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# Mobility Related Terminology

## Status of this Memo



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## Abstract

There is a need for common definitions of terminology in the work to be done around IP mobility. This document defines terms for mobility related terminology. The document originated out of work done in the Seamoby Working Group but has broader applicability for terminology used in IETF-wide discourse on technology for mobility and IP networks. Other working groups dealing with mobility may want to take advantage of this terminology.

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## 1. Introduction

This document presents terminology to be used for documents and discussions within the Seamoby Working Group. Other mobility related working groups could take advantage of this terminology, in order to create a common terminology for the area of mobility in IP networks.

Some terms and their definitions that are not directly related to the IP world are included for the purpose of harmonizing the terminology. For example, 'Access Point' and 'base station' refer to the same component, from the point of view of IP, but 'Access Router' has a very different meaning. The presented terminology may also, it is hoped, be adequate to cover mobile ad-hoc networks.

The proposed terminology is not meant to assert any new terminology. Rather the authors would welcome discussion on more exact definitions as well as missing or unnecessary terms. This work is a collaborative enterprise between people from many different engineering backgrounds and so already presents a first step in harmonizing the terminology.

The terminology in this document is divided into several sections. First, there is a list of terms for general use and mobile access networks followed by terms related to handovers, and finally some terms used within the MANET and NEMO working groups.

## 2. General Terms

**Bandwidth**

The total width of the frequency band available to or used by a communications channel. Usually measured in Hertz (Hz). The bandwidth of a channel limits the available channel capacity.

**Bandwidth utilization**

The actual rate of information transfer achieved over a link, expressed as a percentage of the theoretical maximum channel capacity on that link, according to Shannon's Law.

**Beacon**

A control message broadcast by a node (especially, a base station) informing all the other nodes in its neighborhood of the continuing presence of the broadcasting node, possibly along with additional status or configuration information.

**Binding Update (BU)**

A message indicating a mobile node's current mobility binding, and in particular its care-of address.

**Care-of-Address (CoA)**

An IP address associated with a mobile node while visiting a foreign link; the subnet prefix of this IP address is a foreign subnet prefix. A packet addressed to the mobile node which arrives at the mobile node's home network when the mobile node is away from home and has registered a Care-of Address will be forwarded to that address by the Home Agent in the home network.

**Channel**

A subdivision of the physical medium allowing possibly shared independent uses of the medium. Channels may be made available by subdividing the medium into distinct time slots, or distinct spectral bands, or decorrelated coding sequences.

**Channel access protocol**

A protocol for mediating access to, and possibly allocation of, the various channels available within the physical communications medium. Nodes participating in the channel access protocol agree to communicate only when they have uncontested access to one of the channels, so that there will be no interference.

**Channel capacity**

The total capacity of a link to carry information (typically bits) per unit time. With a given bandwidth, the theoretical maximum channel capacity is given by Shannon's Law. The actual channel capacity of a channel is determined by the channel bandwidth, the coding system used, and the signal to noise ratio.

**Control message**

Information passed between two or more network nodes for maintaining protocol state, which may be unrelated to any specific application.

**Distance vector**

A characteristic of some routing protocols in which, for each desired destination, a node maintains information about the distance to that destination, and a vector (next hop) towards that destination.

**Fairness**

A property of channel access protocols whereby a medium is made fairly available to all eligible nodes on the link. Fairness does not strictly imply equality, especially in cases where nodes are given link access according to unequal priority or classification.

**Flooding**

The process of delivering data or control messages to every node within the network under consideration.

**Foreign subnet prefix**

A bit string that consists of some number of initial bits of an IP address which identifies a node's foreign link within the Internet topology.

**Forwarding node**

A node which performs the function of forwarding datagrams from one of its neighbors to another.

**Home Address (HoA)**

An IP address assigned to a mobile node, used as the permanent address of the mobile node. This address is within the mobile node's home link. Standard IP routing mechanisms will deliver packets destined for a mobile node's home address to its home link [9].

**Home Agent (HA)**

A router on a mobile node's home link with which the mobile node has registered its current care-of address. While the mobile node is away from home, the home agent intercepts packets on the home link destined to the mobile node's home address, encapsulates them, and tunnels them to the mobile node's registered care-of address.

**Home subnet prefix**

A bit string that consists of some number of initial bits of an IP address which identifies a node's home link within the Internet topology (i.e., the IP subnet prefix corresponding to the mobile node's home address, as defined in [9]).

**Interface**

A node's point of attachment to a link.

