Approximate Service Provisioning in an Invisible Network of the Future

Get whatever is the *best* possible at the moment!!

R Venkatesha Prasad, E. Onur, Vijay S Rao, Y. Durmus, A. Rahim, I. Niemegeers.

WMC, EEMCS, TUDelft, NL

October 20, 2011

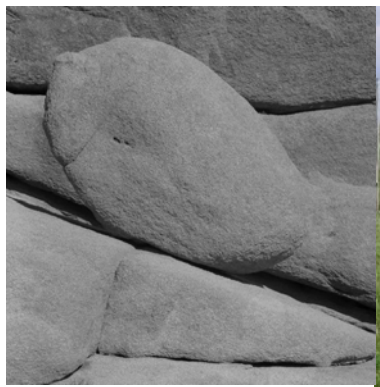
Mark Weiser

- “The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it”

Some examples!

- Ask for a Hammer

You get a Stone!



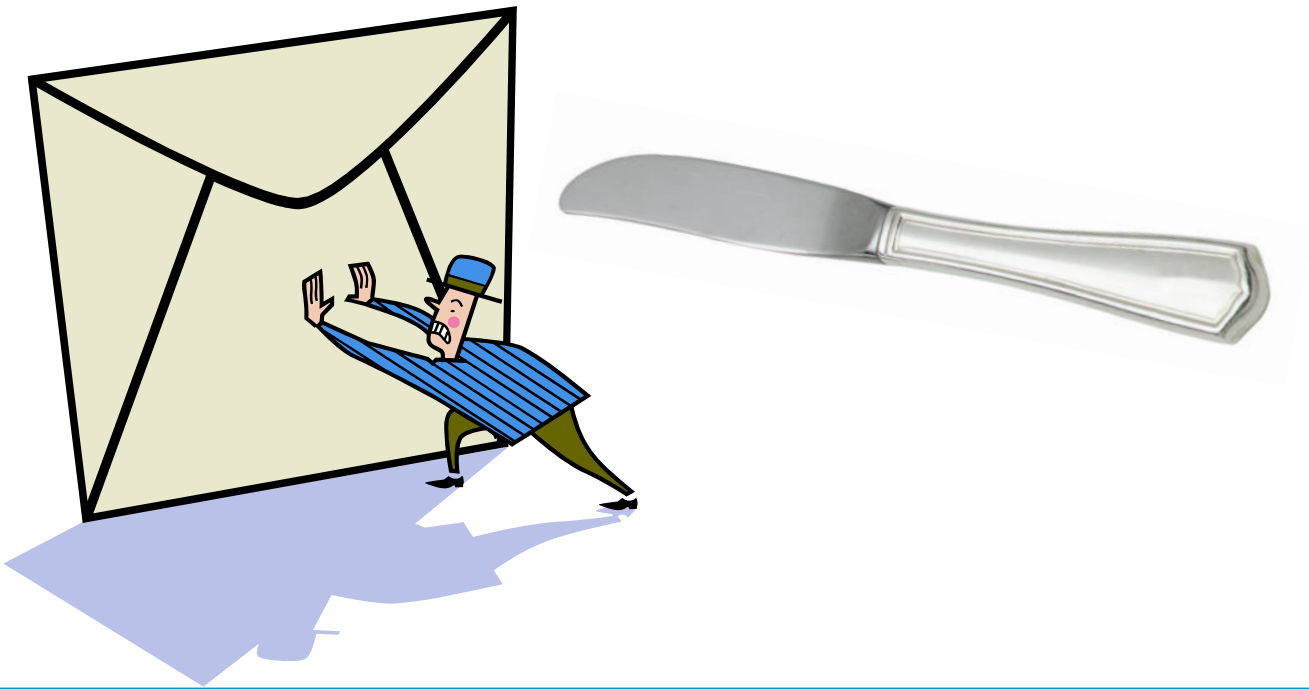
Another??

- Kitchen knife

I use it for ...

One more ??

- Envelope Opener too ???



It’s not my fault to think like this!

- “1000 devices per person” -- WWRF

What is your experience in changing homes??

- Have you counted number of '*things*' you have in your house?
- How come you can keep so many things?
- What things are important?
- Which one is transported first? ...
  - Everything is important ☺ !!

These are invisible things which you will use some many times, and many sometimes in some way!

The future ICT devices will also be something like these ... invisible but still helpful and useful !!

