Advanced Handover Management in Ambient Networks

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Contents

- Ambient Networks project,
- Motivation and focus of the paper,
- HO investigation and HO vision for B-3G.

Ambient Networks
organisational perspective

Ambient Networks:

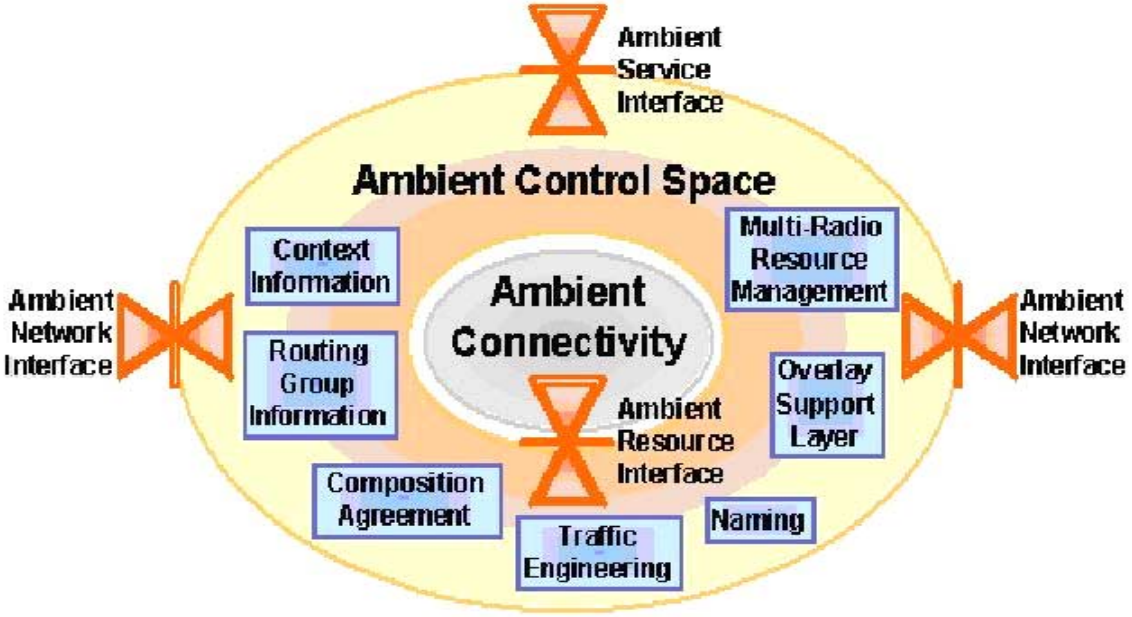
- part of the EU's IST program 6th framework
- 41 organizations from Europe, Canada, Australia and Japan
- running in 2004-2005 in its first phase - conceptual
- Complete project spread over 6 years.
- www.ambient-networks.org

Ambient Networks technical perspective

- Pre-4G standardisation research
- Paradigm “everything is a network”: i.e. everything can be seen as an “Ambient Network”, or “AN”.
- New networking vision based on dynamic composition of ANs into composed ANs through establishment of inter-network agreements.
- AN approach: harmonise usage of all access technologies instead of defining a new one.
- Support for multi-hop, multi-access, multi-operator, multi-domain, multicast/broadcast.
- Supporting a number of scenarios including local access providers, PANs, peer-to-peer, moving networks, sensor networks, competitive scenarios with cost-based access selection.

Ambient Networks technical perspective

- It defines an “Ambient Control Space” as a control stratum realising the AN vision.



- It still allows for different implementation options regarding how this networking realm should be realised.