**IP access address**

An IP address (often dynamically allocated) which a node uses to designate its current point of attachment to the local network. The IP access address is typically to be distinguished from the mobile node's home address; in fact, while visiting a foreign network the IP access address may be considered unsuitable for use as an end-point address by any but the most short-lived applications. Instead, the IP access address is typically used as the care-of address of the node.

**Link**

A communication facility or physical medium that can sustain data communications between multiple network nodes, such as an Ethernet (simple or bridged). A link is the layer immediately below IP. In a layered network stack model, the Link Layer (Layer 2) is normally below the Network (IP) Layer (Layer 3), and above the Physical Layer (Layer 1).

**Asymmetric link**

A link with transmission characteristics which are different depending upon the relative position or design characteristics of the transmitter and the receiver of data on the link. For instance, the range of one transmitter may be much higher than the range of another transmitter on the same medium.

**Link establishment**

The process of establishing a link between the mobile node and the local network. This may involve allocating a channel, or other local wireless resources, possibly including a minimum level of service or bandwidth.

**Link-layer trigger (L2 Trigger)**

Information from the link layer that informs the network layer of the detailed events involved in handover sequencing at the link layer. L2 triggers are not specific to any particular link layer, but rather represent generalizations of link layer information available from a wide variety of link layer protocols [4].

**Link state**

A characterization of some routing protocols in which every node within the network is expected to maintain information about every link within the network topology.

**Link-level acknowledgment**

A protocol strategy, typically employed over wireless media, requiring neighbors to acknowledge receipt of packets (typically unicast only) from the transmitter. Such strategies aim to avoid packet loss or delay resulting from lack of, or unwanted characteristics of, higher level protocols. Link-layer acknowledgments are often used as part of Automatic Repeat-Request (ARQ) algorithms for increasing link reliability.

**Local broadcast**

The delivery of data to every node within range of the transmitter.

**Loop-free**

A property of routing protocols whereby the path taken by a data packet from source to destination never traverses through the same intermediate node twice before arrival at the destination.

Medium Access Protocol (MAC)

A protocol for mediating access to, and possibly allocation of, the physical communications medium. Nodes participating in the medium access protocol can communicate only when they have uncontested access to the medium, so that there will be no interference. When the physical medium is a radio channel, the MAC is the same as the Channel Access Protocol.

Mobile network prefix

A bit string that consists of some number of initial bits of an IP address which identifies the entire mobile network within the Internet topology. All nodes in a mobile network necessarily have an address containing this prefix.

Mobility factor

The relative frequency of node movement, compared to the frequency of application initiation.

Multipoint relay (MPR)

A node which is selected by its one-hop neighbor to re-transmit all broadcast messages that it receives. The message must be new and the time-to-live field of the message must be greater than one. Multipoint relaying is a technique to reduce the number of redundant re-transmissions while diffusing a broadcast message in the network.

Neighbor

A "neighbor" is any other node to which data may be propagated directly over the communications medium without relying on the assistance of any other forwarding node.

Neighborhood

All the nodes which can receive data on the same link from one node whenever it transmits data.

Next hop

A neighbor which has been selected to forward packets along the way to a particular destination.

**Payload**

The actual data within a packet, not including network protocol headers which were not inserted by an application. Note that payloads are different between layers: application data is the payload of TCP, which are the payload of IP, which three are the payload of link layer protocols etc. Thus, it is important to identify the scope when talking about payloads.

**Prefix**

A bit string that consists of some number of initial bits of an address.

**Routing table**

The table where forwarding nodes keep information (including next hop) for various destinations.

**Route entry**

An entry for a specific destination (unicast or multicast) in the routing table.

**Route establishment**

The process of determining a route between a source and a destination.

**Route activation**

The process of putting a route into use after it has been determined.

**Routing proxy**

A node that routes packets by overlays, e.g., by tunneling, between communicating partners. The Home Agent and Foreign Agent are examples of routing proxies, in that they receive packets destined for the mobile node and tunnel them to the current address of the mobile node.

**Shannon's Law**

A statement defining the theoretical maximum rate at which error-free digits can be transmitted over a bandwidth-limited channel in the presence of noise. No practical error correction coding system exists that can closely approach the theoretical performance limit given by Shannon's law.

**Signal strength**

The detectable power of the signal carrying the data bits, as seen by the receiver of the signal.

**Source route**

A source route from node A to node B is an ordered list of IP addresses, starting with the IP address of node A and ending with the IP address of the node B. Between A and B, the source route includes an ordered list of intermediate hops between A and B, as well as the interface index of the interface through which the packet should be transmitted to reach the next hop. The list of intermediate hops might not include all visited nodes, some hops might be omitted for a reason or another.

