IEEE 802.21 Media Independent Handover (MIH)

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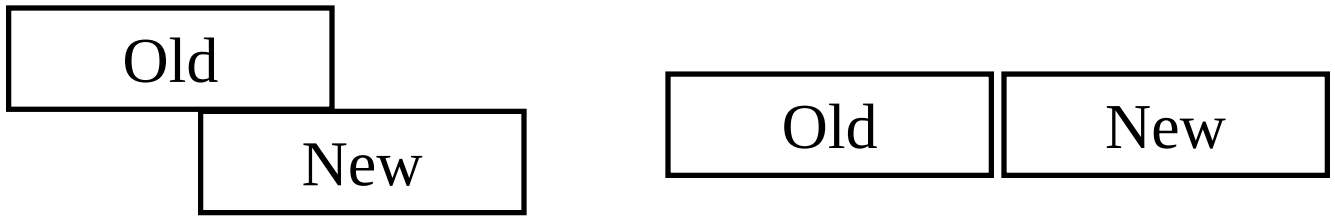
Audio/Video recordings of this lecture are available at:

http://www.cse.wustl.edu/~jain/cse574-10/

Overview

- Types of Handovers
- 802.21 Key Functions
- MIH Services
- MIHF Protocol
- Amendments for MIH

Types of Handovers



Make-before-Break Break-before-make

- Hard handover: Break-before-Make
- Soft handover: Make-before-Break. Need to use two radios
- Horizontal Handover: Same radio access technology (RAT)
- Vertical Handover: Different technologies
- Terminal Controlled
- Terminal Initiated, Network assisted
- Network Initiated, Network controlled

Intra-Technology Handovers

- 802.11i defines pre-authentication
- 802.11r is defining fast BSS transition
- 802.16e defines handover process optimization
- 802.1af is defining port access control (revised 802.1X)
- Most of these reduce handover time by pre-authentication with next target using current service

802.21 History and Timeline

- 1H2004: WG created
- 1H2005: Initial draft
- 2H2005: Changes to 802.11u, 802.16g, MIPSHOP
- 1H2006: WG letter ballot
- 2007: Sponsor ballot
- 2008: Standard
- 2009-10: Deployments

802.21 Key Functions

- Reduce power consumption by avoiding unnecessary scanning and using information. 802.16 module is turned on only if 802.16 is available.
- Reduce power consumption by using backend (core) network
- Reduce handover time by passing security/QoS information to next point of service
- Allow service providers to enforce their policies and roaming agreements

IEEE 802.21 Features

- Network Selection:
  - Allows users to select between 802.3, 802.11, 802.16, 3GPP, 3GPP2 networks
  - MS can automatically connect to the right network by observing user selections or by user policies
  - MS can notify user when available networks change or a switch occurs
- Session Continuity:
  - Allows make before break handovers
- Open Interface for:
  - Link state event reporting
  - Intersystem information service
  - Handover control (command) service

IEEE 802.21 Goals and Non-Goals

- Goals:
  - Architecture to enable low-latency handover across multiple technology access networks
  - Help in handover decision making
  - Standard functions to help gather network characteristics
  - Standard command procedures for seamless handovers
  - Supports both station initiated and network initiated handovers
- Non-Goals:
  - Define handover policies
  - Specify network selection procedure
  - Execute handover
  - Network detection procedure