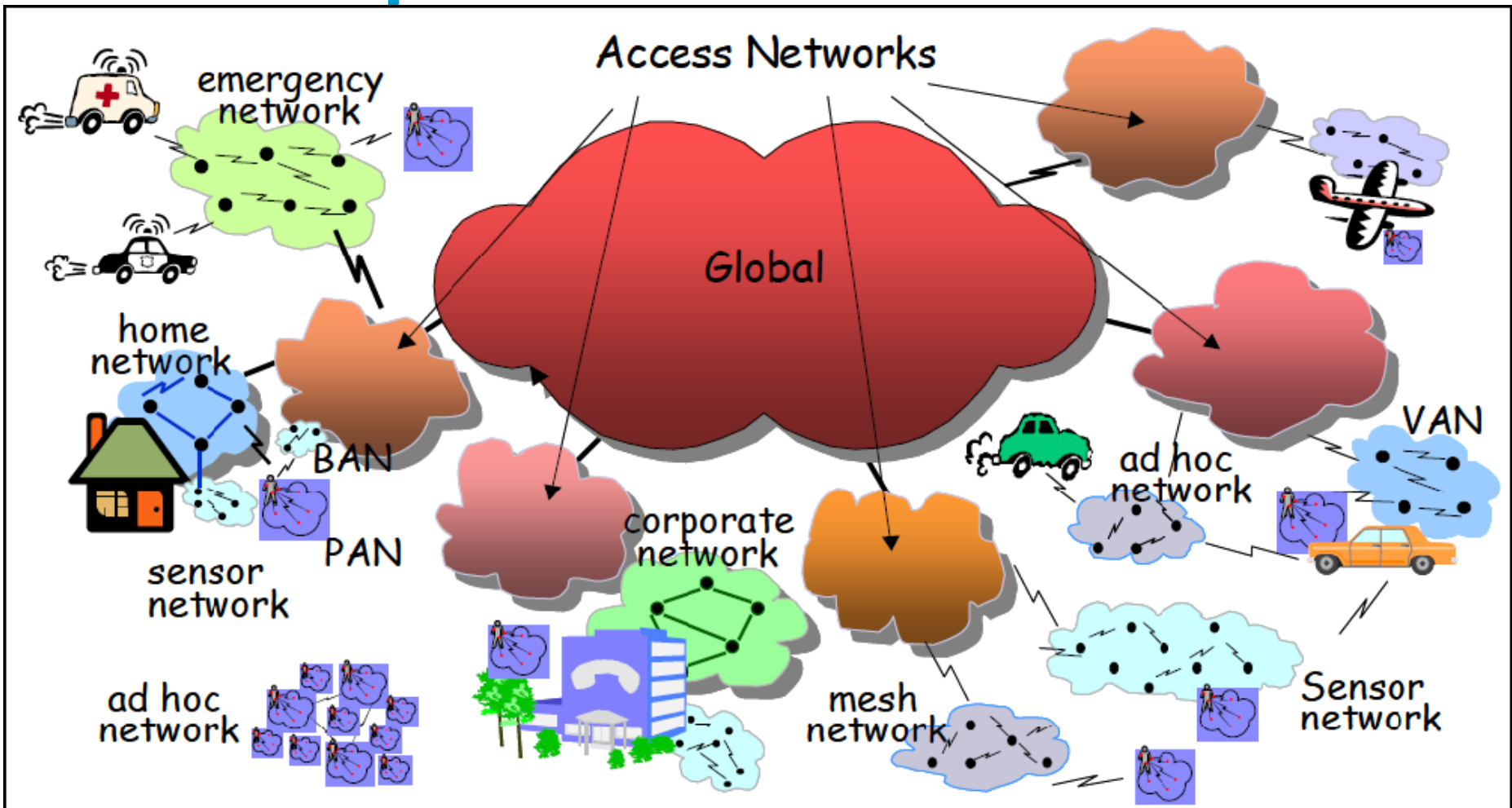
What is needed?

- Internet enabled devices to help us like “things” (devices) in our houses!
- These devices are just similar to umpteen number of tools we use in our daily life

What will happen?

- We envisage, many of the ‘things’ (internet enabled or not) would have some form of presence in the digital world
  - enabled by wireless interface on the device, or a RFID tag,
  - or due to (nano-) sensors in the surroundings
  - decentralized
  - they are in the periphery concentrating around small pockets such as homes, offices, cars, etc.
- Context aware, secure and self-organizing will be the innate characteristics
- It will be a *large scale* network

An example! – Personal Networks



FIRE, FIND, GENI, etc.

