - Joint works with UTIC lab., Tunisia (Heithem Abbes and Mohamed Jemni)
3. Before keeping innovative ideas to reuse in Cloud Architectures / Systems:
   - decentralized architectures and services;
   - large scale systems (FT);
   - interoperability of services (the client is not a prisoner, or if it is, he can choose his prison(s)!)

Desktop Grid Architectures

Desktop Grid



Key Points

- Federation of thousand of nodes;
- Internet as the communication layer: no trust!
- Volatility; local IP; Firewall

Desktop Grid Architectures

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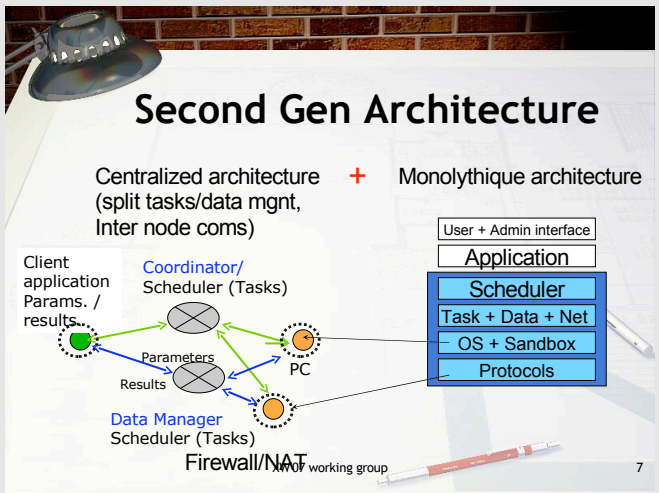

Future Generation (in 2006)

- Distributed Architecture
- Architecture with modularity: every component is "configurable": scheduler, storage, transport protocole
- Direct communications between peers;
- Security;
- Applications coming from any sciences (e-Science applications)

In search of distributed architecture

First line: publish/subscribe system to notify and coordinate services and multiple DG without a central broker ⇒ BonjourGrid;

Second line: approach based on structured overlay network to discover (on the fly) the next node executing the next task ⇒ PastryGrid;

(main contributions of Heithem Abbes in his PhD)

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- Each coordinator searches, in a concurrent way, participants (idle machines)

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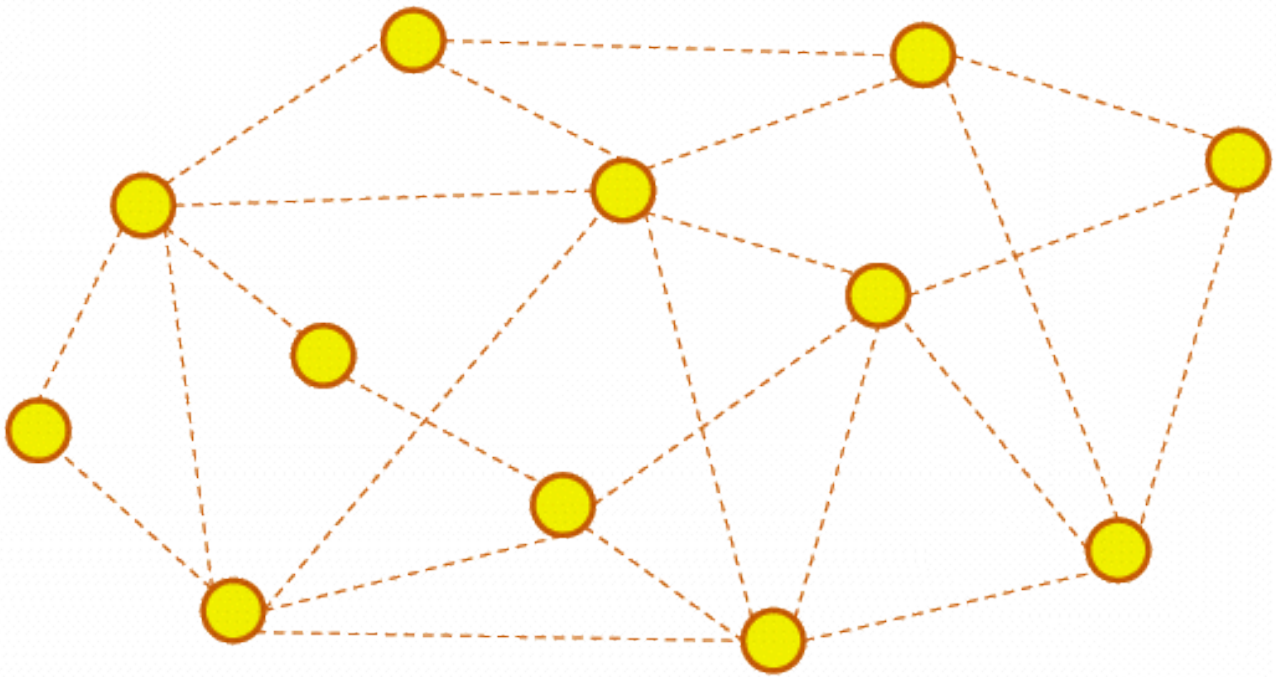

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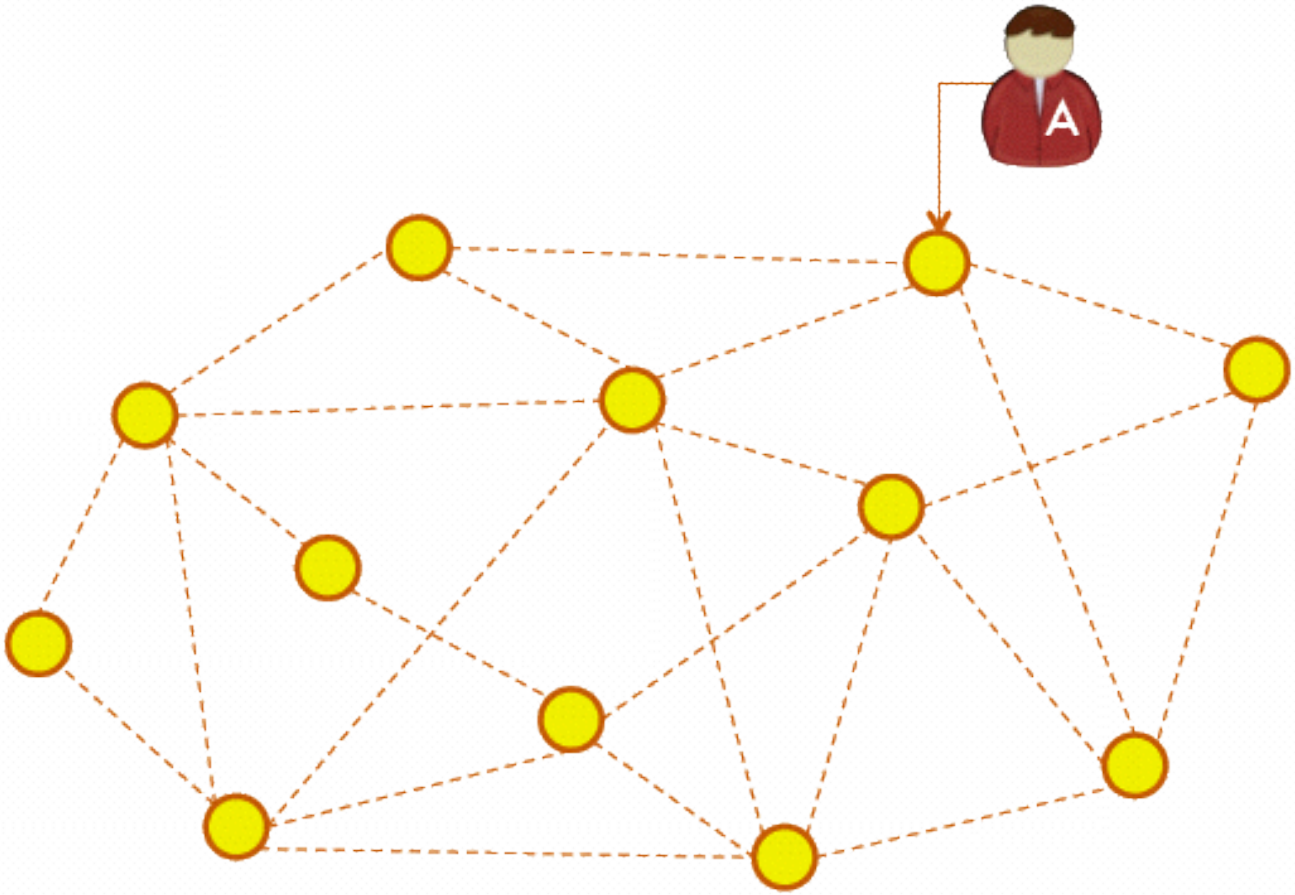