802.21 Concepts

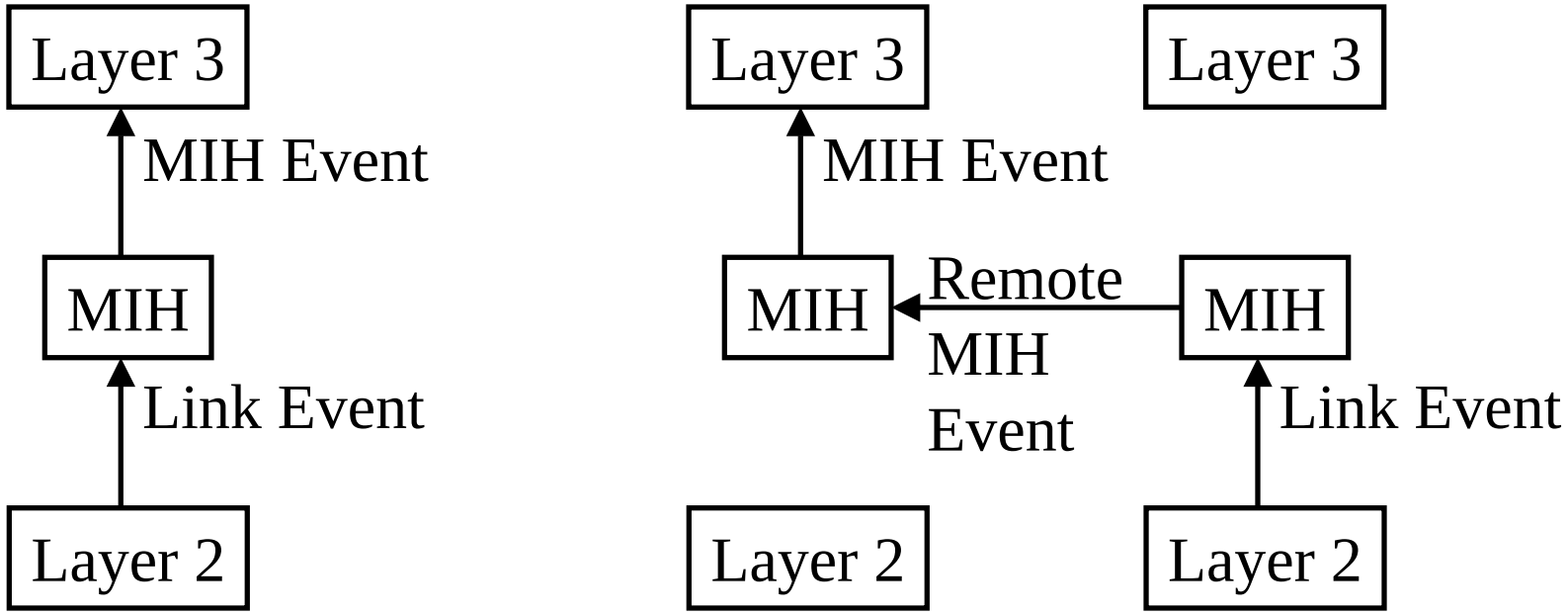
- Point of Access (PoA): Base Station or Access Point
- Mobile Node
- L2 Trigger: Layer 2 events
- Radio Access Technology (RAT): 802.11, 802.16, ...

MIH Services

- **Event Service**: Delivers triggers on events, e.g., link up, link down, new link available
- **Command Service**: Set of standard commands for handover control, e.g., Switch Link, Configure Link, Initiate handover, etc.
- **Information Service**: Defines a service that provides information for faster handovers, e.g., list of available networks, IP version, network operator, etc.
- MIH users access these services using well-defined service access points (SAPs)