**Spatial re-use**

Simultaneous use of channels with identical or close physical characteristics, but located spatially far enough apart to avoid interference (i.e., co-channel interference)

**System-wide broadcast**

Same as flooding, but used in contrast to local broadcast.

**Subnet**

A subnet is a logical group of connected network nodes. In IP networks, nodes in a subnet share a common network mask (in IPV4) or a network prefix (in IPv6).

**Topology (Network Topology)**

The interconnection structure of a network: which nodes are directly connected to each other, and through which links they are connected. Some simple topologies have been given names, such as for instance 'bus topology', 'mesh topology', 'ring topology', 'star topology' and 'tree topology'.

**Triggered update**

A solicited route update transmitted by a router along a path to a destination.

## 3. Mobile Access Networks and Mobile Networks

In order to support host mobility a set of nodes towards the network edge may need to have specific functions. Such a set of nodes forms a mobile access network that may or may not be part of the global Internet. Figure 1 presents two examples of such access network topologies. The figure depicts a reference architecture which illustrates an IP network with components defined in this section.

We intend to define the concept of the Access Network (AN) which may also support enhanced mobility. It is possible that to support routing and QoS for mobile nodes, existing routing protocols (e.g., Open Shortest Path First (OSPF) [14]) may not be appropriate to maintain forwarding information for these mobile nodes as they change their points of attachment to the Access Network. These new functions are implemented in routers with additional capabilities. We can distinguish three types of Access Network components: Access Routers (AR) which handle the last hop to the mobile, typically over a wireless link; Access Network Gateways (ANG) which form the boundary on the fixed network side and shield the fixed network from the specialized routing protocols; and (optionally) other internal Access Network Routers which may also be needed in some cases to support the functions. The Access Network consists of the equipment needed to support this specialized routing, i.e., AR or ANG. AR and ANG may be the same physical nodes.

In addition, we present a few basic terms on mobile networks, that is, mobile network, mobile router (MR), and mobile network node (MNN). More terminology for discussing mobile networks can be found in [13]. A more thorough discussion of mobile networks can be found in the working group documents of the NEMO Working Group.

Note: this reference architecture is not well suited for people dealing with Mobile Ad-hoc Networks (MANET).