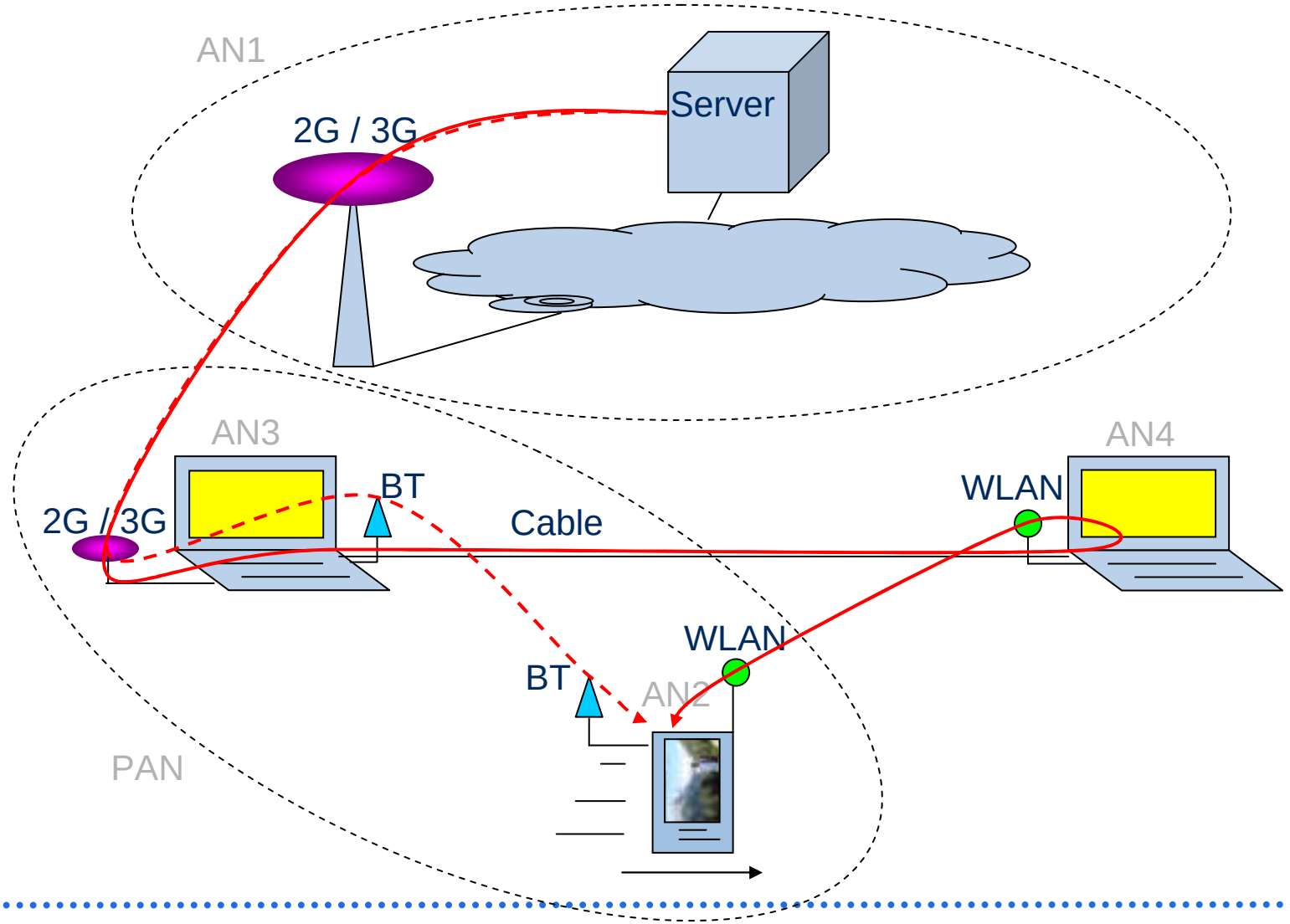
Ambient Networks
focus of the paper

- HO state-of-the-art,
- HO requirements for AN,
- HO steps and HO functions,
- HO management and HO toolbox.

Why a paper on HO management in B-3G?

- Because the AN environment (multi-access, multi-hop, …) poses a number of challenges on HO.

HO scenario - example



HO State of the art (1)

Investigated technologies:

- cellular wide area networks (2G GSM, 3GPP UMTS, CDMA2000),
- wireless local/short-range networks (IEEE 802.11/15/16/21 families),
- IETF mobility protocols including MIP, HMIP, FHO,
- research projects belonging to the IST programme (e. g. MIND, overDRIVE)
- …

HO State of the art (2)

Collection of handover characteristics to be inherited by B-3G HO mechanisms:

- Anchor points / micromobility
- Streamlining / forwarding
- Soft handover states / bicasting
- HO preparation / neighbour info / IP Address
- Post-HO optimisations / route optimisations
- …

HO steps

Recognised HO steps to be inherited in B-3G HO mechanisms:

- Collection precomputation of triggers
- Handover decision process initiation
- HO decision and tool selection
- HO execution and supervision
- Post-HO optimisations (a new handover)

