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## Service Discovery Integrated Network Platform



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# SMONET-NGNI

## SMONET: New services for Mobile NETworks

- SMONET is one working group of the Next Generation Network Initiative (NGNI); <http://www.ngni.org>
- Scope of SMONET-NGNI: Propose a technology that allows the integration of available heterogeneous and homogenous networks into a single platform capable of supporting user roaming between them, while not interrupting active communications
- The mobile NGN has to be a collaborative heterogeneous infrastructure, able to access, connect, converge, transport and deliver anything anytime, anywhere and anyway
- SMONET-NGNI developed roadmaps for new services in NGN environment from self-benchmark works
- Worked on service discovery and interoperability requirements
- More details under: [http://smonet@decoit.de](mailto:smonet@decoit.de)

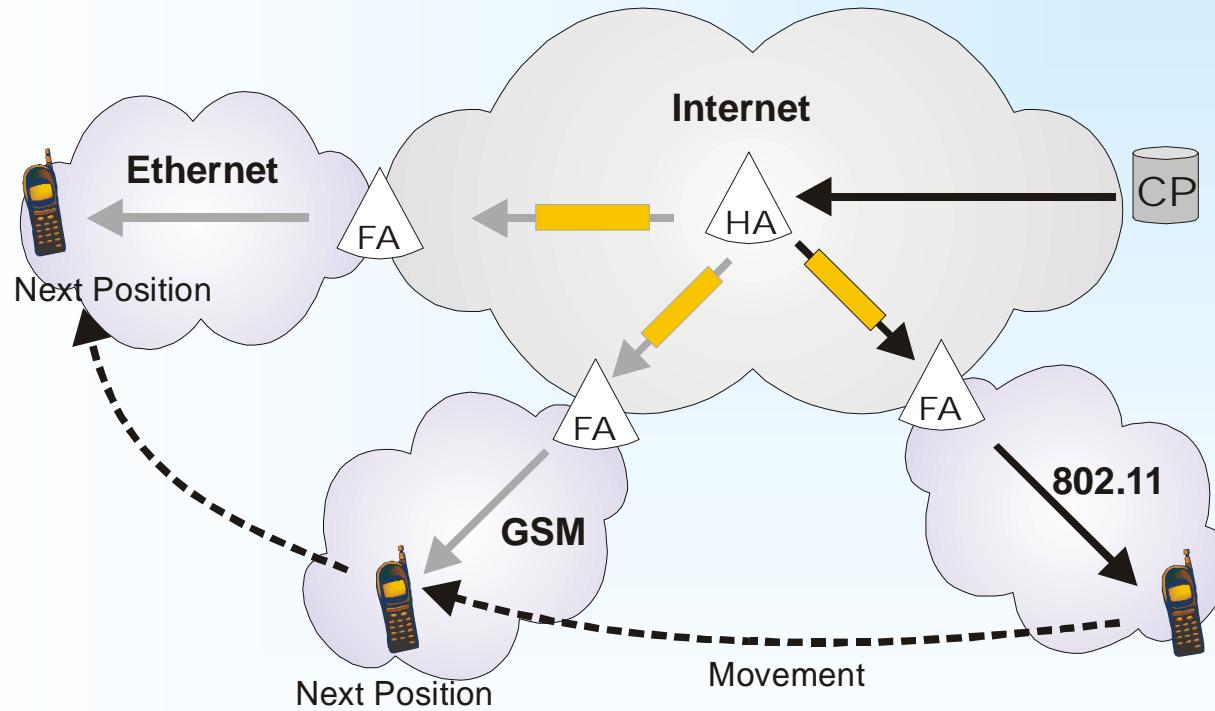
# NOMAD's objectives

- Development of a transparent solution in the form of middleware based on IP mobility and the upcoming IETF standard for ad-hoc network support that will enable the realisation of an integrated network platform which will incorporate every available wireless (e.g. GSM, GPRS, UMTS, IEEE802.11a/b, HiperLAN2, et.) and wire-line access technology that is able to support Internet services
- Location Information assisted Mobile IP handovers: Currently, Mobile IP handovers are managed by mechanisms (movement detection methods) that are based either on the evaluation of the received wireless signal quality, or on periodic advertisements (beacons) that are broadcasted by Mobile IP mobility agents
- Each of these mechanisms is associated with a given period of network service disruption
- Within the boundaries of NOMAD, that assumes the existence of location information, alternative Mobile IP handover mechanisms will be studied that involve assistance from location information

# Integrated Network platforms have numerous advantages

- **True global roaming:** Mobile IP enables roaming between all technologies that support IP services, while not interrupting active communications. Consequently, a user could always remain connected by utilising whatever technology is available at the moment. Moreover, in the complete absence of infrastructure users could establish a dynamic ad-hoc network organisation that spans to the boundaries of the infrastructure and provides connectivity to all.
- **Integration of services:** The services that can be provided over the Internet Protocol no longer focus solely on data services rather have been extended towards telecommunication services. Through an all IP infrastructure it is possible to provide the integration of the two in a seamless manner through a single device.
- **Platform selection depending on network properties:** The variety of possible underlying technologies will enable devices to transparently select between them, with respect to the requirements of the active communications, i.e. a Wireless LAN that provides higher bandwidth capacity might be more attractive for rich content services than UMTS.