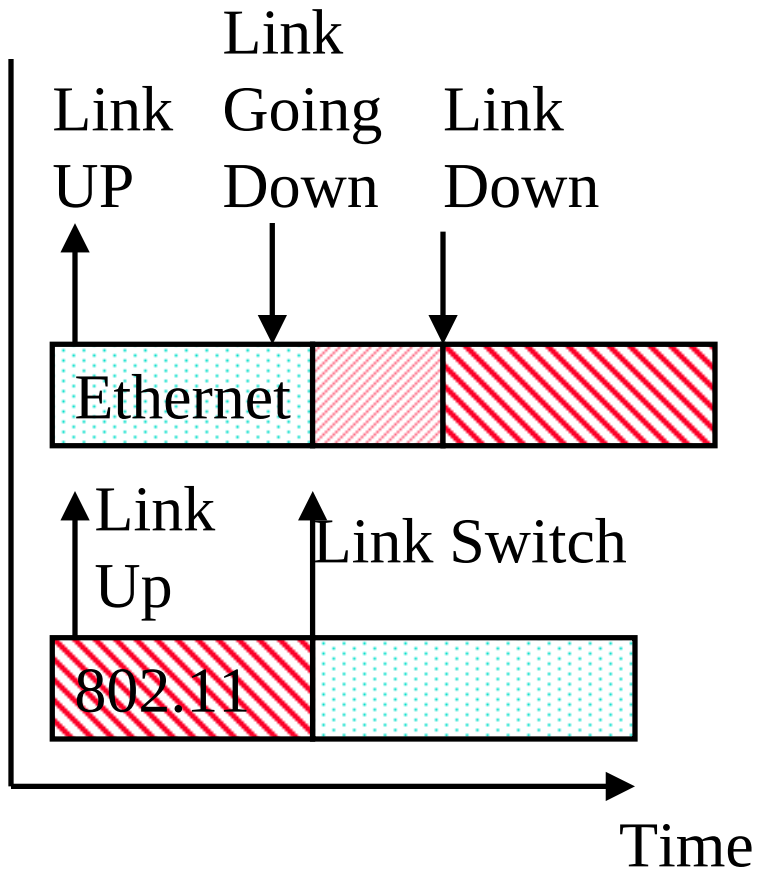
Event Service

- Local (terminal side) and remote (network side) events are supported
- User preferences determine the delivery of events
- Events may trigger user actions