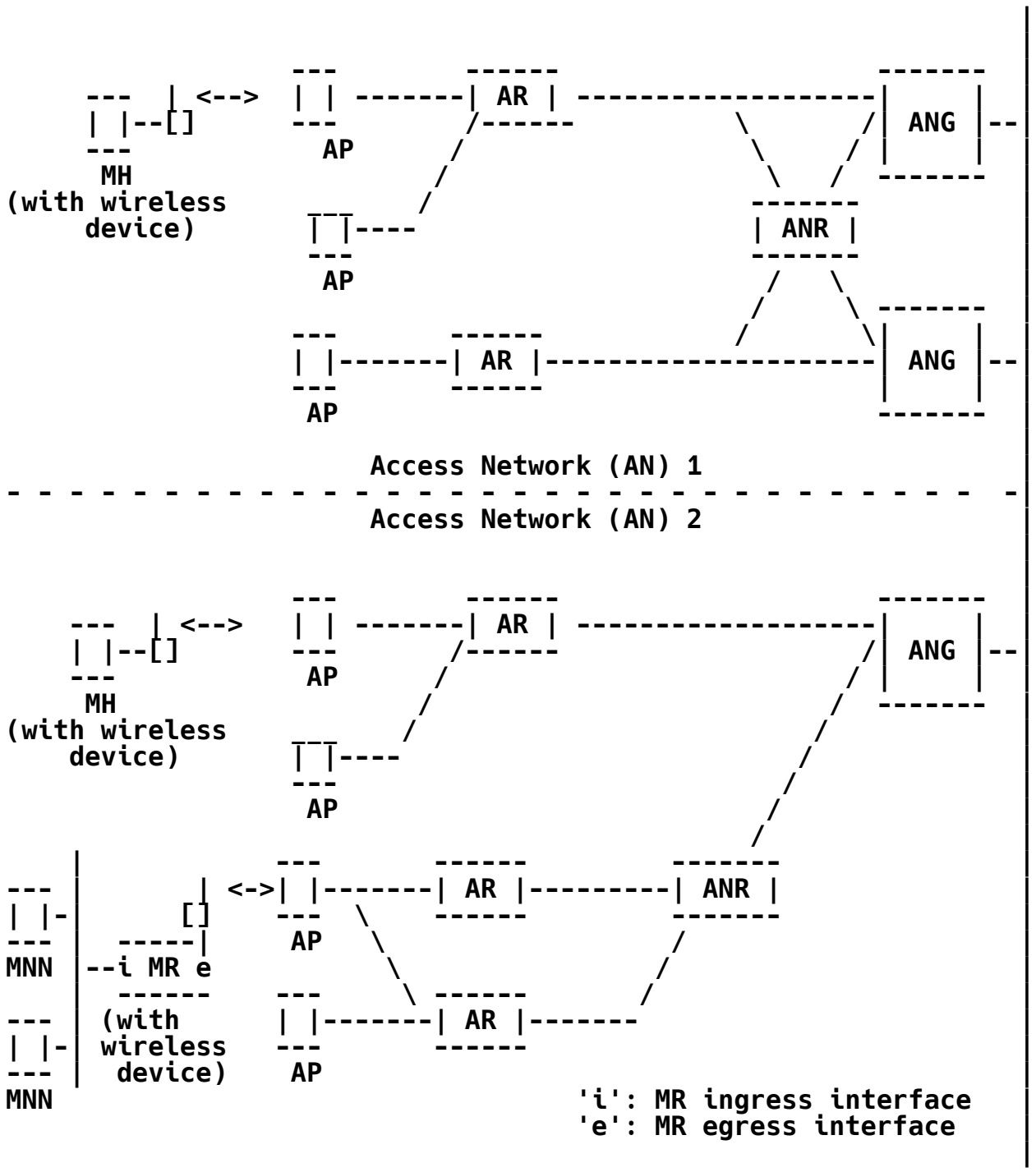


Figure 1: Reference Network Architecture

Mobile Node (MN)

An IP node capable of changing its point of attachment to the network. A Mobile Node may either be a Mobile Host (no forwarding functionality) or a Mobile Router (forwarding functionality).

Mobile Host (MH)

A mobile node that is an end host and not a router. A Mobile Host is capable of sending and receiving packets, that is, being a source or destination of traffic, but not a forwarder of it.

Fixed Node (FN)

A node, either a host or a router, unable to change its point of attachment to the network and its IP address without breaking open sessions.

Mobile network

An entire network, moving as a unit, which dynamically changes its point of attachment to the Internet and thus its reachability in the topology. The mobile network is composed of one or more IP-subnets and is connected to the global Internet via one or more Mobile Routers (MR). The internal configuration of the mobile network is assumed to be relatively stable with respect to the MR.

Mobile Router (MR)

A router capable of changing its point of attachment to the network, moving from one link to another link. The MR is capable of forwarding packets between two or more interfaces, and possibly running a dynamic routing protocol modifying the state by which it does packet forwarding.

A MR acting as a gateway between an entire mobile network and the rest of the Internet has one or more egress interface(s) and one or more ingress interface(s). Packets forwarded upstream to the rest of the Internet are transmitted through one of the MR's egress interface; packets forwarded downstream to the mobile network are transmitted through one of the MR's ingress interface.

Ingress interface

The interface of a MR attached to a link inside the mobile network.

**Egress interface**

The interface of a MR attached to the home link if the MR is at home, or attached to a foreign link if the MR is in a foreign network.

**Mobile Network Node (MNN)**

Any node (host or router) located within a mobile network, either permanently or temporarily. A Mobile Network Node may either be a mobile node or a fixed node.

**Access Link (AL)**

A last-hop link between a Mobile Node and an Access Point. That is, a facility or medium over which an Access Point and the Mobile Node can communicate at the link layer, i.e., the layer immediately below IP.

**Access Point (AP)**

An Access Point is a layer 2 device which is connected to one or more Access Routers and offers the wireless link connection to the Mobile Node. Access Points are sometimes called base stations or access point transceivers. An Access Point may be a separate entity or co-located with an Access Router.

**Radio Cell**

The geographical area within which an Access Point provides radio coverage, i.e., where radio communication between a Mobile Node and the specific Access Point is possible.

**Access Network Router (ANR)**

An IP router in the Access Network. An Access Network Router may include Access Network specific functionalities, for example, related to mobility and/or QoS. This is to distinguish between ordinary routers and routers that have Access Network-related special functionality.

Access Router (AR)

An Access Network Router residing on the edge of an Access Network and connected to one or more Access Points. The Access Points may be of different technology. An Access Router offers IP connectivity to Mobile Nodes, acting as a default router to the Mobile Nodes it is currently serving. The Access Router may include intelligence beyond a simple forwarding service offered by ordinary IP routers.