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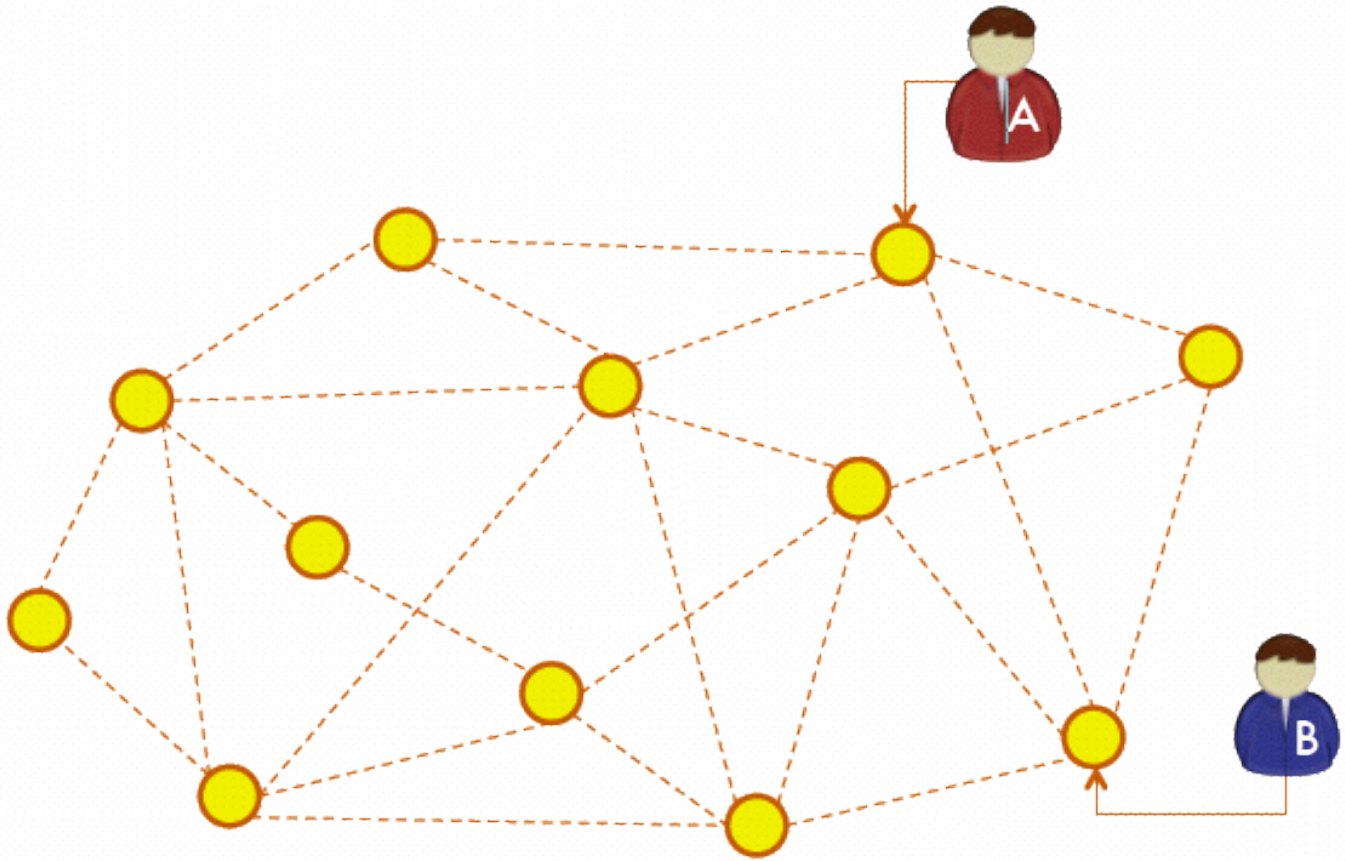

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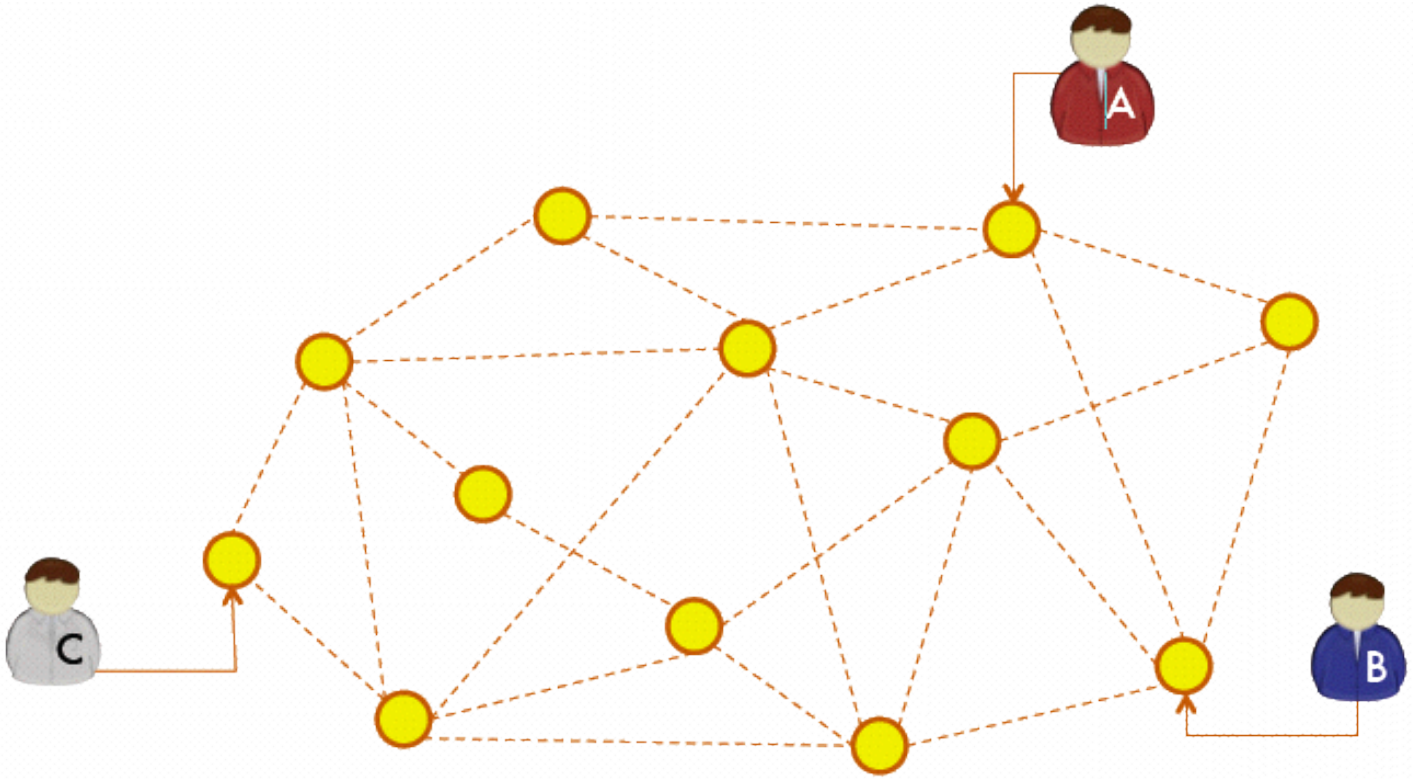