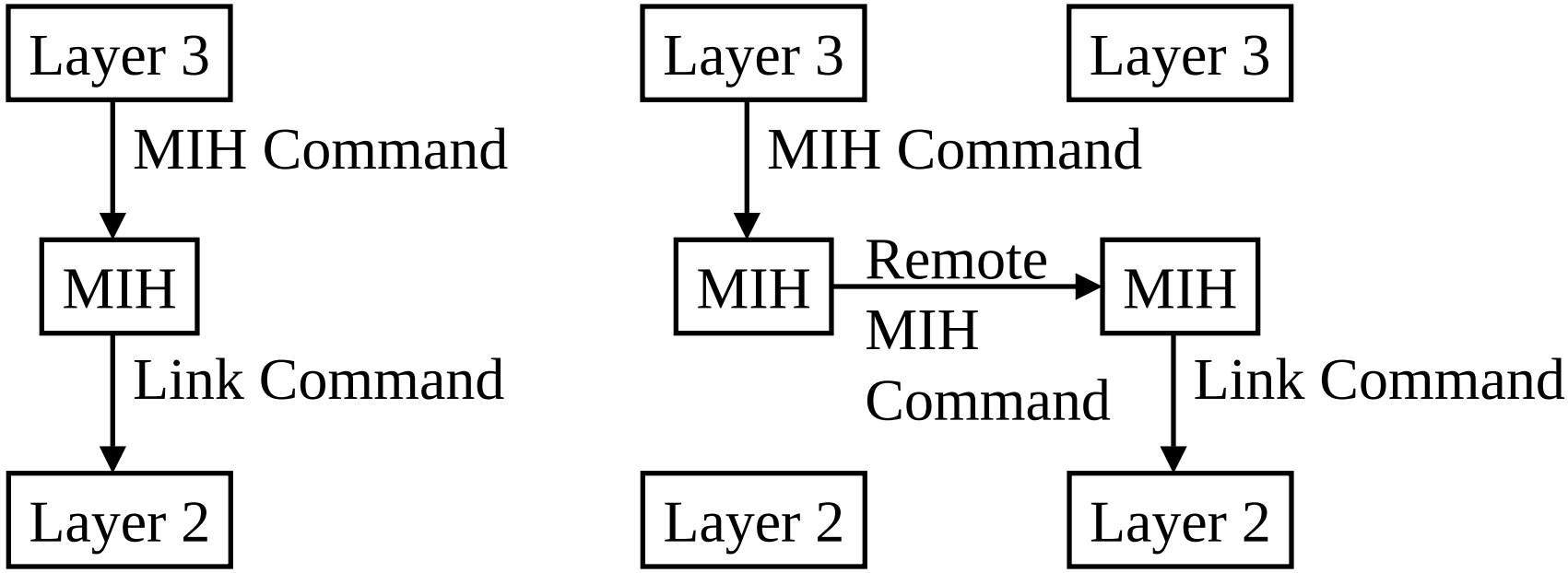
Triggers

- Link Layer Events
- Link up
- Link Down
- Link Going Down
- Link Detected (new link)
- Link Parameters Change (threshold crossing)
- Link Even Rollback
- Link SDU Transmit Status
- Link Handover Imminent
- Link Handover Complete



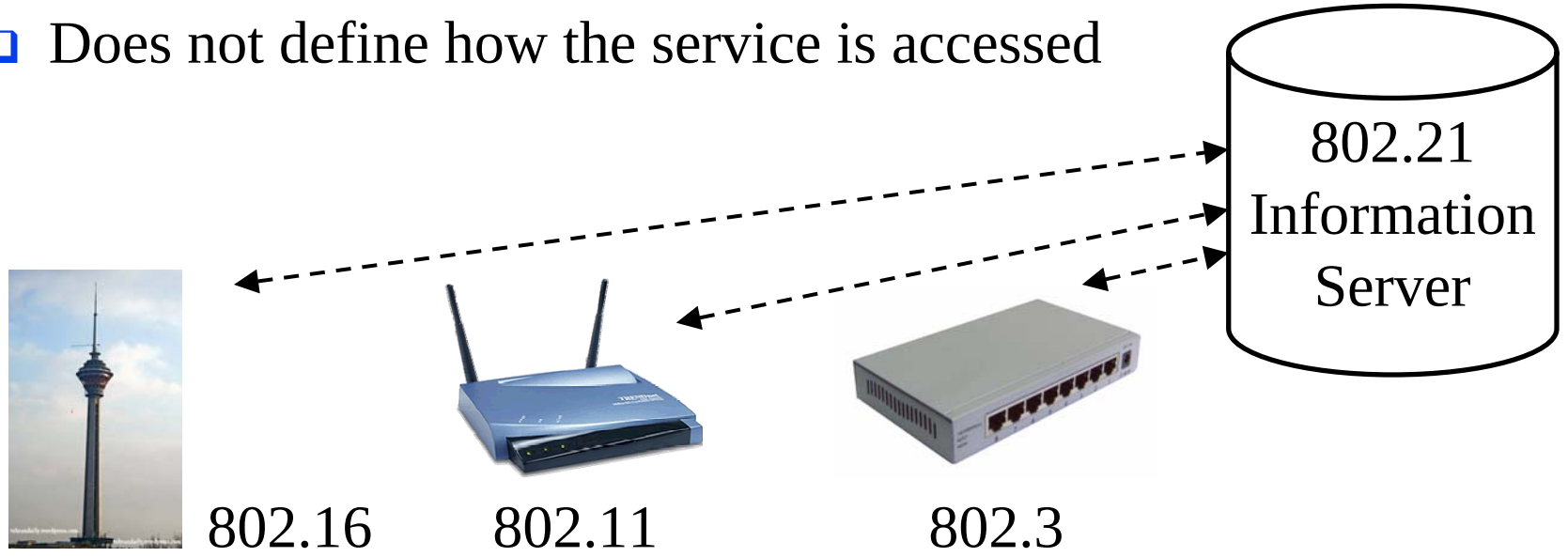
Command Service

- Commands flow from user to MIH and then to link layer
- Commands allow users to switch links
- User communicates separately with each technology
  $\Rightarrow$ Commands do not flow from one technology to another