Access Network Gateway (ANG)

An Access Network Router that separates an Access Network from other IP networks, much in the same way as an ordinary gateway router. The Access Network Gateway looks to the other IP networks like a standard IP router. In a small network, an ANG may also offer the services of an AR, namely offer the IP connectivity to the mobile nodes.

Access Network (AN)

An IP network which includes one or more Access Network Routers.

Administrative Domain (AD)

A collection of networks under the same administrative control and grouped together for administrative purposes [5].

Serving Access Router (SAR)

The Access Router currently offering the connectivity to the MN. This is usually the point of departure for the MN as it makes its way towards a new Access Router (at which time the Serving Access Router takes the role of the Previous Access Router). There may be several Serving Access Routers serving the Mobile Node at the same time.

New Access Router (NAR)

The Access Router that offers connectivity to the Mobile Node after a handover.

**Previous Access Router (PAR)**

An Access Router that offered connectivity to the Mobile Node prior to a handover. This is the Serving Access Router that will cease or has ceased to offer connectivity to the Mobile Node. Often also called Old Access Router (OAR).

**Candidate Access Router (CAR)**

An Access Router to which the Mobile Node may do a handoff. See Section 4.8.

## 4. Handover Terminology

These terms refer to different perspectives and approaches to supporting different aspects of mobility. Distinctions can be made according to the scope, range overlap, performance characteristics, diversity characteristics, state transitions, mobility types, and control modes of handover techniques.

**Roaming**

An operator-based term involving formal agreements between operators that allows a mobile to get connectivity from a foreign network. Roaming (a particular aspect of user mobility) includes, for example, the functionality by which users can communicate their identity to the local AN so that inter-AN agreements can be activated and service and applications in the MN's home network can be made available to the user locally.

**Handover**

The process by which an active MN (in the Active State, see section 4.6) changes its point of attachment to the network, or when such a change is attempted. The access network may provide features to minimize the interruption to sessions in progress. Also called handoff.

There are different types of handover classified according to different aspects involved in the handover. Some of this terminology follows the description in [4].

### 4.1. Scope of Handover

**Layer 2 handover**

A handover where the MN changes APs (or some other aspect of the radio channel) connected to the same AR's interface. This type of handover is transparent to the routing at the IP layer (or it appears simply as a link layer reconfiguration without any mobility implications).

**Intra-AR handover**

A handover which changes the AR's network interface to the mobile. That is, the Serving AR remains the same but routing changes internal to the AR take place.

**Intra-AN handover**

A handover where the MN changes ARs inside the same AN. Such a handover is not necessarily visible outside the AN. In case the ANG serving the MN changes, this handover is seen outside the AN due to a change in the routing paths. Note that the ANG may change for only some of the MN's data flows.

**Inter-AN handover**

A handover where the MN moves to a new AN. This requires support for macro mobility. Note that this would have to involve the assignment of a new IP access address (e.g., a new care-of address) to the MN.

**Intra-technology handover**

A handover between equipment of the same technology.

**Inter-technology handover**

A handover between equipment of different technologies.

**Horizontal handover**

This involves MNs moving between access points of the same type (in terms of coverage, data rate and mobility), such as, UMTS to UMTS, or WLAN to WLAN.

Vertical handover

This involves MNs moving between access points of different type, such as, UMTS to WLAN.

Note that the difference between a horizontal and vertical handover is vague. For example, a handover from an AP with 802.11b WLAN link to an AP with 802.11g WLAN link may be considered as either a vertical or a horizontal handover, depending on an individual's point of view.

Note also that the IP layer sees network interfaces and IP addresses, rather than specific technologies used by those interfaces. Thus, horizontal and vertical handovers may or may not be noticed at the IP layer. Usually a handover can be noticed if the IP address assigned to the interface changes, the network interface itself changes (which can also change the IP address), or there is a link outage, for example, when the mobile node moves out of coverage for a while. For example, in a GPRS network a horizontal handover happens usually unnoticed by the IP layer. Similarly, a WLAN horizontal handover may be noticed if the IP address of the interface changes. On the other hand, vertical handovers often change the network interface and are, therefore, noticed on the IP layer. Still, some specific network cards may be able to switch between access technologies (e.g., GPRS to UMTS) without changing the network interface. Moreover, either of the two handovers may or may not result in changing the AR. For example, an AR could control WLAN and Bluetooth access points, and the mobile node could do horizontal and vertical handovers under the same AR without changing its IP address or even the network interface.

## 4.2. Handover Control

A handover must be one of the following two types (a):

Mobile-initiated handover

The MN is the one that makes the initial decision to initiate the handover.