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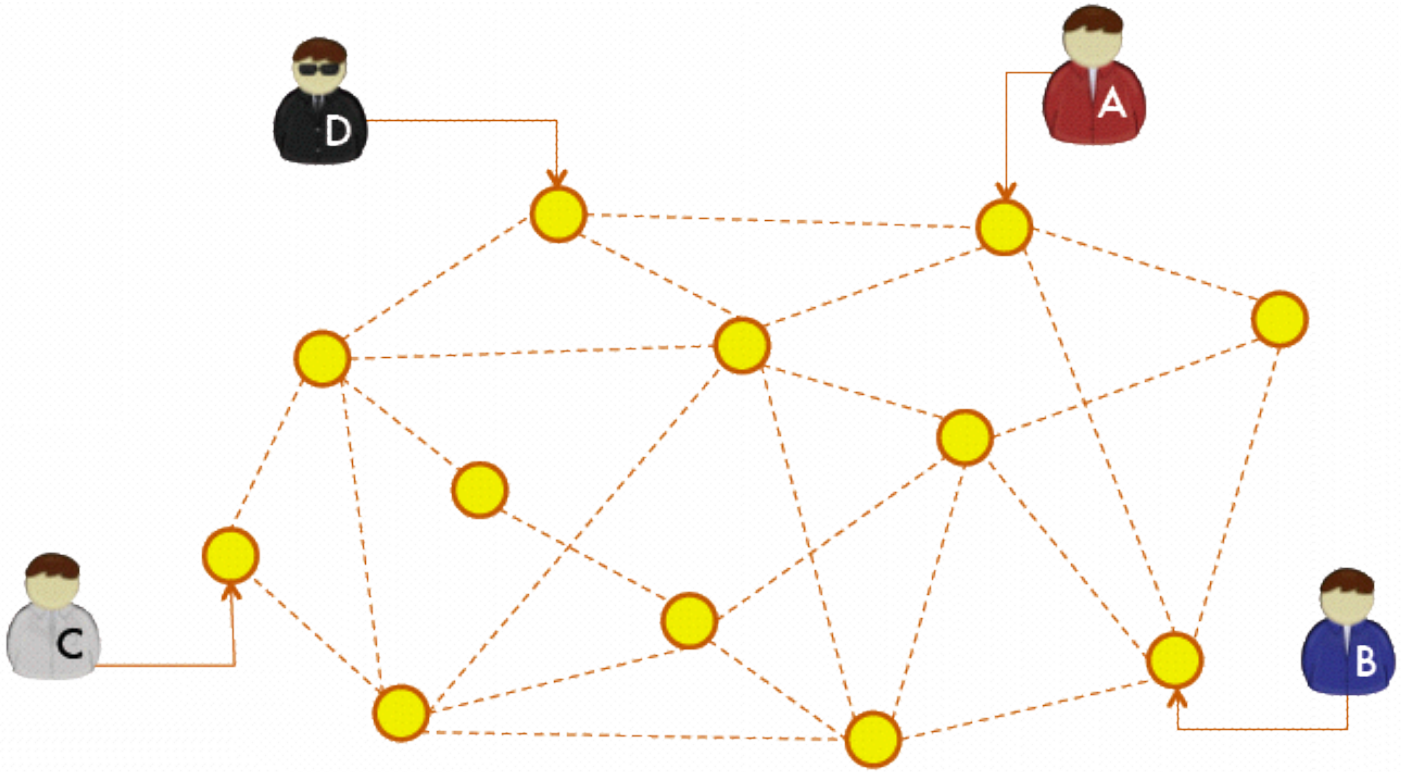

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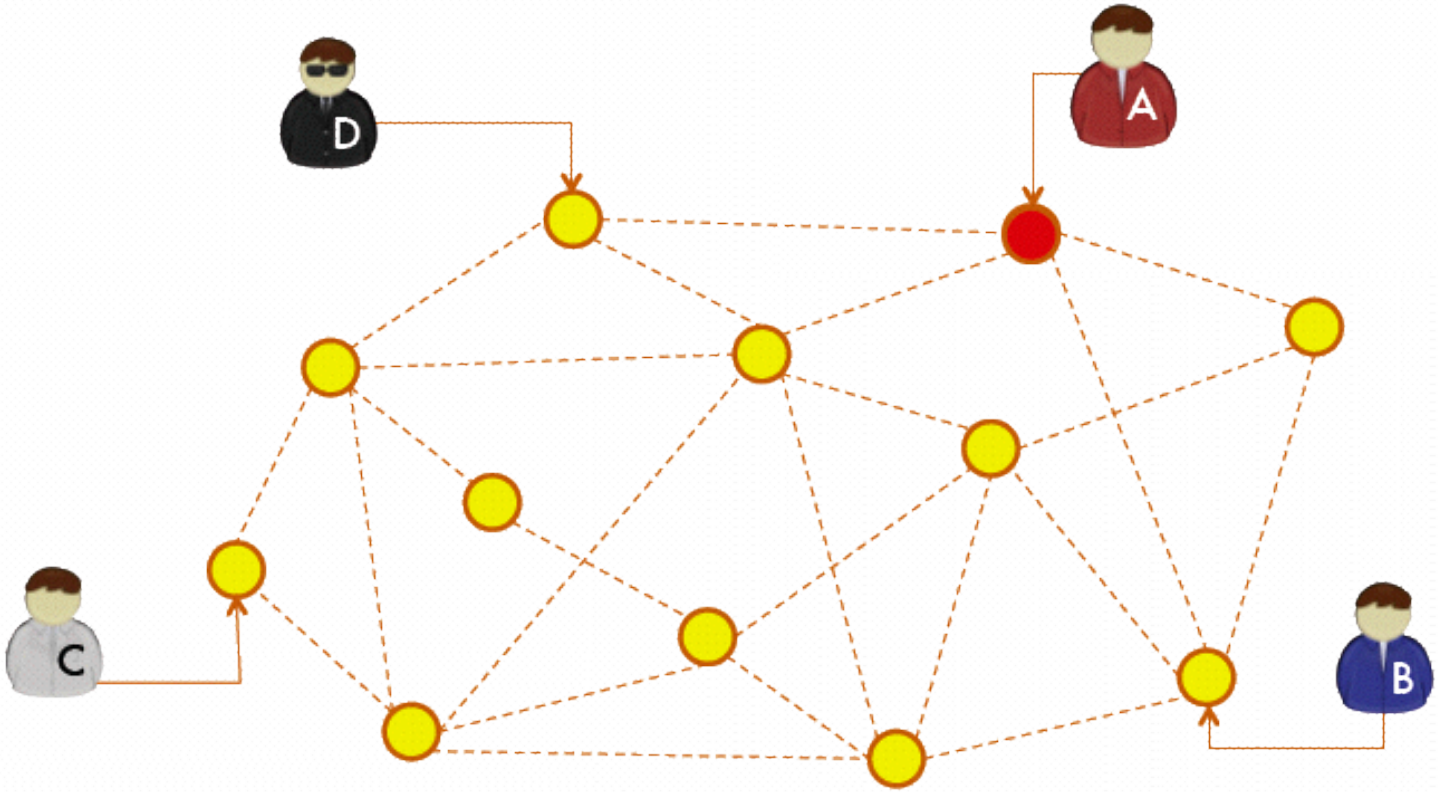

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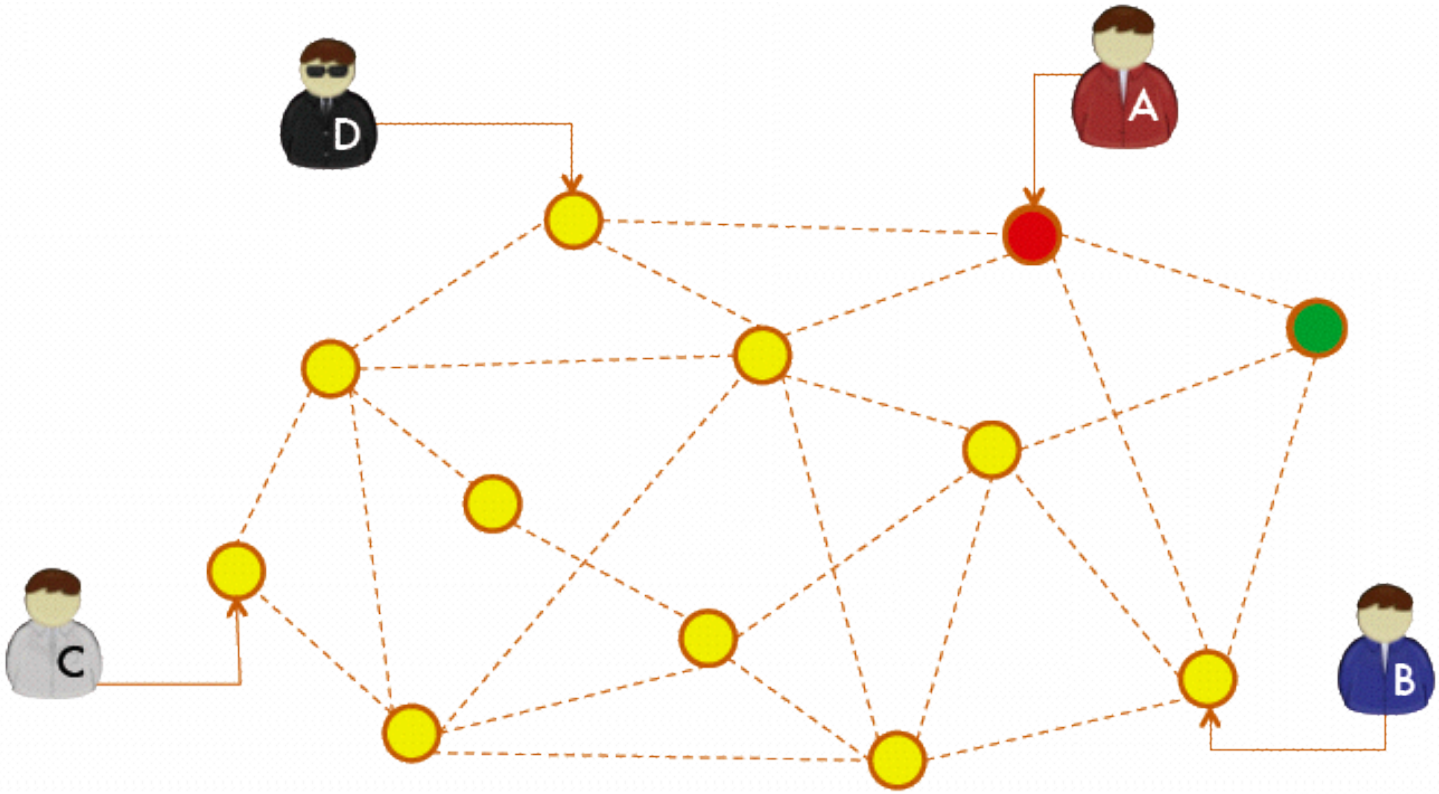