Usually we had …

- Client-Server paradigm
- Service Oriented Architecture
- But now evolving towards
  - Cognitive Networking and,
  - Cognitive plane/knowledge plane …

Vision

- Humans can use instruments, objects, and all the available resources
  - physical or intangible (knowledge, experience, etc.)
  - adaptively in any situation
  - context and availability
- Get services which are not exact but still are able to carry on
  - In a small area if one could somehow find an apple
  - Inform a person who is hungry
- This is trivial for us, but it is not easy, we ask ….

"*Is it possible to use the Internet (of Things) depending on the requirements and the context, just as we humans do?"*

An example: I am able to search/find/use anything

- Just as Google does it for us in the virtual world.

Approximate Service

- a service that is a conglomeration of various functions offered by single or multiple object to "**satisfy**" a user in realtime. It includes,

(1) Exact service;
(2) Approximate service;
(3) Opportunistic service;
(4) a Federation of multiple services to compose an approximate service
(5) Offloading computationally intensive tasks; and
(6) Dynamic composition of services.

Construction of Approximate Services

We should have the following variables, capability set, etc. The following is a non-exhaustive example set:

(1) Functional capabilities;

(2) Resource capabilities;

(3) Latency (real-time) capability;

(4) Level of cognitive abilities;

(5) Lifetime/resources left;

(6) Dynamically found remaining resource/lifetime;

(7) Number of concurrent support functions;

(8) Generic functions (characteristics of the functions) offered

Formalism

Let $f_1, f_2, \ldots f_N$ be functions available

$$S_e = \psi(f_1, f_2, \ldots, f_N)$$ Exact service

Define a *Mapping*

$$\Gamma : F \rightarrow A$$

$$A = \{a_1, a_2, \ldots, a_M\}$$ Approximate function

$$S_a = \varphi(a_1, a_2, \ldots, a_M)$$ Approximate service

Γ Can be one-one or on-to

Aura as a Service platform

What can I do if Iris and Finger print checking service is not working?

- Use a surveillance camera -> take a picture!
- Use the information about my meeting/schedule
- Go to Google and match my face with many in the net and come back
- Get a “threshold” of match
- Decide whether this threshold is ‘enough’ !??
- If Yes, then I am allowed to the meeting venue ...

This is how I entered WWRF meeting

Objects as enablers

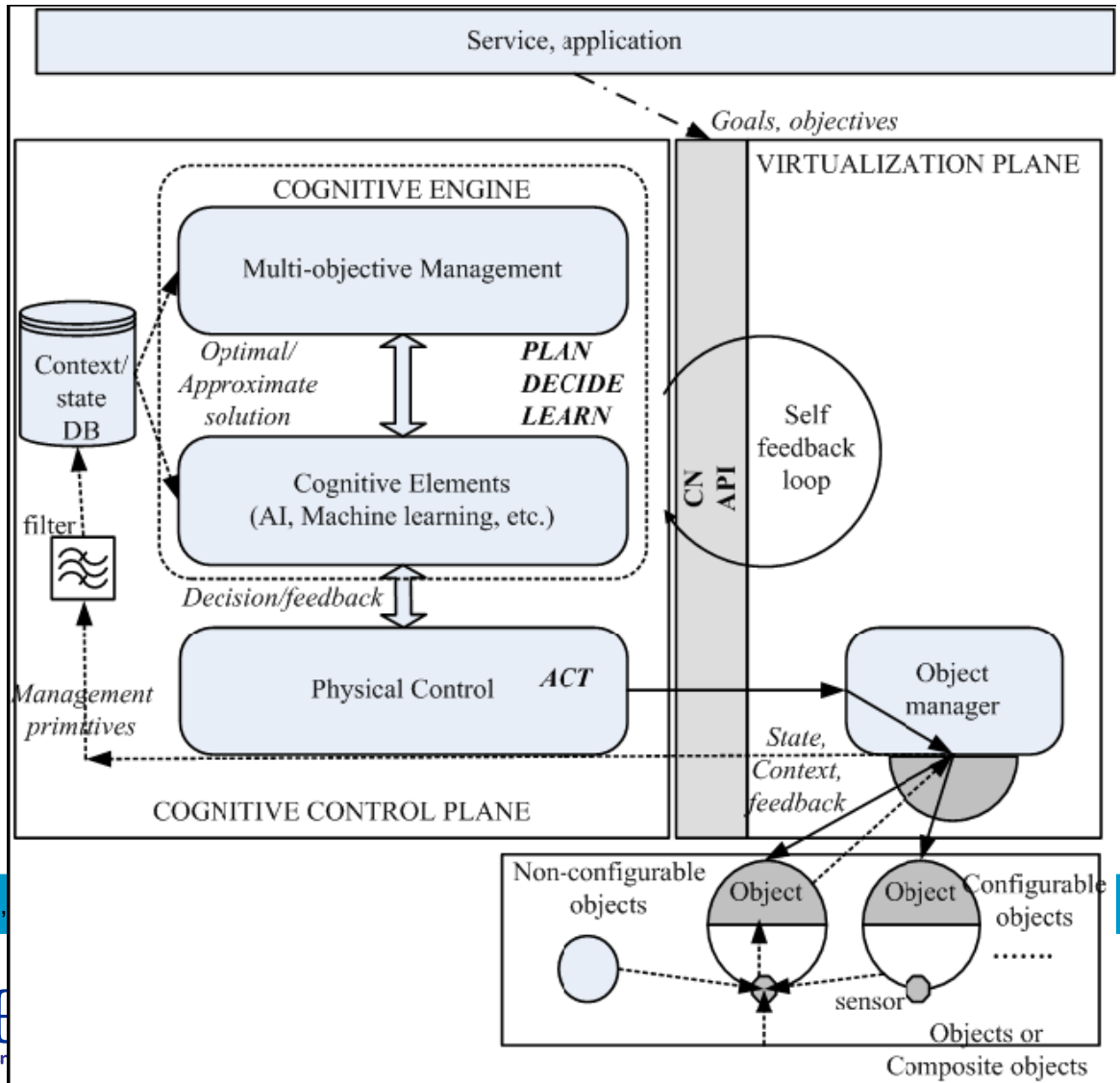
- Devices and their functions be represented as an *object*.
- It is an ephemeral compilation of functions and attributes, that provides a complete and coherent interface
- An object may span over multiple devices.
- Cognition for composition of the approximate services
- Cognition should continuously evolve
- Context and learning from the preferences and reaction of the owner of the aura is required