Network-initiated handover

The network makes the initial decision to initiate the handover.

A handover is also one of the following two types (b):

Mobile-controlled handover

The MN has the primary control over the handover process.

Network-controlled handover

The network has the primary control over the handover process.

A handover decision usually involves some sort of measurements about when and where to handover to. Therefore, a handover is also either of these three types (c):

Mobile-assisted handover

Information and measurement from the MN are used by the AR to decide on the execution of a handover.

Network-assisted handover

A handover where the AN collects information that can be used by the MN in a handover decision.

Unassisted handover

A handover where no assistance is provided by the MN or the AR to each other.

Note that it is possible that the MN and the AR both do measurements and decide on the handover.

A handover is also one of the following two types (d):

Push handover

A handover either initiated by the PAR, or where the MN initiates a handover via the PAR.

Pull handover

A handover either initiated by the NAR, or where the MN initiates a handover via the NAR.

The handover is also either proactive or reactive (e):

Planned handover

A proactive (expected) handover where some signaling can be done in advance of the MN getting connected to the new AR, e.g., building a temporary tunnel from the previous AR to the new AR.

Unplanned handover

A reactive (unexpected) handover where no signaling is done in advance of the MN's move from the previous AR to the new AR.

The five handover types (a-e) are mostly independent, and every handover should be classifiable according to each of these types.

## 4.3. Simultaneous connectivity to Access Routers

Make-before-break (MBB)

During a MBB handover the MN makes the new connection before the old one is broken. Thus, the MN can communicate simultaneously with the old and new AR during the handover. This should not be confused with "soft handover" which relies on macro diversity, described in Section 4.5.

Break-before-make (BBM)

During a BBM handover the MN breaks the old connection before the new connection is made. Thus, the MN cannot communicate simultaneously with the old and the new AR.

## 4.4. Performance and Functional Aspects

Handover latency

Handover latency is the difference between the time a MN is last able to send and/or receive an IP packet by way of the PAR, and the time the MN is able to send and/or receive an IP packet through the NAR. Adapted from [4].

Smooth handover

A handover that aims primarily to minimize packet loss, with no explicit concern for additional delays in packet forwarding.

**Fast handover**

A handover that aims primarily to minimize handover latency, with no explicit interest in packet loss.

**Seamless handover**

A handover in which there is no change in service capability, security, or quality. In practice, some degradation in service is to be expected. The definition of a seamless handover in the practical case should be that other protocols, applications, or end users do not detect any change in service capability, security or quality, which would have a bearing on their (normal) operation. As a consequence, what would be a seamless handover for one less demanding application might not be seamless for another more demanding application. See [7] for more discussion on the topic.

**Throughput**

The amount of data from a source to a destination processed by the protocol for which throughput is to be measured, for instance, IP, TCP, or the MAC protocol. The throughput differs between protocol layers.

**Goodput**

The total bandwidth used, less the volume of control messages, protocol overhead from the data packets, and packets dropped due to CRC errors.

**Pathloss**

A reduction in signal strength caused by traversing the physical medium constituting the link.

**Hidden-terminal problem**

The problem whereby a transmitting node can fail in its attempt to transmit data because of destructive interference which is only detectable at the receiving node, not the transmitting node.

**Exposed terminal problem**

The problem whereby a transmitting node A prevents another node B from transmitting, although node B could have safely transmitted to anyone else but the transmitting node A.

### 4.5. Micro Diversity, Macro Diversity, and IP Diversity

Certain air interfaces (e.g., the Universal Mobile Telephone System (UMTS) Terrestrial Radio Access Network (UTRAN) running in Frequency Division Duplex (FDD) mode) require or at least support macro diversity combining. Essentially, this refers to the fact that a single MN is able to send and receive over two independent radio channels ('diversity branches') at the same time; the information received over different branches is compared and that from the better branch passed to the upper layers. This can be used both to improve overall performance, and to provide a seamless type of handover at layer 2, since a new branch can be added before the old is deleted. See also [6].

It is necessary to differentiate between combining/diversity that occurs at the physical and radio link layers, where the relevant unit of data is the radio frame, and that which occurs at layer 3, the network layer, where what is considered is the IP packet itself.

In the following definitions micro- and macro diversity refer to protocol layers below the network layer, and IP diversity refers to the network layer.

Micro diversity

For example, two antennas on the same transmitter send the same signal to a receiver over a slightly different path to overcome fading.

Macro diversity

Duplicating or combining actions taking place over multiple APs, possibly attached to different ARs. This may require support from the network layer to move the radio frames between the base stations and a central combining point.

