



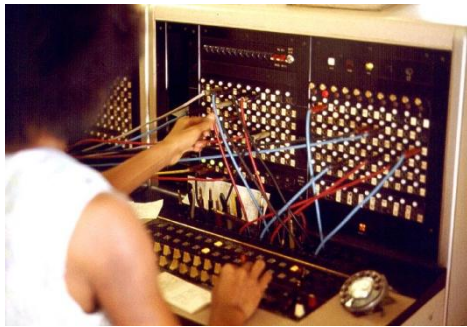
Context-Aware Location in the Internet of Things

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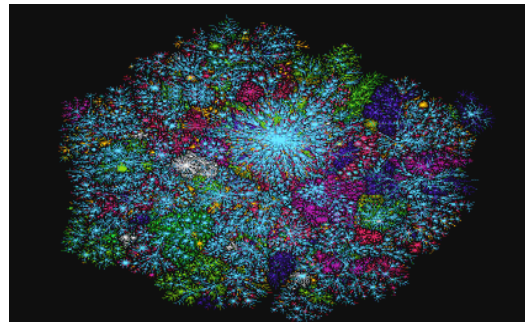
*Workshop on the Network of the Future
Co-located with IEEE Globecom
Miami, FL, USA – December 10, 2010*

Internet Reloaded

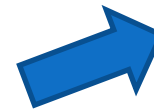
- We are on the verge of an epic transition:



**The path
(i.e. *circuit*)
is important**



**End-to-end
connectivity
(i.e. *host*)
is important**



**Information
(i.e. *content*)
is important**

The Internet of Things

- At the same time...

“By 2025 Internet nodes may reside in everyday things – food packages, furniture, paper documents, and more. Today's developments point to future opportunities and risks that will arise when people can remotely control, locate, and monitor even the most mundane devices and articles.”

(National Intelligence Council – Six Disruptive Civil Technologies 2008)



For those who cannot wait

- Many “things” (= embedded devices) already in place:
 - Transportation
 - Security/public safety
 - Industrial processes
 - Energy distribution
 - Building automation
 - ...

**Proprietary systems
not interconnected!**

Lack of interoperability!

Difficulties

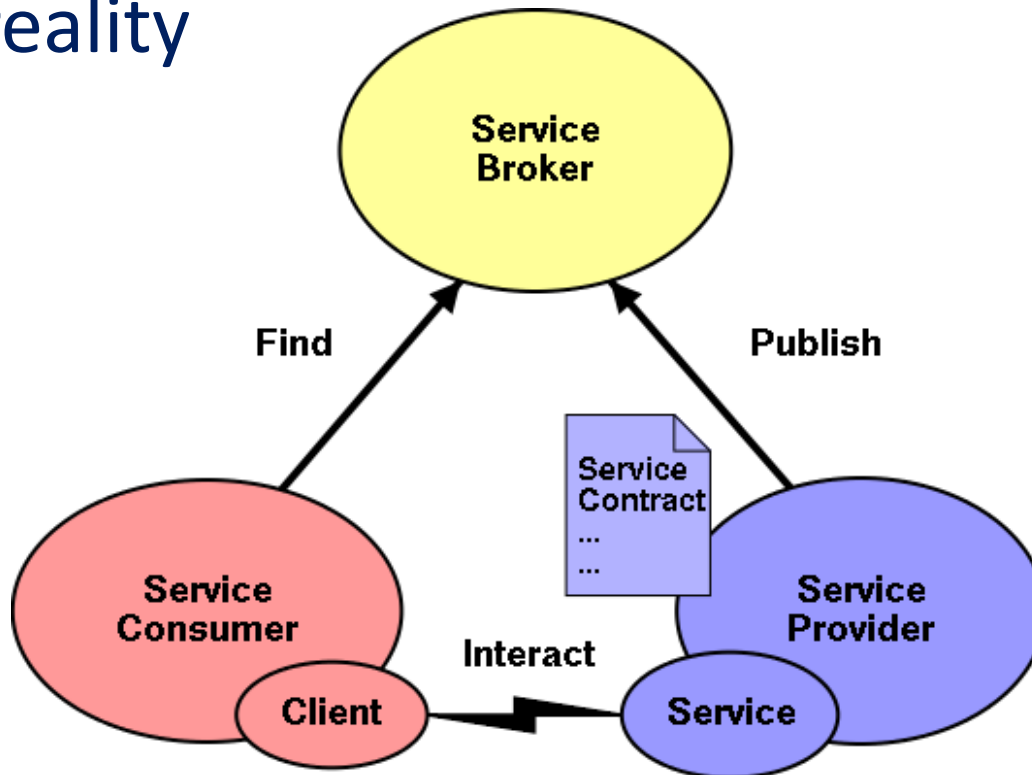
- The assumptions of the current host-centric Internet do not fit the requirements of emerging applications