MIH Information Service

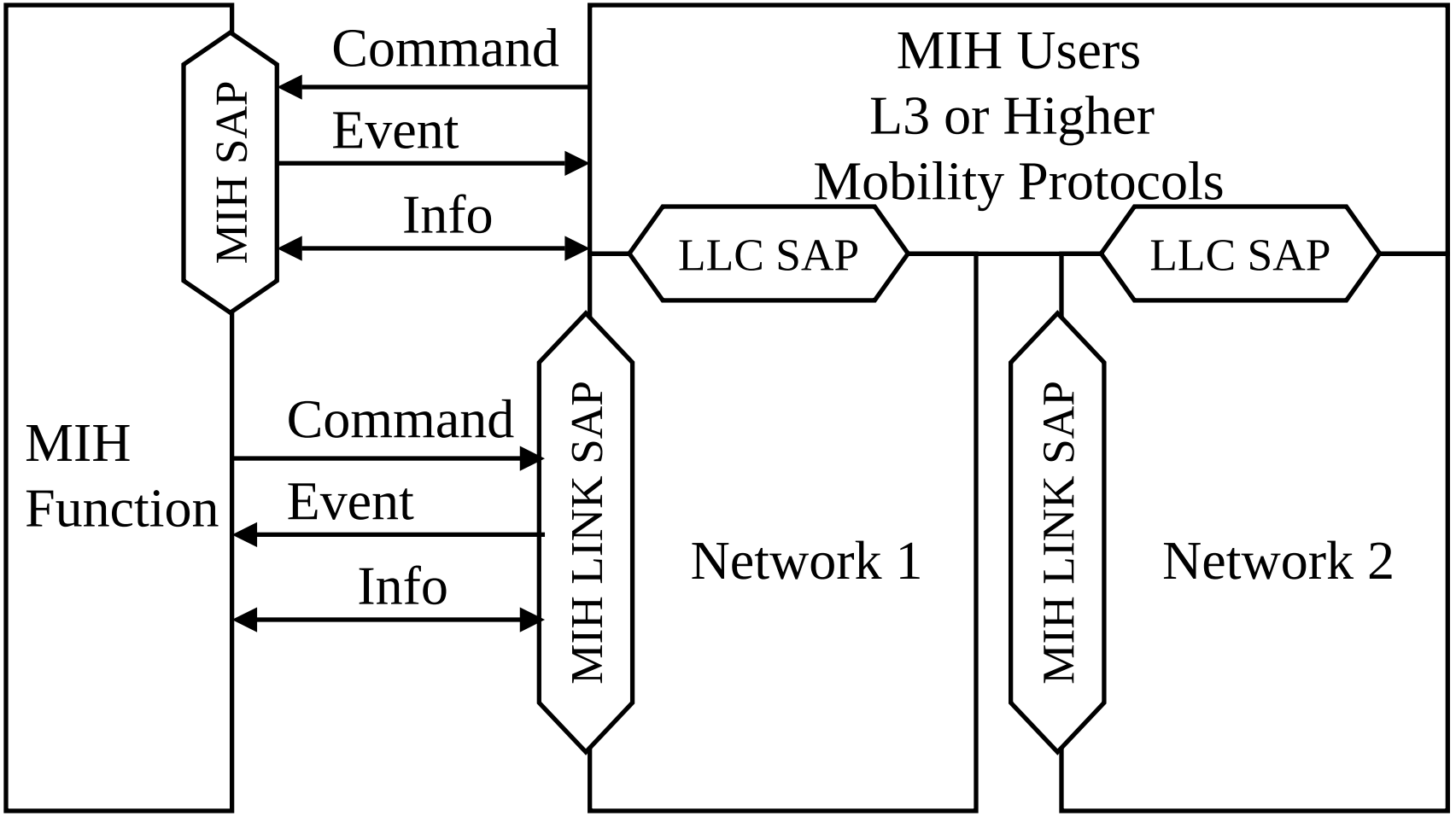
- Provides information about networks in a particular geographical area
- Information delivery via queries or by broadcast/multicast
- Generally static information
- 802.21 defines what information is required
- Does not define how the service is accessed