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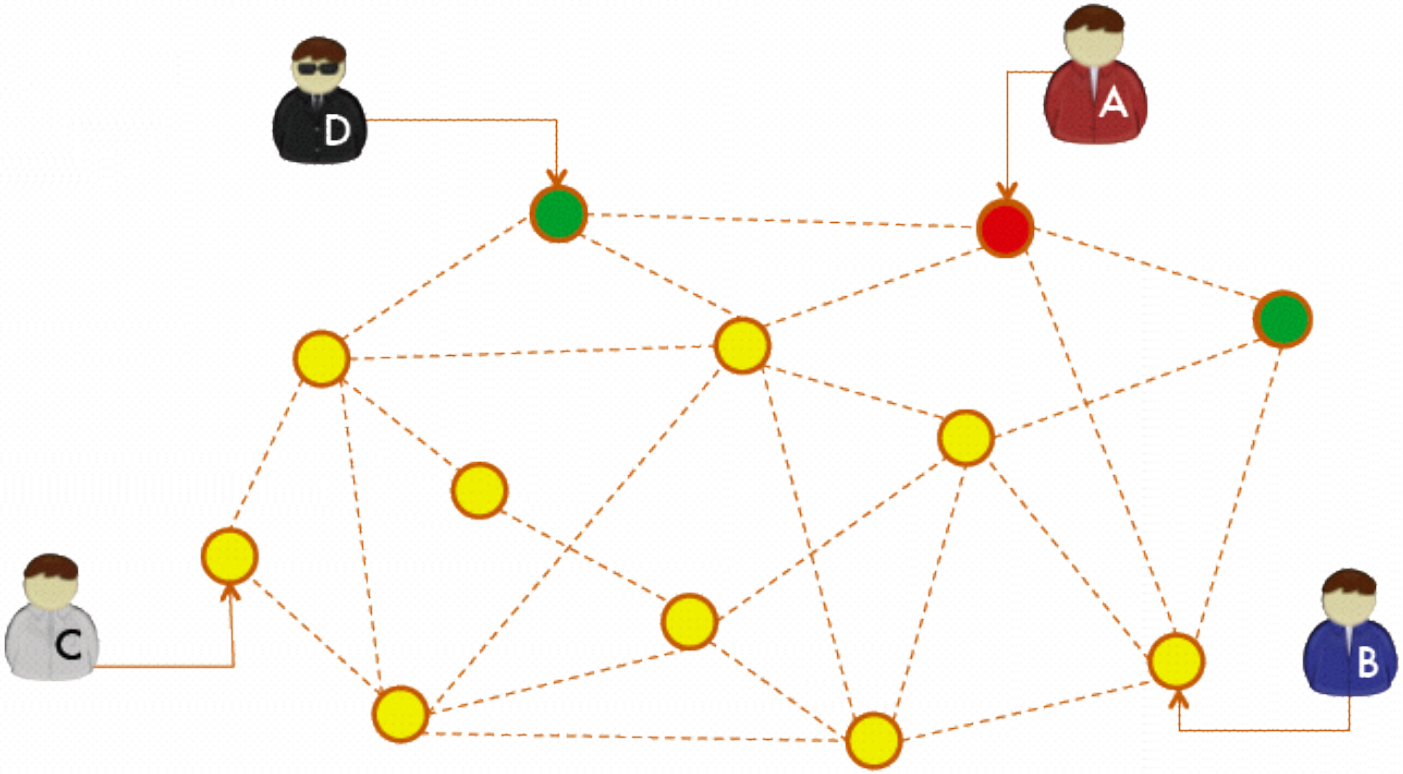

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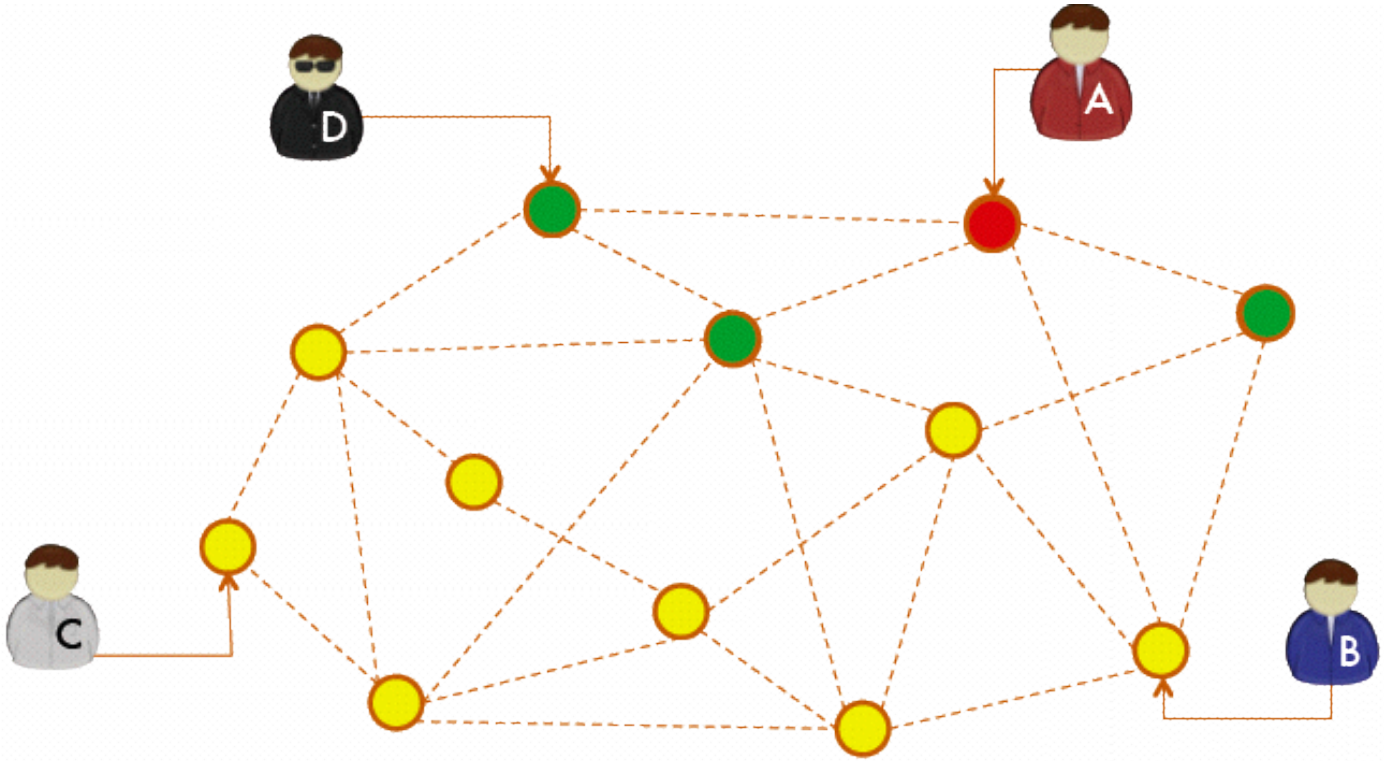