- **processing capabilities are not an issue**
- **hosts always reachable**
- **hosts are not interchangeable**
- **network elements are static**
- ...

The SOA Opportunity

- Within this interconnected environment, Service Oriented Architectures (SOAs) can be made reality



ID/Locator Split

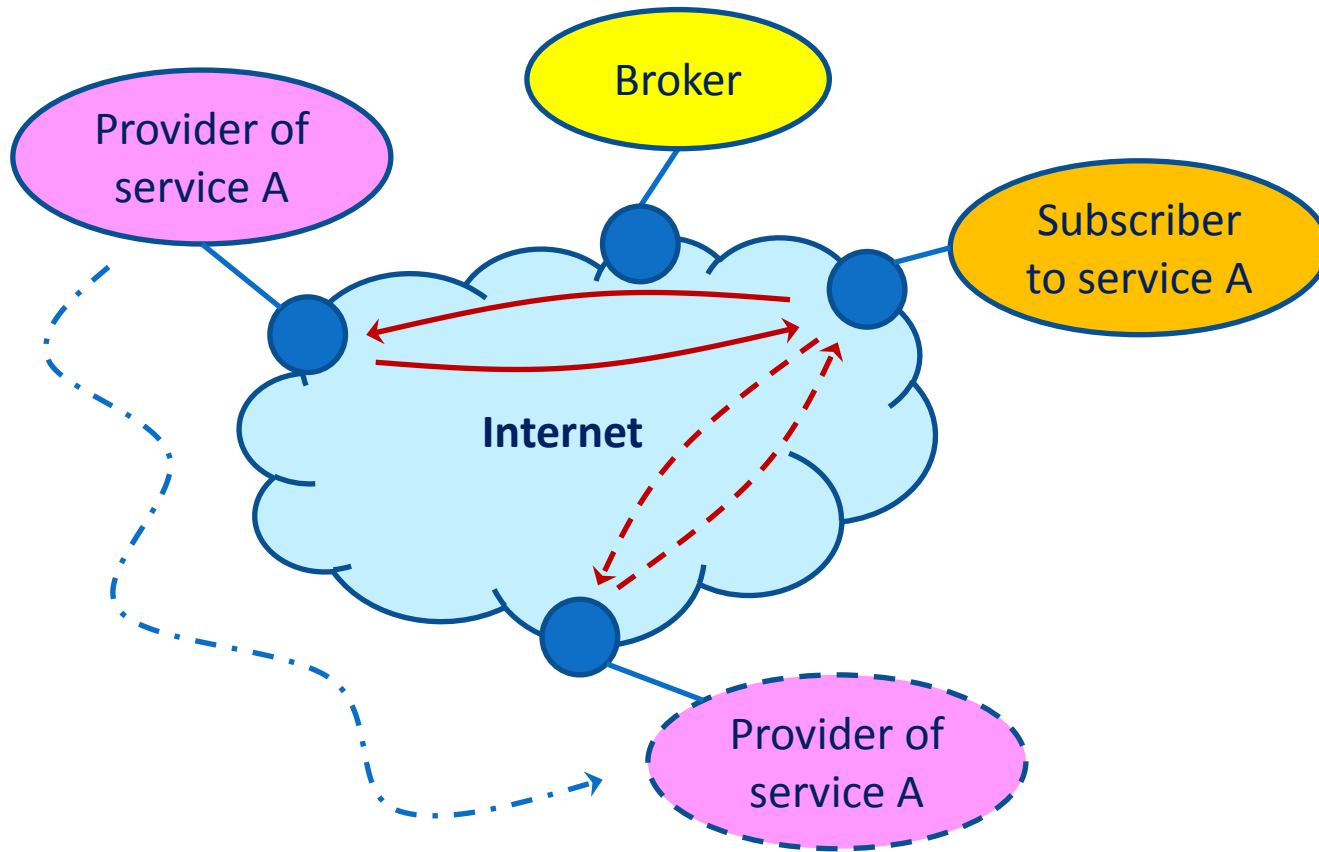
- First step towards IoT as a SOA:

decoupling the identification of an object from
the location where the object can be found



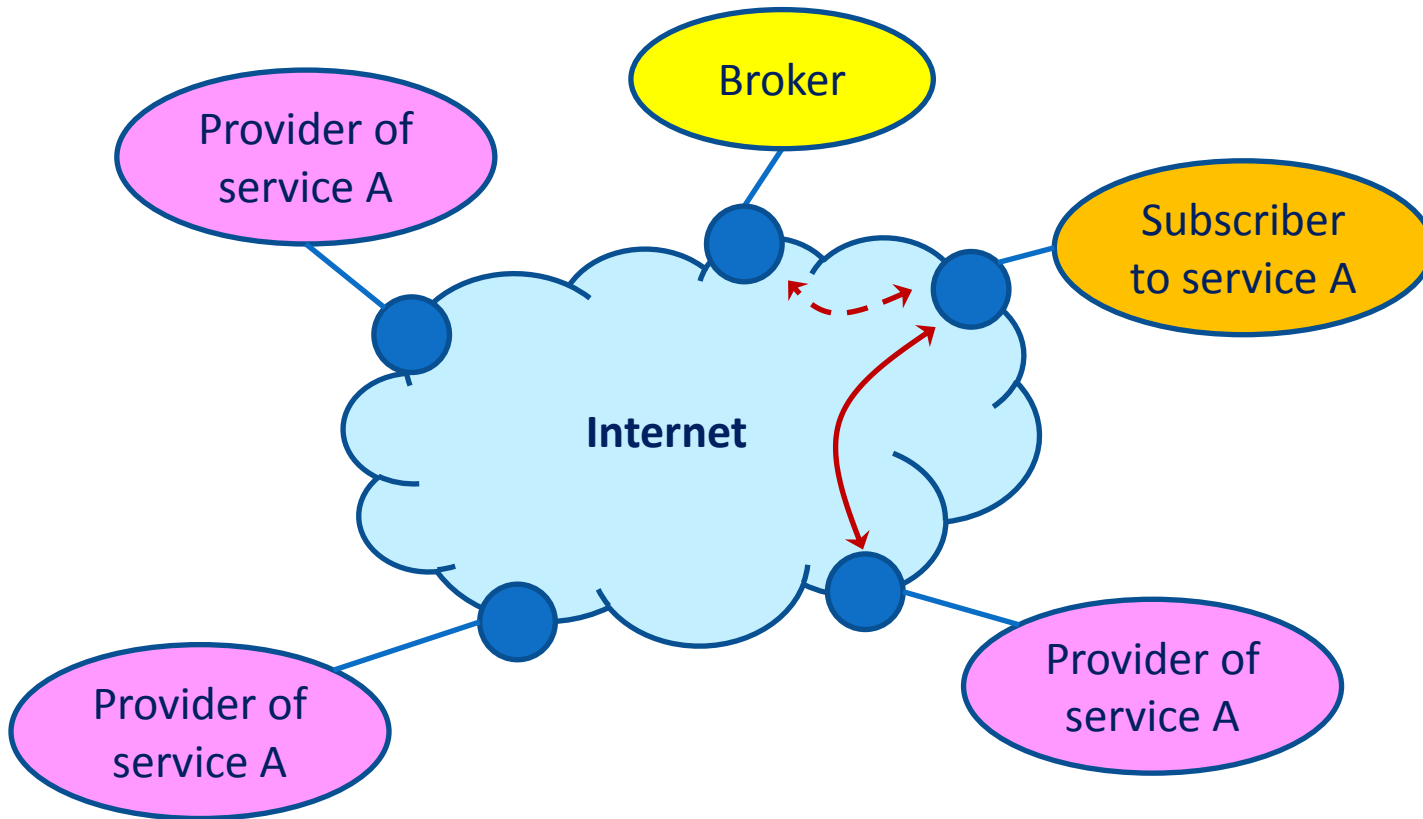
Advantages (I)