Collaboration and Cognition for Sustenance

- Key elements:
  - Approximation
  - Opportunism
  - Cognition and cooperation

- Supporting network would be invisible but always present opportunistically
- We call this set up a completely an Invisible network

Cognition – one way



Conclusions

In five minutes you will say that it is all so absurdly simple.

- Sherlock Holmes, The adventure of the Dancing men

- Sir Arthur Conan Doyle

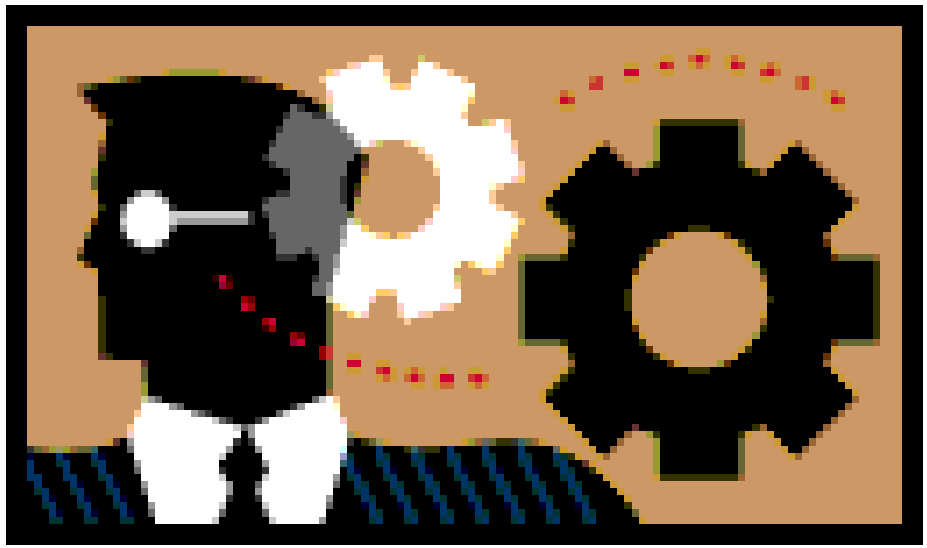
Conclusions

- We presented a vision for future internet and future outlook for IoT.
- Multiple devices offer multiple sets of functionalities have to be stitched together
- When not possible,
  - A grand new vision of approximate service provisioning
  - Some possible ways of achieving this type of services
  - Possible constructs to build such services
  - Unless the services are provided seamlessly with whatever the level of satisfaction, the future Internet will not be able to evolve into a substrate in our lives.
- The prospect of something around a person, without the notice of the person, keeps looking for possibilities of providing useful services is very likely due to the advent of technology.

Acknowledgements

- We thank

Questions?



Collaborations / Projects

Contact: rvprasad@gmail.com
rvprasad@ieee.org