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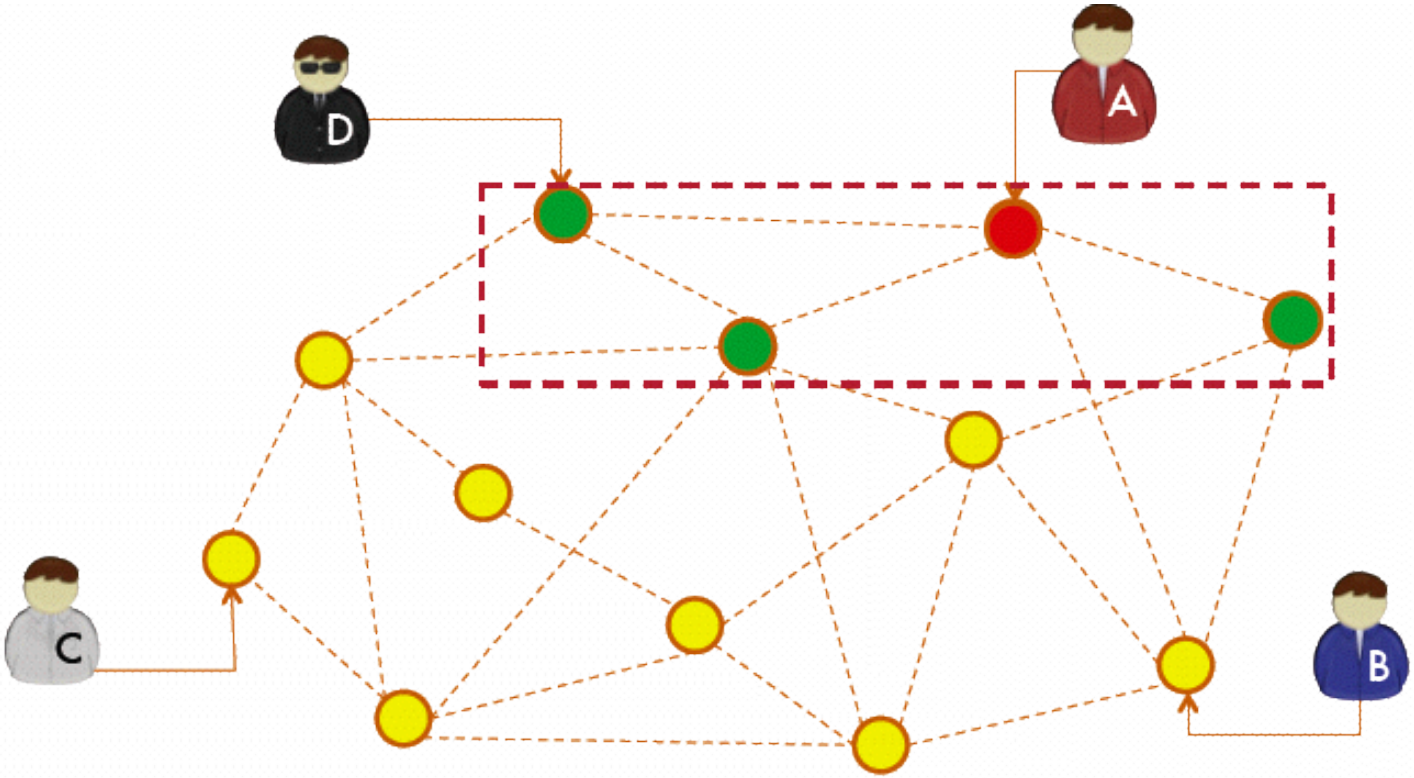

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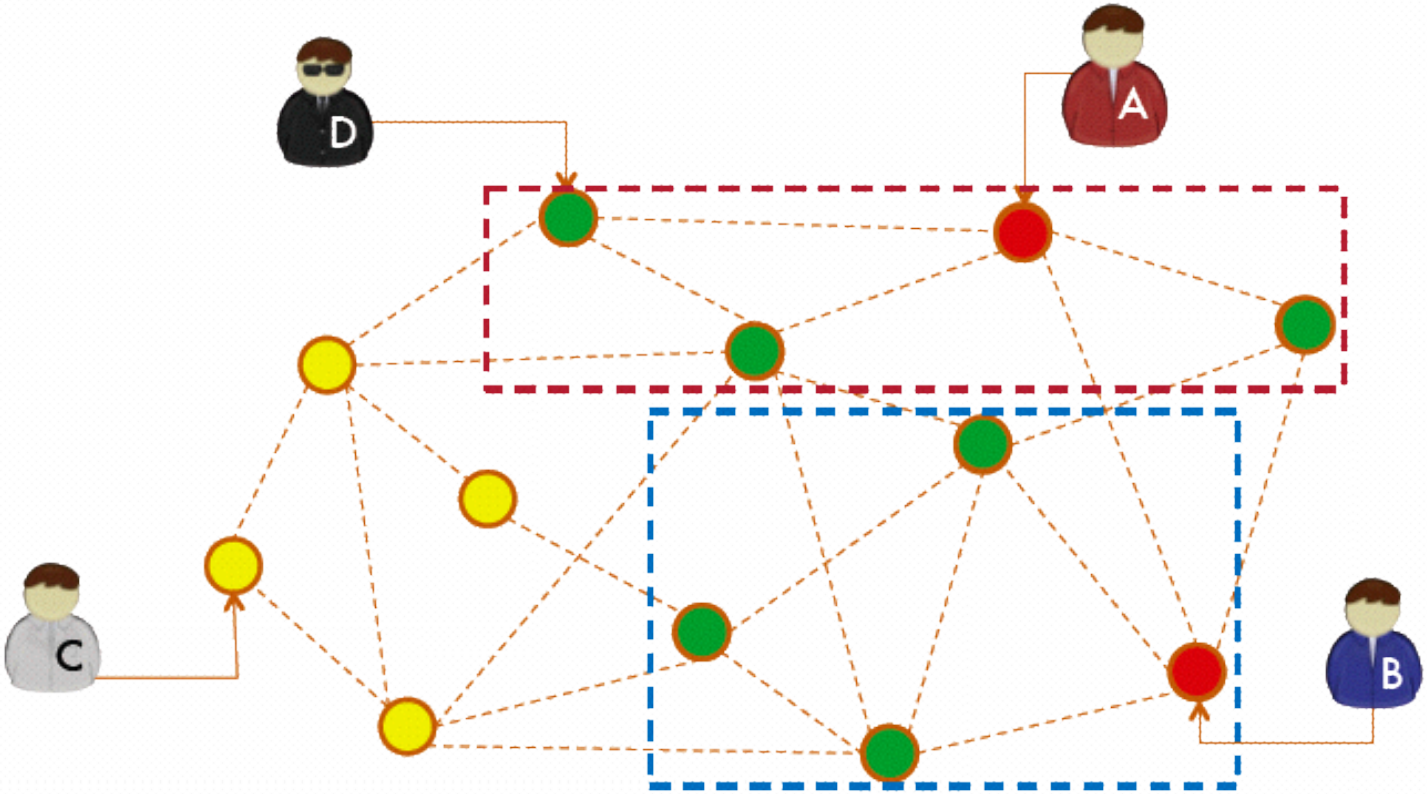

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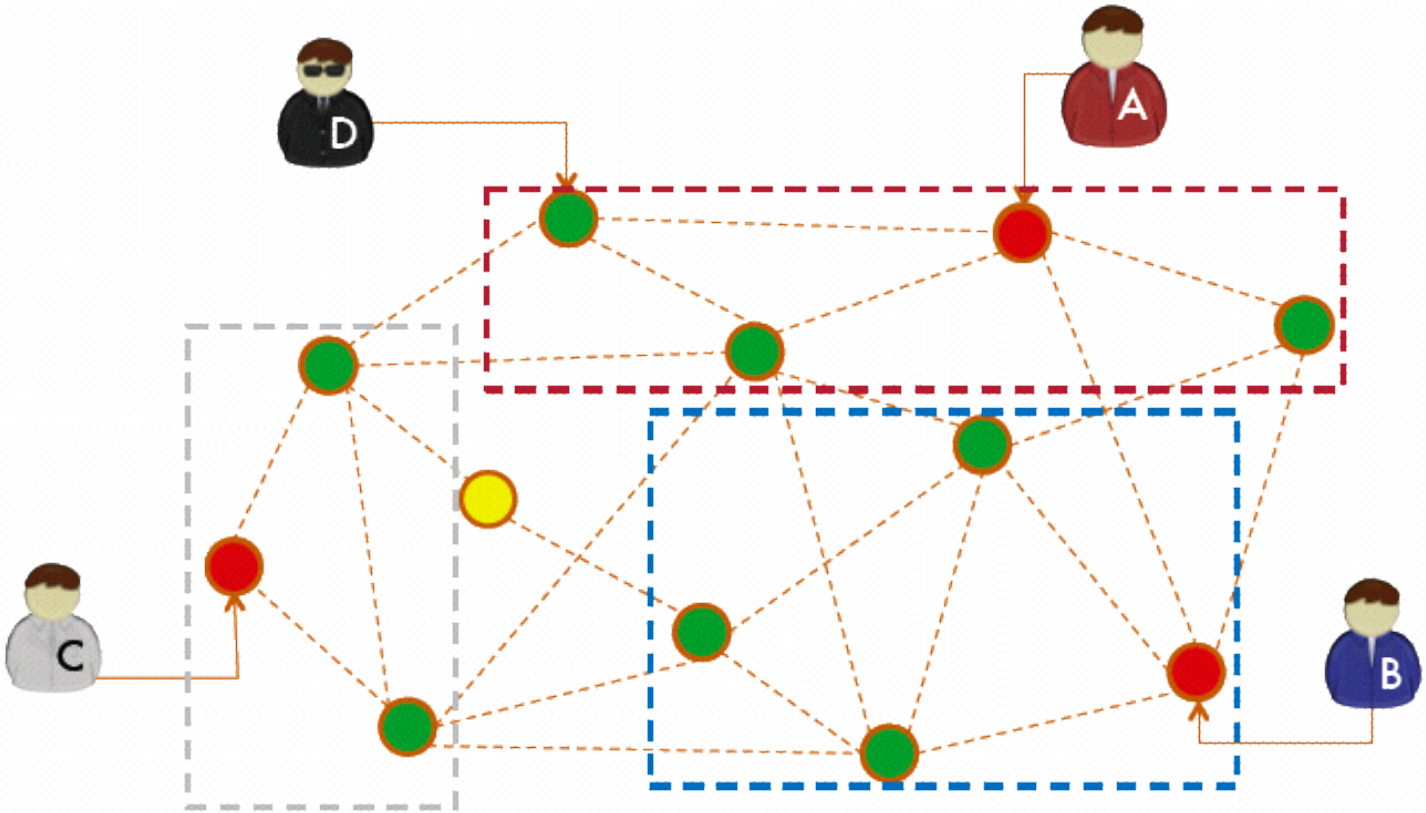

