Mobility support for the small and smart Future Internet devices

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ICTs evolution has led to wireless personal devices such as smart phones, personal computers and PDAs. These devices have in common that are designed to operate over IP Networks. Hence, the number of devices that are connected to the Internet is growing exponentially. This has led to define a new conception of Internet, the commonly called Future Internet, which started with a new version of the Internet Protocol (IPv6), in order to increase the address space, to support all the existing and new devices. IPv6 has been designed to provide at all times secure communications to users, so there is no place any intrusion into their lives, and mobility for all the devices attached to the user; thereby users can be always connected. IPv6 features are what have made possible to think about to connect all the objects that surround us to Internet, the so-called Internet of things (IoT). The objective of IoT is the integration and unification of all communications systems that surround us. Hence, the systems can get a control and access total to the other systems for leading to provide ubiquitous communication and computing with the purpose of defining a new generation of services.

These small and smart things with connectivity and communication capacity are what we can find, since some years ago, in the Low-power Wireless Personal Area Networks (LoWPANs). Recently, the IETF working group has defined, in RFC 4919 and RFC 4944, standards to support IPv6 over that LoWPANs (6LoWPAN), in order to provide the technological basis for extending the Internet to small devices. 6LoWPAN offers to the LoWPANs all the advantages from IP such as scalability, flexibility, tested, extended, ubiquitous, open, and end-to-end connectivity. In addition, it could be considered that 6LoWPAN devices are also empowered with IP protocols, i.e., protocol for mobility such as MIPv6, management such as SNMP, security such as IPSec etc. However it is not feasible for the 6LoWPAN devices to be associated with host based mobility, management, security etc. protocols because 6LoWPAN nodes are energy and resource constrained, host based protocols require most of the signalling on node's end, and because the design features of 6LoWPAN network were not considered in the design issues of the host based protocols. For example, a 6LoWPAN node may run out of energy causing a fault in the network, this has restriction in size packets and this presents aggressive techniques to conserve energy by using of sleep schedules with long sleep periods, they just wake up to receive IPv6 signalling messages, this feature introduces delays in the reception of messages because they are not attended until that the node wakes up. Therefore, these delays, power restrictions, packet size restrictions etc. are not considered in the current IPv6 protocols.

Particularly, our position paper and consequently technical topic to discuss in the workshop is mobility support for small and smart devices based on 6LoWPAN. Mobility has been chosen for our research, since it is one of the most important issues in the Future Internet, because it is utilized in realizing many applications where sensor nodes sense and transmit the gathered data to a monitoring server, such as healthcare, transport, home automation, and smart grid. In addition, mobile communication increases the fault tolerance capacity of the network, increases the connectivity between nodes and clusters, allows to extend and adapt network to changes of their location and environment infrastructure, and the deployment of multiple controlled mobile elements can be used to provide load balancing. The mentioned features are requirements to

satisfy the dependability and scalability of the Future Internet. Therefore, this makes it obvious that mobility support will be prevalent in the next generation of smart devices connected to the Future Internet, the so-called Internet of Things, in order to provide ubiquitous access and seamless communication among a large population of networked smart objects located around the world.

The required mobility is heavily dependent on the individual service scenario and the Future Internet architecture. For that reason, the protocols presented are distinguished in two main solutions.

The first solution is focused on Future Internet architectures, which follow the current Internet philosophy for the management of Identification and Location, i.e. IPv6 continues being used for Identification of the session in the transport and application layers, and Locator of the devices for routing in the network layer. For this kind of architectures, it has been evaluated Mobile IPv6 to verify the suitability of this for the Future Internet of Things [1], where was concluded that it presents a high overload. For that reason, the protocols defined under this architecture present how to compress mobility headers to reduce overload [2] and mainly how to exploit the other elements of the architecture (border router and gateways) with high capacity, high resources and not so constrained with power consumption to carry out the moving signalling, in order to reduce the overload in the mobile nodes. These approaches are close to the approach from Network Mobility (NEMO) [3], which is also supported by external entities to the mobile node. Some of our initial approaches are found in [4-6], and the most relevant approach in this area is found [7].

The second solution is focused on Future Internet architectures, which follow the new Future Internet architectures based on ID/Locator split such as the presented in [9]. This architecture presents the advantage that mobility is directly supported by the separation of the session ID with the Locator of the device, which is de problem of the current Internet architecture. Our approach on this is mainly focused on how to support safe update of the Locator and with low signalling and overhead for 6LoWPAN devices. Remark, that parallel works are also carrying out to support scalable security mechanism based on Elliptic Curve for 6LoWPAN devices, since IPSec is not suitable for 6LoWPAN devices [9], it was considered to define new optimized cryptographic primitives [10], at the same way that was defined in TinyECC and NanoECC, but with the difference that our security library is optimized for the mobility requirements. For example with the optimized support of schemes to share keys such as Elliptic Curve Diffie-Hillman (ECDH), and verification of Mobile Nodes with adapted techniques based on Return Routability from Mobile IP to the new Future Internet architectures.

Finally, it can be found in [11] a summary about the initial approaches to support mobility for smart devices and the defined design issues for the future approaches.

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