- Seamless mobility



Advantages (II)

- Replication



Our Proposal

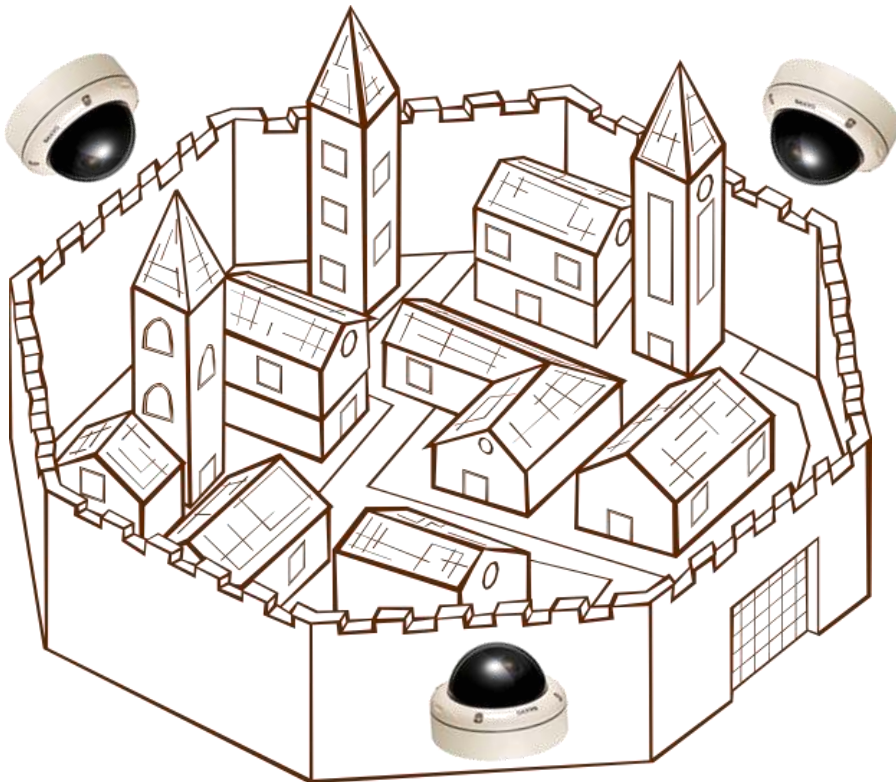
- Moving from SOA to IoT:

Enrich location information with context

Do not rely on a Service Broker:
use a distributed approach instead

Providing Context Information

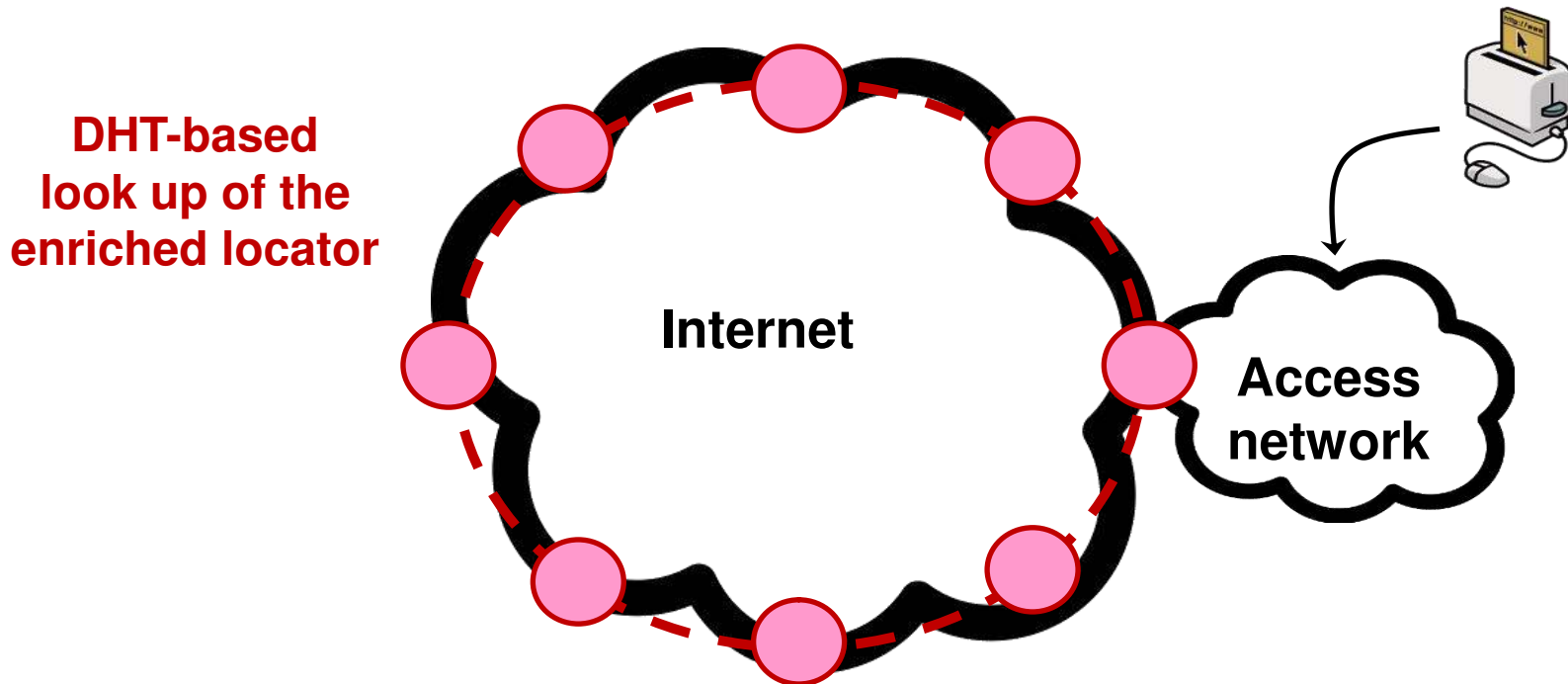
- The distribution of locators can be enriched by adding context data!



```
<locator>
  <ipv4>1.2.3.4</ipv4>
  <protocol>tcp</protocol>
  <port>1234</port>
</locator>
<metadata>
  <gps>43716164,10396492</gps>
  <video>
    <codec>mpeg2</codec>
    <fps>18</fps>
    <resolution>640,480</resolution>
  </video>
  <security>
    <accessType>open</accessType>
  </security>
</metadata>
```

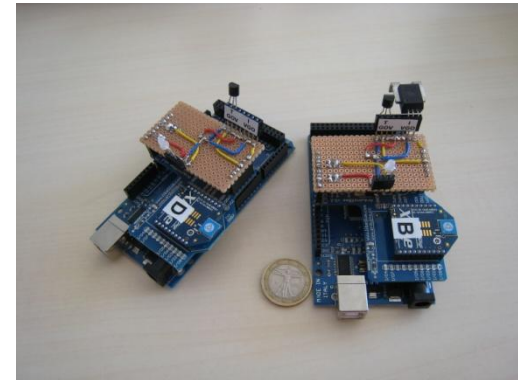
Distributed Resolution

- We have developed an enriched Locator Distribution Network (eLDN) based on P2P, interconnecting nodes among the Internet