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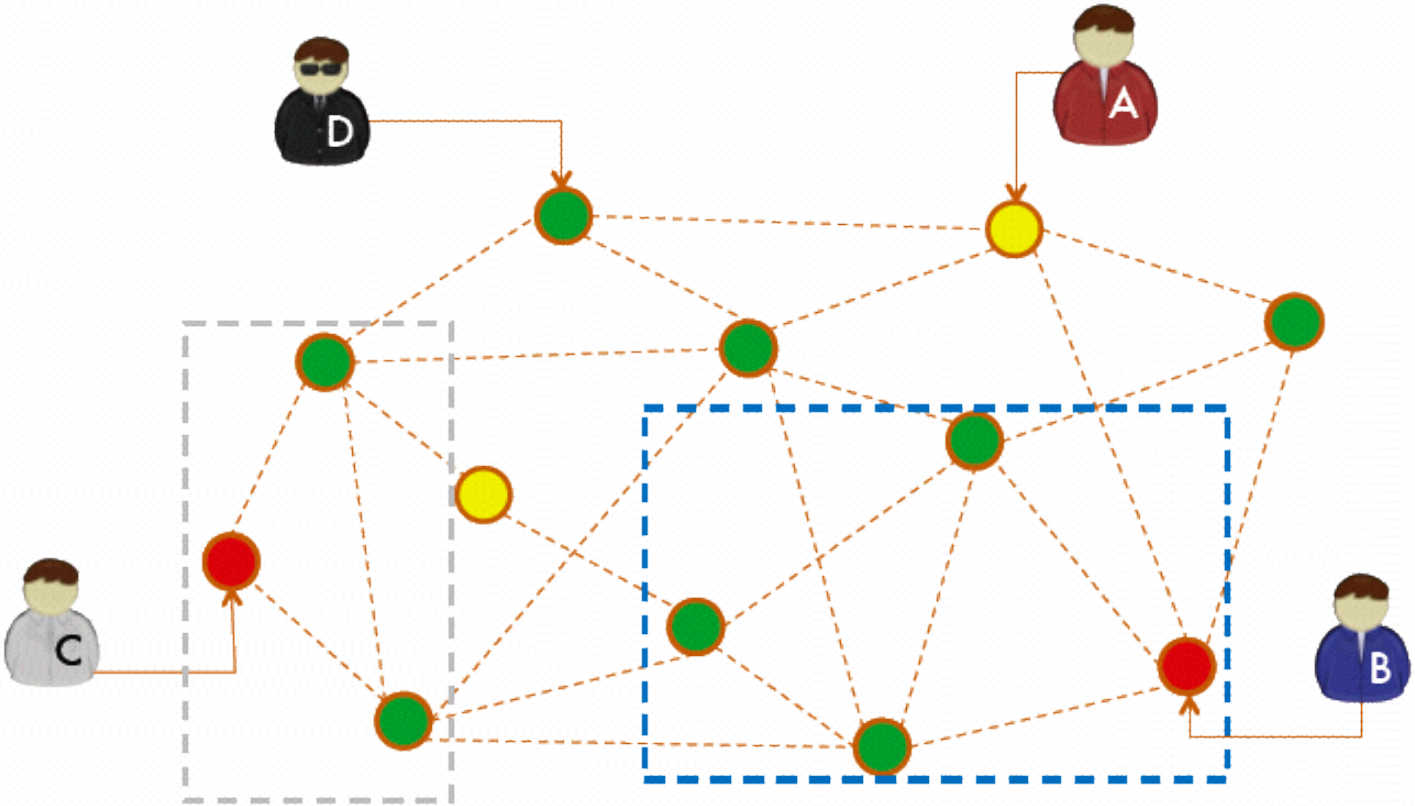

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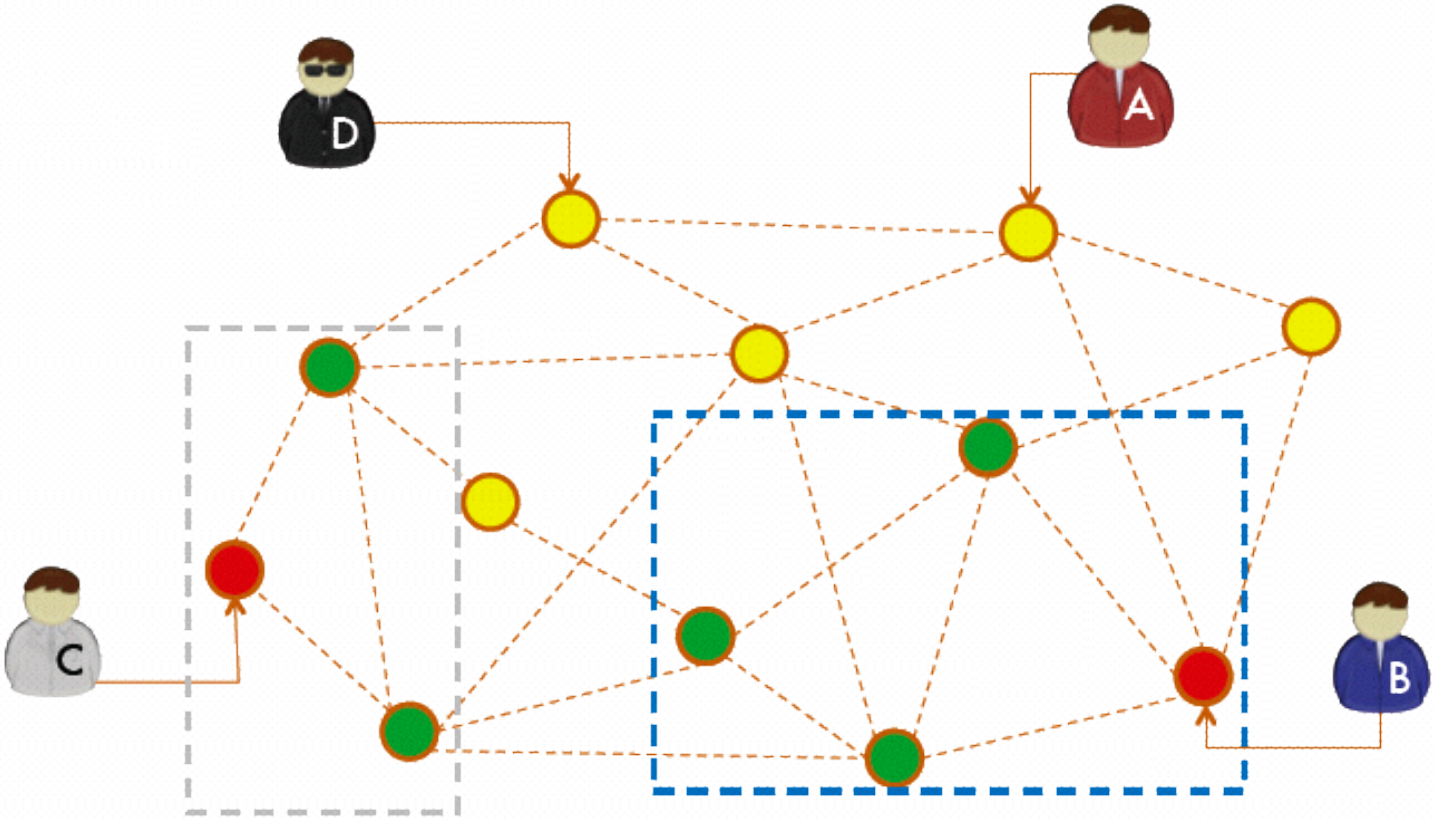