# Mobility in Integrated Networks



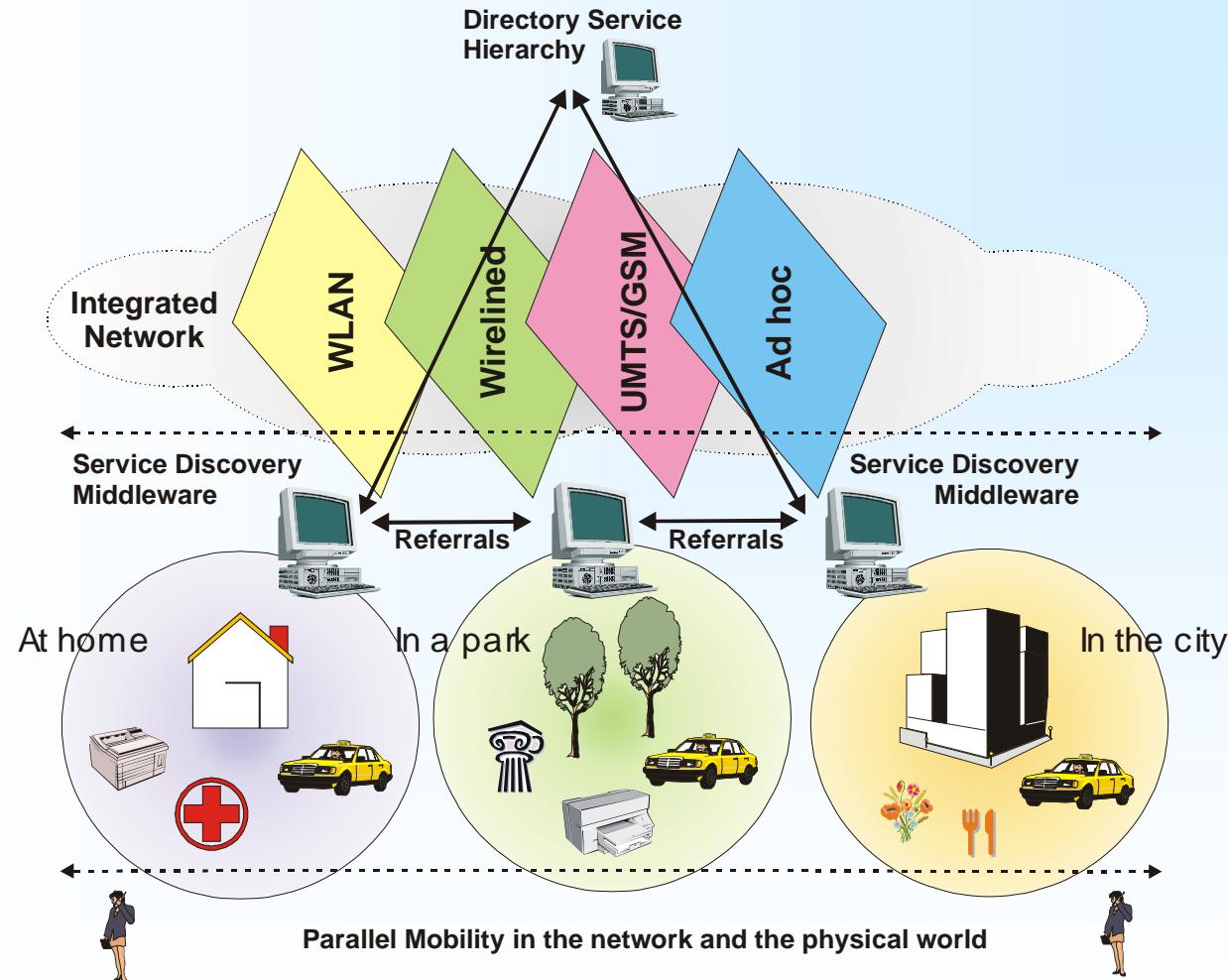
# Integrated Network scenarios

- Ideally in all indoor locations it will be possible to deploy a Wireless LAN infrastructure
- As such a mobile user coming out of an airport and into a taxi, to his hotel and any travel destination will be able to take advantage of this low-cost high-bandwidth platform
- Between locations, the mobile equipment (WLAN-enabled laptop / palmtop) will use the service offered by a local cellular provider (GPRS, UMTS)
- In areas where infrastructure is not present or those with high user concentration, travellers may attempt to participate in a multi-hop ad hoc network
- This will enable for very low cost, high data rate service
- Mobile IP will play an important role in gapping heterogeneous technologies and mobility between Internet administrative domains
- Each technologies provides different service characteristics and can support different QoS requirements