IP diversity

Refers to the process of duplicating IP packets and sending them to the receiver through more than one point of attachment. This is semantically allowed by IP because it does not guarantee packet uniqueness, and higher level protocols are assumed to eliminate duplicates whenever that is important for the application.

## 4.6. Paging, and Mobile Node States and Modes

Mobile systems may employ the use of MN states in order to operate more efficiently without degrading the performance of the system. The term 'mode' is also common and means the same as 'state'.

A MN is always in one of the following three states:

Active state

When the AN knows the MN's SAR and the MN can send and receive IP packets. The access link may not be active, but the radio layer is able to establish one without assistance from the network layer. The MN has an IP address assigned.

Dormant state

A state in which the mobile restricts its ability to receive normal IP traffic by reducing its monitoring of radio channels. The AN knows the MN's Paging Area, but the MN has no SAR and so packets cannot be delivered to the MN without the AN initiating paging. Often also called Idle state.

Time-slotted dormant mode

A dormant mode implementation in which the mobile alternates between periods of not listening for any radio traffic and listening for traffic. Time-slotted dormant mode implementations are typically synchronized with the network so the network can deliver paging messages to the mobile during listening periods.

Inactive state

the MN is in neither the Active nor Dormant State. The MN is no longer listening for any packets, not even periodically, and not sending packets. The MN may be in a powered off state, it may have shut down all interfaces to drastically conserve power, or it may be out of range of a radio access point. The MN does not necessarily have an IP access address from the AN.

Note: in fact, as well as the MN being in one of these three states, the AN also stores which state it believes the MN is in. Normally these are consistent; the definitions above assume so.

Here are some additional definitions for paging, taking into account the above state definitions.

**Paging**

A procedure initiated by the Access Network to move a Dormant MN into the Active State. As a result of paging, the MN establishes a SAR and the IP routes are set up.

**Location updating**

A procedure initiated by the MN, by which it informs the AN that it has moved into a new paging area.

**Paging area**

A part of the Access Network, typically containing a number of ARs/APs, which corresponds to some geographical area. The AN keeps and updates a list of all the Dormant MNs present in the area. If the MN is within the radio coverage of the area it will be able to receive paging messages sent within that Paging Area.

**Paging area registrations**

Signaling from a dormant mode mobile node to the network, by which it establishes its presence in a new paging area. Paging Area Registrations thus enable the network to maintain a rough idea of where the mobile is located.

**Paging channel**

A radio channel dedicated to signaling dormant mode mobiles for paging purposes. By current practice, the paging channel carries only control traffic necessary for the radio link, although some paging protocols have provision for carrying arbitrary traffic (and thus could potentially be used to carry IP).

**Traffic channel**

The radio channel on which IP traffic to an active mobile is typically sent. This channel is used by a mobile that is actively sending and receiving IP traffic, and is not continuously active in a dormant mode mobile. For some radio link protocols, this may be the only channel available.

## 4.7. Context Transfer

**Context**

The information on the current state of a routing-related service required to re-establish the routing-related service on a new subnet without having to perform the entire protocol exchange with the MN from scratch.

**Feature context**

The collection of information representing the context for a given feature. The full context associated with a MN is the collection of one or more feature contexts.

**Context transfer**

The movement of context from one router or other network entity to another as a means of re-establishing routing-related services on a new subnet or collection of subnets.

**Routing-related service**

A modification to the default routing treatment of packets to and from the MN. Initially establishing routing-related services usually requires a protocol exchange with the MN. An example of a routing-related service is header compression. The service may also be indirectly related to routing, for example, security. Security may not affect the forwarding decision of all intermediate routers, but a packet may be dropped if it fails a security check (can't be encrypted, authentication failed, etc.). Dropping the packet is basically a routing decision.

## 4.8. Candidate Access Router Discovery

**Capability of an AR**

A characteristic of the service offered by an AR that may be of interest to an MN when the AR is being considered as a handoff candidate.

**Candidate AR (CAR)**

An AR to which MN has a choice of performing IP-level handoff. This means that MN has the right radio interface to connect to an AP that is served by this AR, as well as the coverage of this AR overlaps with that of the AR to which MN is currently attached.

Target AR (TAR)

An AR with which the procedures for the MN's IP-level handoff are initiated. TAR is selected after running a TAR Selection Algorithm that takes into account the capabilities of CARs, preferences of MN and any local policies.

## 4.9. Types of Mobility

We can differentiate between host and network mobility, and various types of network mobility. Terminology related more to applications such as the Session Initiation Protocol, such as personal mobility, is out of scope for this document.