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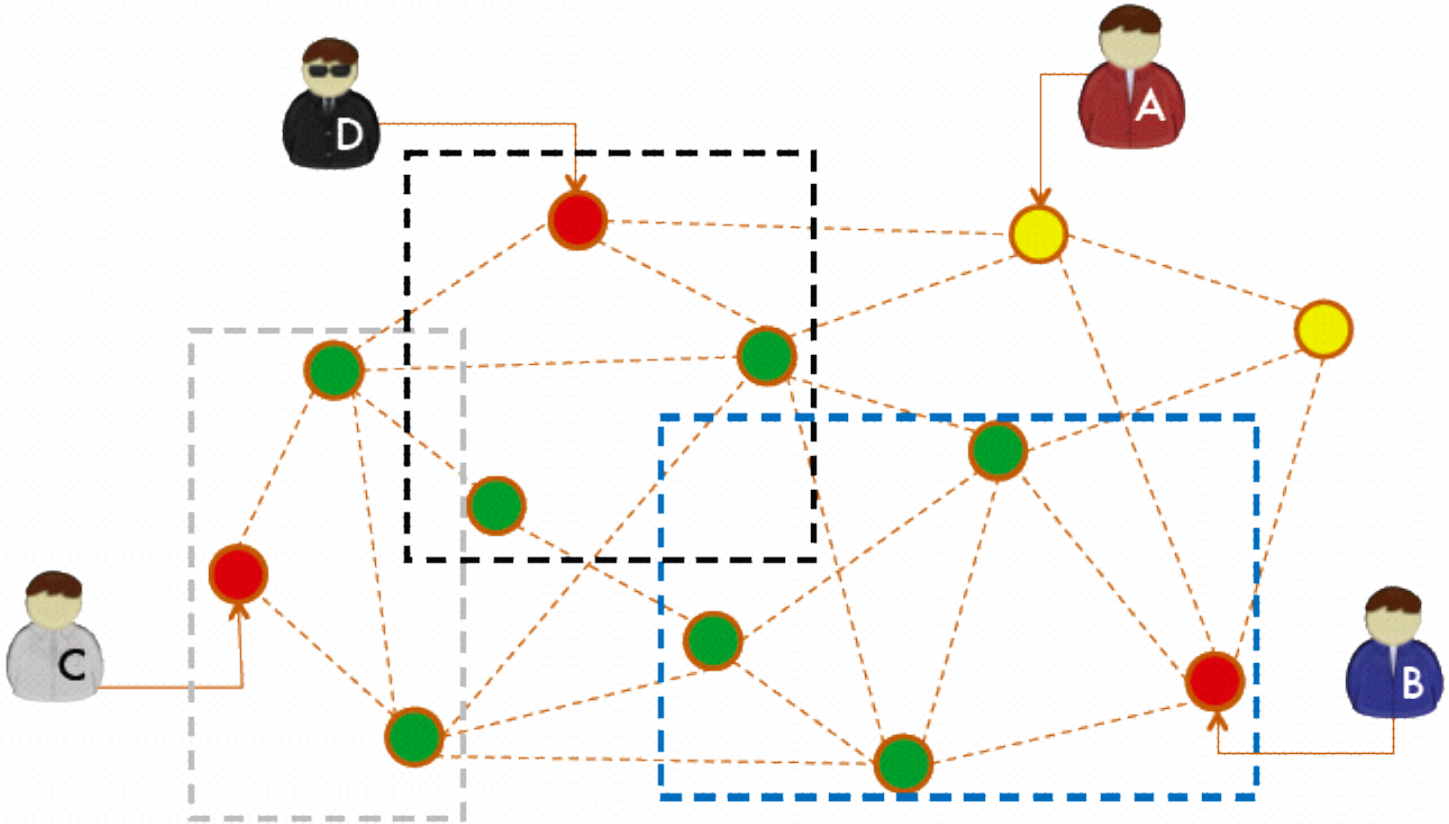

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- The current protocol has been developed/specified with 'ad-hoc' methods → we need to consolidate the trust (ongoing project to verify it, based on Colored Petri Nets)

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- Our solution: tolerate the failure of coordinators
  - For any application we create and manage dynamically copies of the coordinator;
  - We manage k copies; based on passive replication.
  - When a service disappears: we added a special status flag to distinguish between 'end of the application' / 'failure' $\Rightarrow$ slaves can redirect the communication to a copy.

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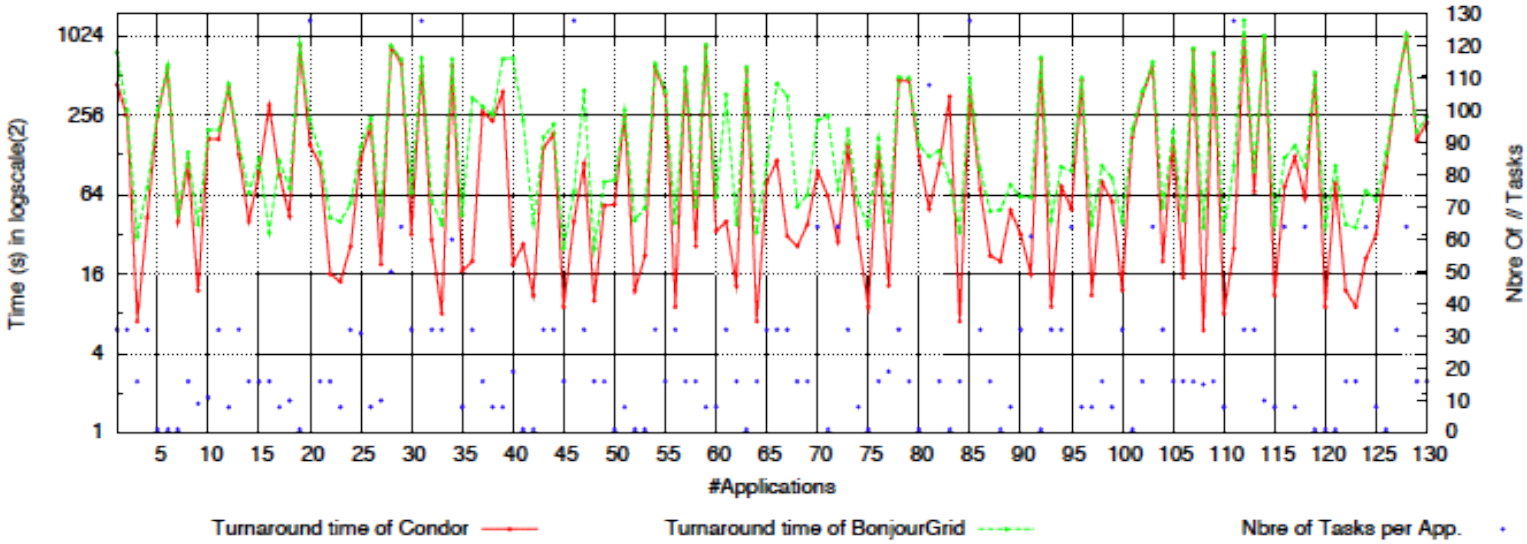
  - in terms of robustness in supporting FT;
- Example Condor: 130 applications (2 to 128 // tasks), 200 nodes, application task: 1s to 500s. Result: with BonjourGrid, 35% of applications generate a delay of about 30s.

Experiments: one example



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  - provide a defined interface for the separation of concerns between different handlers;
  - it is not sufficient that a user sits down at her terminal for an event to elicit reaction necessarily $\Rightarrow$ (event, notification)

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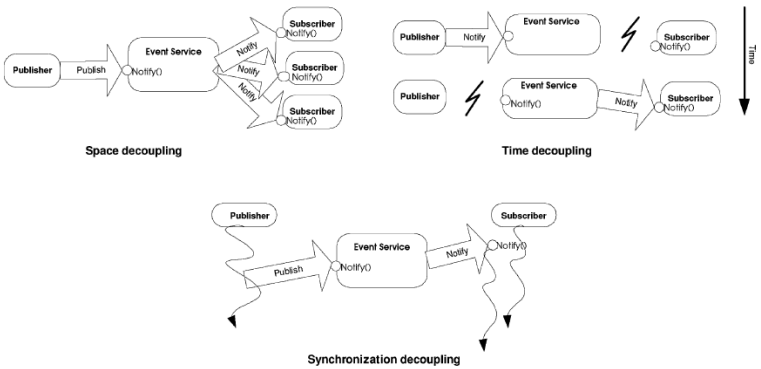