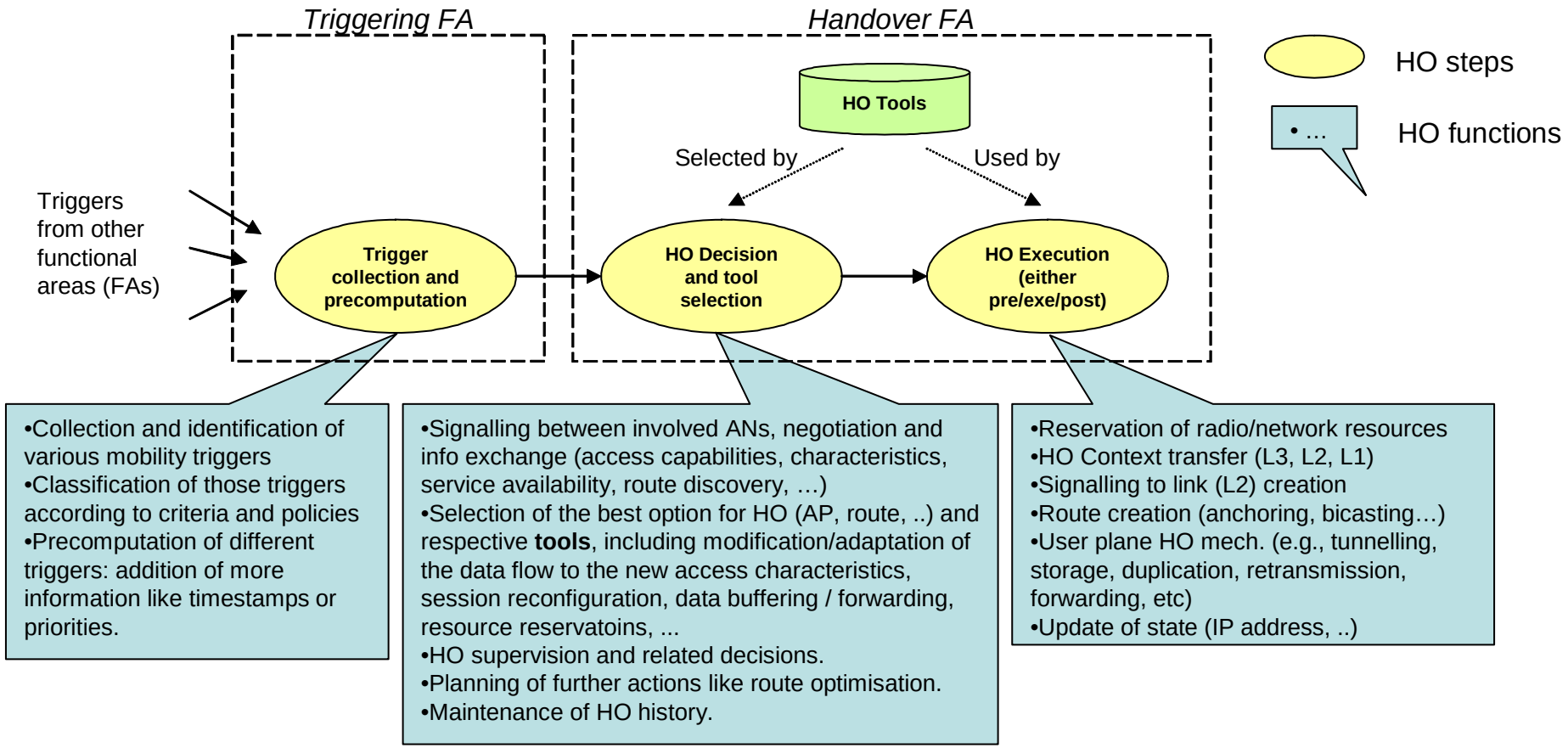
New challenges for HO management (1)

- To handover different mobile entities: users, devices, networks, applications, flows, sessions.
- To support different bearer service QoS and modes (unicast, multicast, broadcast)
- To account for heterogeneous access technologies and multi-hop networks.
- To allow for different HO types: e.g. seamless HO, fast HO, smooth HO, best effort HO, hard/soft(er) HO and mobile device/network initiated HO.
- To consider exchange of relevant parameters prior to HO.

New challenges for HO management (2)

- To support cross domain HO (inter-RAT, address, provider, administrative, security, etc.)
- To account for advanced characteristics such as Multi-homing and Advanced location services
- To allow usage of specific mechanisms and characteristics of a certain technology (e.g, softer handover, pre-reservation of resources, IPv4/IPv6).
- To consider user and operator HO policies capable of handling conflicts.
- To include a comprehensive security framework
- To allow efficient usage of resources (e.g., low cost path/rerouting, signalling load, e.g., aggregate HO).