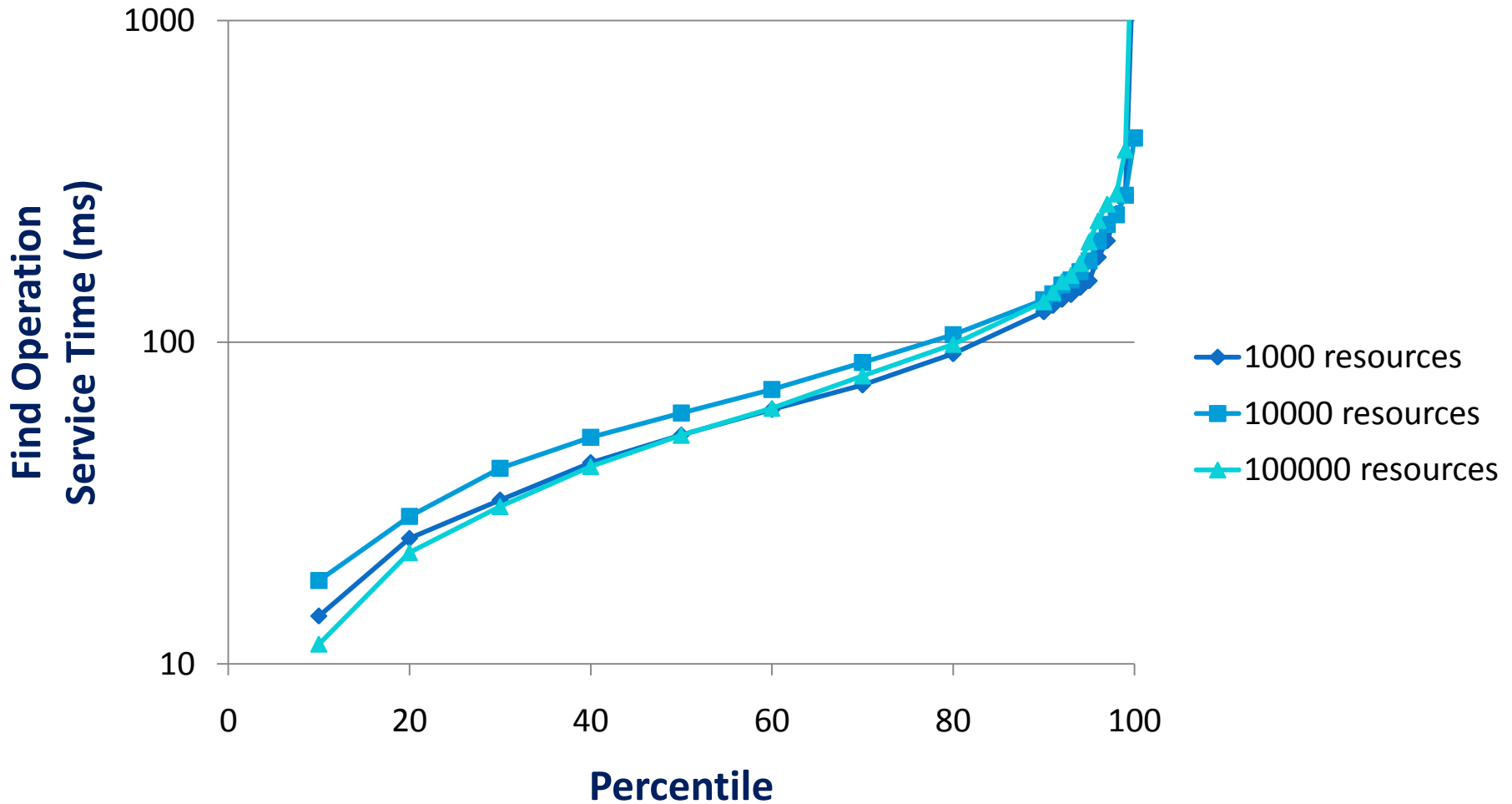


Evaluation


- Implementation on a small-scale testbed:
 - Low-cost embedded PCs as access points
 - ZigBee sensors as service providers



Scalability analysis



Conclusions

- Steep road towards the IoT 
- New paradigms for connecting objects needed
- Possible starting point is SOA through ID/Locator decoupling + enriched context
- Next steps:
 - Open communication interfaces
 - Open platforms for reducing TTM
 - Support of access/core networking technologies



That's all folks

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TOULOUSE (F)