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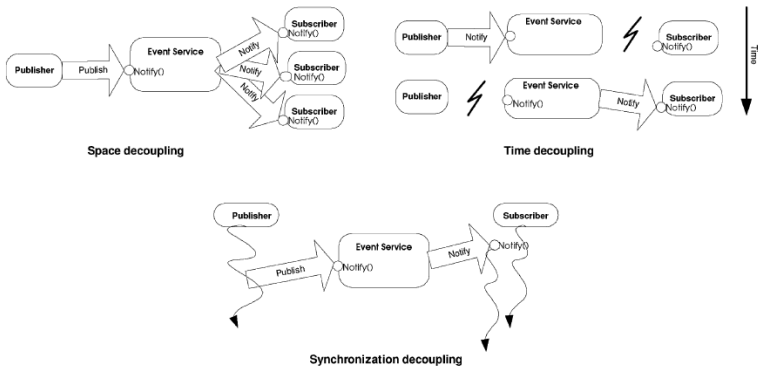

- Decoupling production and consumption = increases scalability (less dependencies between participants)

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- SOA = RPC → not good for scalability, not good for Clouds (main idea)

Towards PaaS and Clouds

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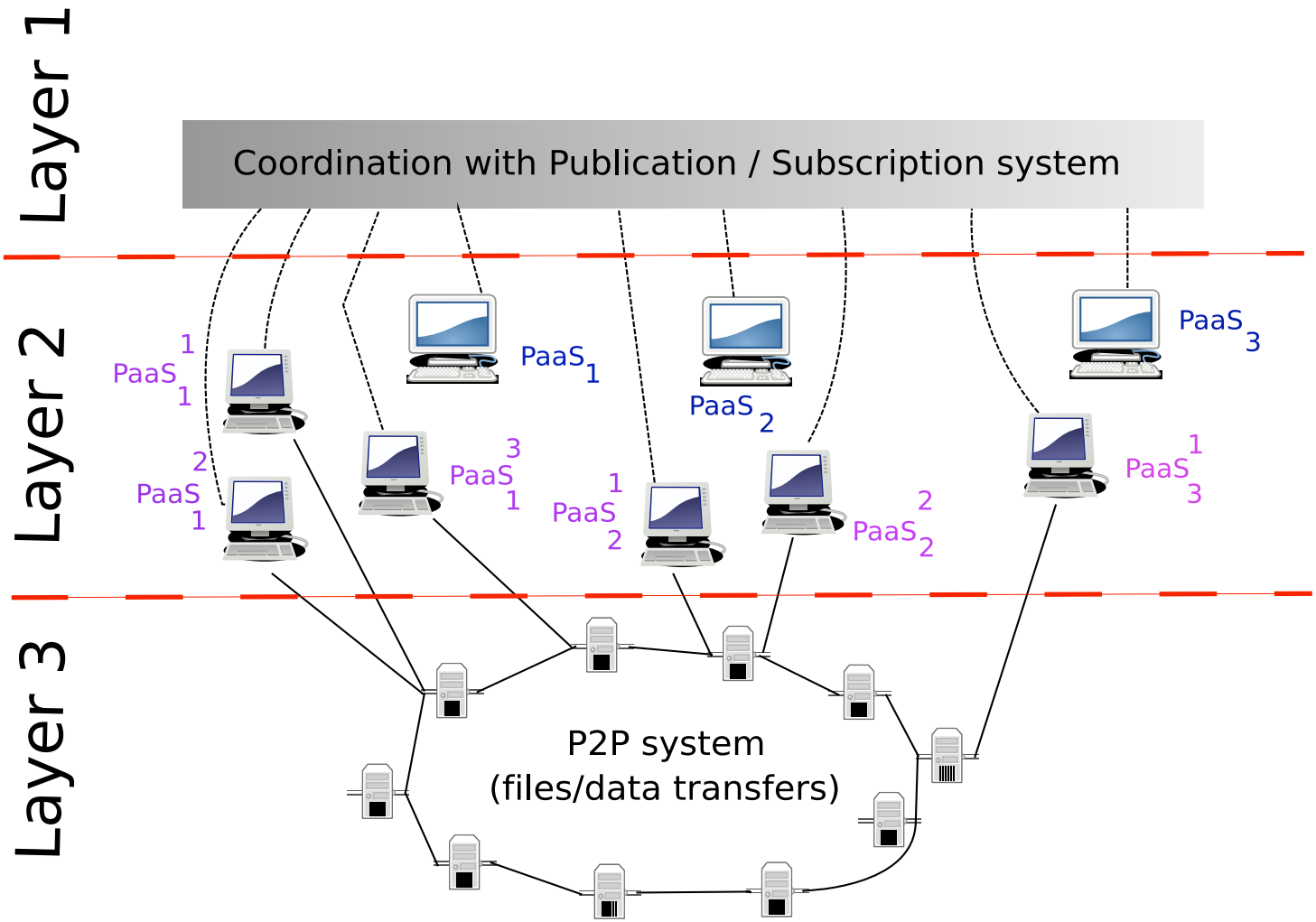
- We have started an initiative for defining and designing a "general purpose PaaS" based on distributed protocols for coordination and data exchange.

Architecture overview of the PaaSoordinated project



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- MORE FREEDOM

Some Challenges

- Where to insert the different connectors in the PaaS software stack to get an open infrastructure?

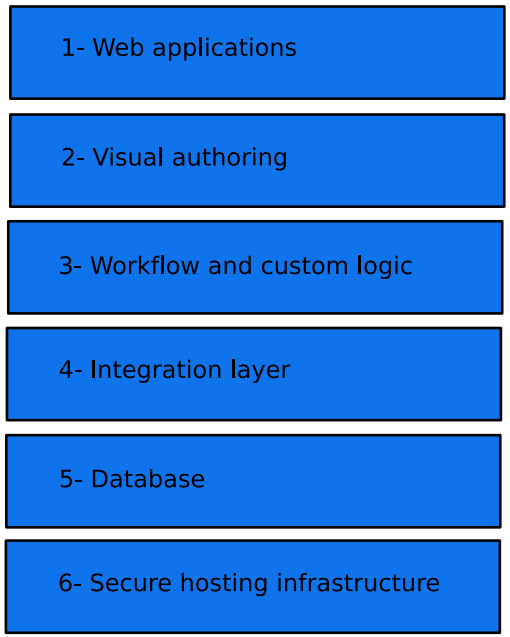

Figure: Software stack in PaaS (source: Coghead)

Research opportunities

Above the Clouds: A Berkeley View of Cloud Computing

- Availability of a service → mastering FT → redundancy;

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- Programming: https://www.myerp5.com/kb/developer-How.To.Become.ERP5.Developer/view
- OSOE course: http://www.osoe-project.org/lesson
- TioLive tutorial: https://www.tiolive.com/documentation/tiolive-tutorial
- Documentation for developers:

  https://www.myerp5.com/kb/documentation_section/developer/

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- Who and What:
  - www.ileo.net: BS2 storage, IaaS, Data center, Internet connectivity
  - www.mandriva.com: Xtreem Storage Server, GNU Linux (server, desktop, netPC);
  - www.nexedi.com: TioLive (SaaS/PaaS), NEO Transactionnal cloud Storage, SLAP (Accounting and Provisionning), ERP5
  - www.tiolive.com: ERP/CRM/KM SaaS/KM PaaS

Nexedi projects

Special focus on SLAP

- Simple Languages for Accounting and Provisioning (SLAP) leverages and extends buildout technology to install any kind of self contained Cloud Computing containers on any operating system.
- Buildout technology (http://www.buildout.org/): Python-based build system for creating, assembling and deploying applications from multiple parts, some of which may be non-Python-based. It lets you create a buildout configuration and reproduce the same software later.
- SLAP Cloud Engine leverages open source ERP5 to provide accounting and billing of allocated Cloud resources;

Nexedi projects

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- Key Applications:
  - Automated Datacenter Management;
  - Cloud Computing Resource Allocation, Optimization and Exchange;
  - Accounting and Billing.
- Strength:
  - Compatible with any software technology and any OS;
  - Built-in CRM and ERP;

- **Nexedi**

SlapGrid

- software component of TioLive Grid https://www.tiolive.com/news/news-tiolive-grid-debut or grid.tiolive.com
- role: protocole for the coordination of VM
- Slapgrid Cloud Enginer combines desktop grid computing and cloud computing to distribute Cloud Compputing resources over multiple suppliers of raw computing power, either in Data Centers or at home. Slapgrid also includes billing and provisionning features.

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  http://www.freecloudalliance.org/
- Main change: accept to manage redundancy, scaling the server (even for temporary needs), synchronisation ⇒ coordination with grid technology (BonjourGrid, PastryGrid?);

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- Ex: a company wants to install the Virtual Desktop EyeOS and the TioLive/ERP5 PaaS. During the night, the company rents different services:
  - one (company) to many – many (services) to many (companies) = new abilities, new business!
  - demonstrate that a single coordination protocol is better than configuring as many middlewares than we have software!

From Grids to Clouds to PaaS: new research challenges – AOC Team –

Christophe Cérin[1]

[1]Université de Paris XIII, CNRS UMR 7030, France

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