# Integrated Network features

- Integrated Networks include heterogeneous access networks (terrestrial & satellite, mobile & fixed, wireless & wire-line, symmetric & asymmetric, public & private) which offer new opportunities, but also new restrictions
- Such platforms are composed of multiple technologies with very different basic features
- A major issue with integrated network platforms is in fact, that different segments of such a platform that happen to operate on different network technologies effectively constituting different Internet administrative domains that are termed into planes
- A major requirement of service discovery on integrated network platforms is therefore the transparent bridging of the gap created by the discrepancy between locations in the physical world and locations in the virtual world of the network.

# Different Planes of Integrated Networks



# Service Discovery (1)

- Internet standards in this area capable of providing mechanisms relevant to service discovery include
  - Service Location Protocol (SLP)
  - Lightweight Directory Access Protocol (LDAP)
  - Dynamic Host Configuration Protocol (DHCP)
- All of which operate on different layers
- These protocols cover basic requirements of service discovery such as a means to specify the required service and formulate queries as well as ways for locating and communicating with the appropriate service provider
- Service discovery functionality as specified by these protocols however focuses on Intranet resource discovery

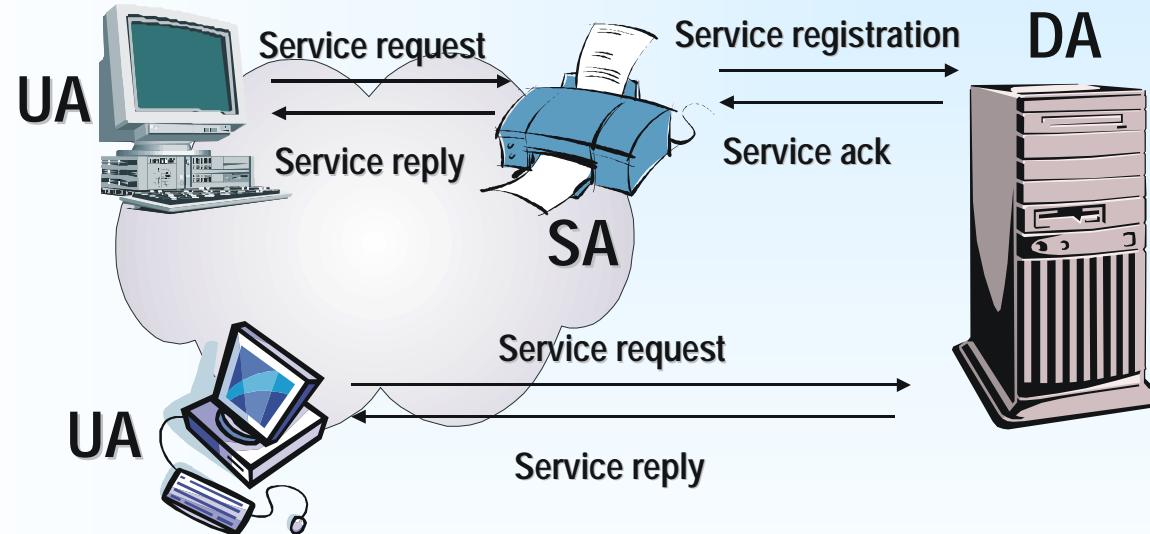
# Service Discovery (2)

- The actual discovery of the requested services is accomplished in two separate ways, either by directly contacting a known address that can supply the client with information on the available services (LDAP), or by broadcast
- Broadcasts can be focused on
  - the local network (DHCP)
    - Disadvantage: includes a big amount of overhead traffic that grows exponentially with the number of hops (Time-to-Live, TTL) the broadcast is allowed to make
    - Small TTLs reduce the amount of signalling traffic generated, but can lead to ineffective service discovery queries
  - use mechanisms like multicast (SLP) to reach a much larger group of service agents without the need for predefined addresses
    - Advantage: support mobile clients constantly move from one physical location and segment of the integrated platform to another
- Clients and service providers in close physical proximity are not guaranteed to find each other, due to possibly large “virtual” distances separating them in the networked world