Host mobility support

Refers to the function of allowing a mobile node to change its point of attachment to the network, without interrupting IP packet delivery to/from that node. There may be different sub-functions depending on what the current level of service is being provided; in particular, support for host mobility usually implies active and dormant modes of operation, depending on whether the node has any current sessions or not. Access Network procedures are required to keep track of the current point of attachment of all the MNs or establish it at will. Accurate location and routing procedures are required in order to maintain the integrity of the communication. Host mobility is often called 'terminal mobility'.

Network mobility support

Refers to the function of allowing an entire network to change its point of attachment to the Internet, and, thus, its reachability in the topology, without interrupting IP packet delivery to/from that mobile network.

Two subcategories of mobility can be identified within both host mobility and network mobility:

Global mobility

Same as Macro mobility.

Local mobility

Same as Micro mobility.

Macro mobility

Mobility over a large area. This includes mobility support and associated address registration procedures that are needed when a MN moves between IP domains. Inter-AN handovers typically involve macro-mobility protocols. Mobile-IP can be seen as a means to provide macro mobility.

Micro mobility

Mobility over a small area. Usually this means mobility within an IP domain with an emphasis on support for active mode using handover, although it may include idle mode procedures also. Micro-mobility protocols exploit the locality of movement by confining movement related changes and signaling to the access network.

Local mobility management

Local mobility management (LMM) is a generic term for protocols dealing with IP mobility management confined within the access network. LMM messages are not routed outside the access network, although a handover may trigger Mobile IP messages to be sent to correspondent nodes and home agents.

## 5. Specific Terminology for Mobile Ad-Hoc Networking

Cluster

A group of nodes located within close physical proximity, typically all within range of one another, which can be grouped together for the purpose of limiting the production and propagation of routing information.

Cluster head

A cluster head is a node (often elected in the cluster formation process) that has complete knowledge about group membership and link state information in the cluster. Each cluster should have one and only one cluster head.

Cluster member

All nodes within a cluster except the cluster head are called members of that cluster.

Convergence

The process of approaching a state of equilibrium in which all nodes in the network agree on a consistent collection of state about the topology of the network, and in which no further control messages are needed to establish the consistency of the network topology.

Convergence time

The time which is required for a network to reach convergence after an event (typically, the movement of a mobile node) which changes the network topology.

Laydown

The relative physical location of the nodes within the ad hoc network.

Pathloss matrix

A matrix of coefficients describing the pathloss between any two nodes in an ad hoc network. When the links are asymmetric, the matrix is also asymmetric.

Scenario

The tuple <laydown, pathloss matrix, mobility factor, traffic> characterizing a class of ad hoc networks.

## 6. Security-related Terminology

This section includes terminology commonly used around mobile and wireless networking. Only a mobility-related subset of the entire security terminology is presented.

Authorization-enabling extension

An authentication which makes a (registration) message acceptable to the ultimate recipient of the registration message. An authorization-enabling extension must contain an SPI (see below) [10].

Mobility security association

A collection of security contexts, between a pair of nodes, which may be applied to mobility-related protocol messages exchanged between them. In Mobile IP, each context indicates

an authentication algorithm and mode, a secret (a shared key, or appropriate public/private key pair), and a style of replay protection in use. Mobility security associations may be stored separately from the node's IPsec Security Policy Database (SPD) [10].

Registration key

A key used in the Mobility Security Association between a mobile node and a foreign agent. A registration key is typically only used once or a very few times, and only for the purposes of verifying a small volume of Authentication data [12].

Security context

A security context between two nodes defines the manner in which two nodes choose to mutually authenticate each other, and indicates an authentication algorithm and mode.

Security Parameter Index (SPI)

An index identifying a security context between a pair of routers among the contexts available in the mobility security association.

The Mobile IPv6 specification includes more security terminology related to MIPv6 bindings [9]. Terminology about the MIP challenge/response mechanism can be found in [11].

## 7. Security Considerations

This document presents only terminology. There are no security issues in this document.

## 8. Contributors

This document was initially based on the work of Tapio Suihko, Phil Eardley, Dave Wisely, Robert Hancock, Nikos Georganopoulos, Markku Kojo, and Jukka Manner.

Charles Perkins has provided input terminology related to ad-hoc networks.

Thierry Ernst has provided the terminology for discussing mobile networks.

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Some definitions of terminology have been adapted from [1], [2], [3], [4], [7], [8], [9] and [10].

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## 11. Appendix A - Index of Terms

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