Performance Analysis of Publish/Subscribe Systems

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Outline

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1. Resource discovery in grids
   - Motivation
   - Exploiting your neighbourhood

2. Performance Analysis
   - Framework
   - Measurements

Grids

Why putting grids around us?

Computational resources are more and more demanding.

- Computational grids
- Data grids, peer-to-peer networks
- Mobile computing, pervasive computing
- Inter-node communications, Instant grids!

What does not scale ?

- Fault tolerance (nodes, network)
- Data circulation (firewalls, rate, quantity)
- Intermittent node management (desktop grids)

Flexible grids need to be aware of new resources in a distributed way.

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Fallacies of Distributed Computing

Joy/Lyon/Deutsch/Gosling

1. The network is reliable.
2. Latency is zero.
3. Bandwidth is infinite.
4. The network is secure.
5. Topology doesn't change.
6. There is one administrator.
7. Transport cost is zero.
8. The network is homogeneous.

(copied from Wikipedia)

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Living in a pervasive computing world.

Make yourself known!

Communication between random nodes is often limited. We need to build an overlay network.

- Main requirement: announce of existence (broadcast one-to-all);
- Good performance (low latency, congestion management, data rate);
- Topology of the overlay network: full graph, star graph (tree?), ring;
- Already existing: Ethernet level, LAN, VPN... not desktop grid;
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Uniqueness of designation

Be unique!

Resources use unique identifiers necessary for host-to-host communications.

- Second requirement: verification of uniqueness;
- Well-knwon distributed allocation problem;
- Requires many-to-one (does not scale) or other means (retry in case of conflict);
- No perfect solution (asynchronous) $\rightarrow$ retries.
- Unique identifier required also for security conscious protocols;
- Good solutions based on host identity for uniqueness.

Network topology

Don't get lost!

Routing through the network is also one of the expected functionality of a grid building infrastructure

- Complete graph: most simple;
- Star graph: used by the difficult to reach;
- Cloud: general internet routing;
- Ring: very efficient for all-to-all communications (not for general purpose communications)

Implementations:

- Kernel level $\longrightarrow$ virtual devices, unmodified applications;
- User-space level $\longrightarrow$ virtual nodes, node-specific process translation (e.g. web services, virtual addresses);
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Bonjour® and Avahi

- Zeroconf is a set of techniques sanctioned by various IETF RFCs:
  - Sets up local IP address (IPV4LL/RFC 3927, IPV6/RFC 2462)
  - Two independent parts: mDNS/DNS-SD.
  - mDNS conveys DNS over multicast (224.0.0.251 port 5353 UDP)
  - DNS-SD: encapsulated in DNS request/replies, provides answers to service discovery.
- Bonjour
  - Developed by Apple® (initially called Rendezvous)
  - Windows+Java API
- AVAHI
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« La cerise sur le gâteau »

Pastry (`http://freepastry.rice.edu/`)

- Framework for peer-to-peer applications
- Builds the overlay network and abstracts fault-tolerance
- Provides routing and load balancing
- Free-Pastry is a free implementation
- Works over the Internet
- Can also transfer data efficiently

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Grid'5000
French experimental Grid platform

Grid 5000:

- has been mentioned already
- is a research effort developping a large scale nation wide infrastructure for Grid research

What we did:

- Compilation of a specific kernel/distribution with support for Pastry, Avahi and Bonjour.
- Reservation of 308 nodes on Orsay site. Runs of all measurements with complete logging of timings.

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- Registering one service per node;
- Large-enough delay $\delta > \mu_R$ between the registrations;
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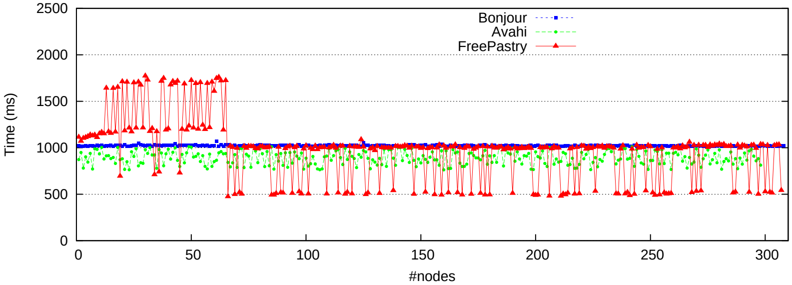

Simultaneous registration

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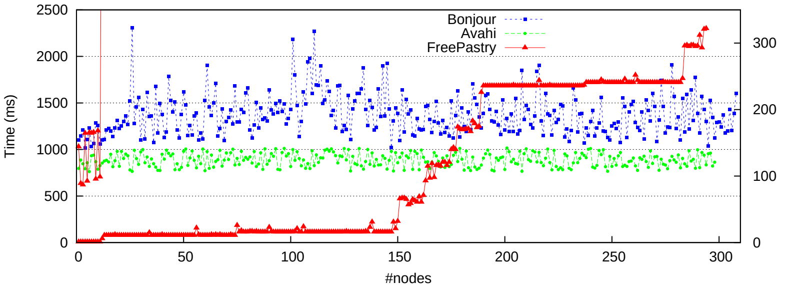

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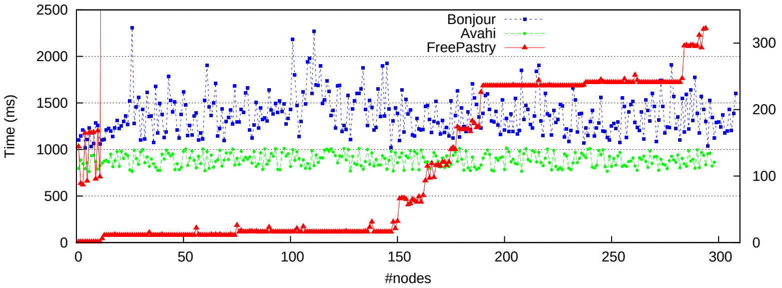

Browsing time

- Registering one service per node;
- Measurement of time between service registration and discovery per first-node and browsing process;

Bonjour No loss of information; discovery time less than 1s.

Avahi Heavy loss of registered services in simultaneous registration (60%) and time goes to 220 s; sequential registration much better (less than 2 s).

FreePastry About 3% losses in all registration modes.

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- Performance collapse for Freepastry with a great number of registrations.

- Perspectives
  - Blinking registrations, error bars.
  - Overlay networks (openHIP) to cross the link-local barrier.
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For Further Reading I

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Merci *Thank you* شكرًا