# Technical issues of NOMAD

- Investigate and facilitate the integration of Directory Agents and Directory Servers into gateways that can communicate with customers as well as Service Agents
- Investigate the usage of DHCP as a substitute for SLP when searching for a local Directory Server
- Investigate ways to extend and improve referrals for usage in an integrated network platform
- Directory Servers acting as **service discovery middleware**, that receive requests from a specific physical location and are connected to one or more networks could use an enhanced referral mechanism to communicate with other “local” Directory Servers that serve a different network or physical area to exchange information on queries and available services
- This solution could help bridge the gap between different physical locations and parts of the Integrated Network

# User Agents (UA), Service Agents (SA) & Directory Agents (DA)



# Integration Concept (1)

- SMONET-NGNI project see an era of convergence where growing numbers of services are increasingly being made available across fewer numbers of delivery devices
- In the future the services will be available on a converged device will no longer exist as monolithic, discrete and complete services
- Such services can be thought of as **compound services**, where each compound service is constructed out of atomic services
- Many of these services replicate functionality that other monolithic services already implement for their own purposes
- In an era of ambient computing, where all services are available for hire at any location, it makes no sense for the replication of services at the atomic level

# Integration Concept (2)

- A compound service can be “simulated” through the ad-hoc composition of atomic services into composite services
- SMONET-NGNI proposes a deployment model where services available in a network exist of atomic service components and that the software, hosted on the service convergence devices that exploit these services, compose the compound services for themselves when required
- Such services have a lifetime that is dependent upon their current usefulness
- SMONET-NGNI further propose that the software, hosted on the service convergence devices that compose these ad-hoc services will need to be persistent, act autonomously and display intelligent characteristics in order to function in an environment where domain knowledge is, by definition, always incomplete
- Software complying with these requirements already exists in the form of intelligent agent technology

# Middleware solution

- It is unreasonable to expect that a user could remember how many compound services there are on a network (or where they exist) or to compose composite services from any atomic services available
- Therefore, this deployment model requires that the agents consuming the atomic services encapsulate not only a knowledge of the compound services that a user is likely to request and the atomic services extant in the network, but also of the process(es) involved in decomposing atomic service descriptions from a compound service request and executing a composite service to correctly meet the requirements of the original compound service request
- However, SMONET-NGNI judges that it is likely that the most frequently requested services will actually exist as instances of compound services to ensure that a balance between service reuse and host resource consumption are adequately managed
- Also the devices (supporting client agent deployment) will always place demands upon the agent that restrict its footprint, indirectly limiting the client agent's degree of sophistication

# Dynamic Platform Discovery

- SMONET-NGNI examined dynamic platform discovery with entity discovery
- Entity discovery means the process of the agent or the platform on the mobile device being able to detect the network to locate local services
- Local in this case means the local network the user has roamed into, like the hotel network that might not necessarily be connected to the Internet, or might have an extra charge for doing so
- Before locating agents on the network, there needs to be a mechanism that allows the agents to detect when the network is present
- There are few possible ways of doing this:
  - Agent on the platform whose (only) functionality is to monitor the network: Monitor Agent (MA)
  - Java can be used hardware independently through a Java Virtual Machine be used to detect the network presence
  - After the network connection has been established the platform needs to locate services in the network. This is done easily by first locating a local Directory Facilitator (DF), and then asking it for local services available
  - Once the remote platform is known, the mobile platform's DF can register the remote platform's DF in its database

# Conclusion (1)

- The results of current developments in both wireless data communications and mobile computers are being combined to facilitate a new trend: nomadic computing
- Bandwidth, latency, delay, error rate, quality of display and other non-functional parameters may change dramatically when a nomadic end-user moves from one location to another and thus from one computing environment to another, for example, from a wire-line LAN to a UMTS network
- The nomadic end-user would benefit from having the following functionality provided by the infrastructure:
  - information about expected performance,
  - agent monitoring and controlling the transfer operations, and
  - adaptability
- It is in situations like these where agent technologies will become very useful
- User agents on user's device can discover the network, and locate and communicate with services on the network transparently to the user

# Conclusion (2)

- **SMONET-NGNI** uses cases and demonstrators illustrate a scenario of ad-hoc service discovery
  - Furthermore it described how ad-hoc networking can be solved using an agent platform, especially a design and implementation for ad-hoc networking
  - Meta-services has to be developed which enable other application services to be discovered (through incomplete, and heterogeneous, network connectivity environments) and composed from service elements
- **NOMAD** project deals with the integration of location aware service discovery mechanisms, handover procedures and service / user profiling, by developing technology that allows users to freely roam across existing and future network infrastructures
  - The NOMAD network platform concept includes the methods for transparent discovery and seamless provision of services and the integration of services / user profiles
  - The NOMAD platform will be available for testing and refining the implemented software during the project lifetime



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