HO functional model



HO toolbox

Definitions:

- HO Toolbox: set of different HO tools
- HO tools: basic HO mechanisms or commands
- HO management (HO_FA): machinery that selects and executes the appropriate HO tools for a given HO need.

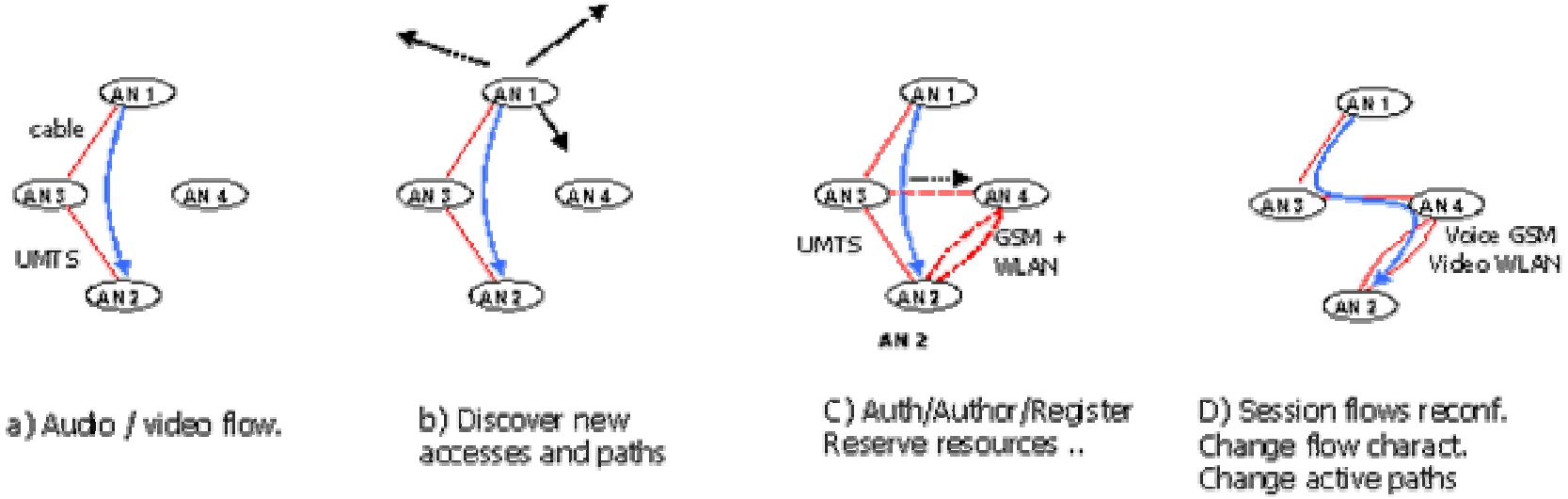
HO tools – example (1)

1. **Discover new accesses and paths**: to trigger new access discovery for HO purpose.
2. **Authenticate**: to authenticate a mobility entity to specific ANs or network services.
3. **Authorize**: to authorise a mobility entity to specific ANs or network services.
4. **Register**: register a mobile entity to specific ANs or services.
5. **Exchange info**: transfer context info from one AN to another.
6. **Reserve resources**: book access resources for a certain time and period.
7. **Use security mechanism**: set specific security mechanisms.

HO tools – example (2)

8. **Start buffering**: start buffering of flows in an AN.
9. **Forward**: to start content forwarding from one AN to another.
10. **Flush**: to discard stored information related to one or more flows.
11. **Reconfigure Session flows**: reconfigure flows within a session.
12. **Change data flow characteristics**: to change e.g. data rate, adapt media content, …
13. **Change active paths**: to handover from the old to the new transmission paths.
14. **Update Mobility Management context**: Update network status and handover history.
15. …

Usage of HO Toolbox - example



We build a control plane that selects between the available HO tools to construct the handover that best suits the specific needs.

HO Toolbox – implementation options

Most relevant implementation options envisaged:

- If the HO Toolbox is a set of elementary HO commands, the HO_FA is a machinery controlling a mobility protocol that transports those HO commands (therefore the AN project would define new mobility protocols).
- If the HO Toolbox is a set of different mobility protocols and extensions, the HO_FA is a control function that selects the appropriate mobility protocol and extension.

Conclusions

- The major HO characteristics and requirements for the B-3G AN environment have been collected.
- A unified framework for HO management in B-3G has been given, based on:
  - HO functional model,
  - HO steps,
  - HO Toolbox.
- Implementation options:
  1. Design of new mobility protocols for AN environments.
  2. New control space selecting among existing/future mobility protocols and extensions.