MIH Information Service (Cont)

- Common information representation
- List of available networks
- Location of POA
- Operator ID
- Roaming Partners
- Cost, Security, QoS
- Capabilities (emergency services, IMS)

MIH Services



Network Initiated Handovers

- MIH Handover Initiate: Suggested PoA
- MIH Handover Prepare: current to target network
- MIH Handover Commit: Client commits to do handover
- MIH Handover complete: New network to old network. Send all buffered packets.

MIHF Protocol

- MIHF message sent between peer entities
- Communicates events, commands, and information
- MAC independent messages defined in 802.21
- Container for MIH messages for 802.11 defined in 802.11u
- Container for MIH messages for 802.16 defined in 802.16g
- Transport for MIH protocol defined in IETF MIPSHOP (Mobility for IP: Performance, Signaling, and Handoff Optimization)

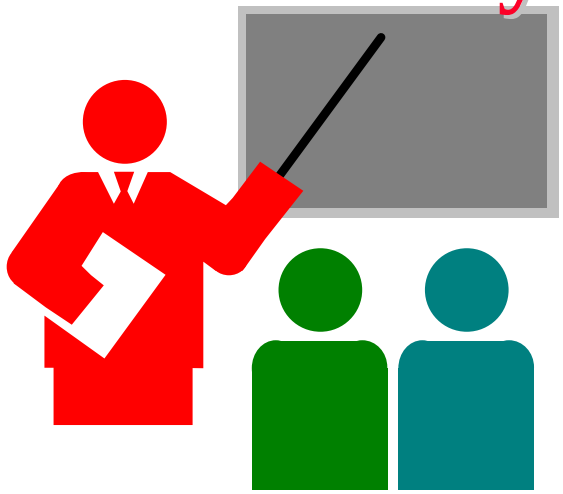
802.21 Transport

- CS, ES, IS messages are transported over L2 or L3
- 802.11u is defining transport of 802.21 messages over 802.11
- MIPSHOP is defining transport over IP

802.11 Amendments for MIH

- MIH Capability indication in beacon
- MAC Layer Management Entity (MLME) Service Access Point (SAP): Link up indication, Scan confirm
- Information service for generic network selection: IS query frame
- Transport of MIHF protocol over 802.11

Summary



- 802.21 is a common protocol for handover initiation, network selection, handover
- 802.21 provides a common interface to L3 and higher mobility protocols
- Has triggers that allow higher layers to take action
- Has commands that allow higher layer to request action
- Has information service that allows all layers to not have to discover the static information

IEEE 802.21 References

- J. Stein, "Survey of IEEE802.21 Media Independent Handover Services," http://www.cse.wustl.edu/~jain/cse574-06/handover.htm
- K. Taniuchi, Y. Ohba, V. Fajardo, et al, "IEEE 802.21: Media Independent Handover: Features, Applicability, and Realization," IEEE Communications Magazine, January 2009, pp. 112-120, *http://www.cs.columbia.edu/~dutta/research/802.21-january-comsoc.pdf*
- IEEE P802.21-2008, "Standard for Local and Metropolitan Area Networks: Media Independent Handover Services," January 2009, 323 pp., http://*standards.**ieee**.org/get**ieee**802/**802.21**.html*

IEEE 802.21 References (Cont)

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- Stefano M. Faccin, "IEEE 802.21 Media Independent Handoff: Overview of services and scenarios for 3GPP2," Liaison to 3GPP2, Jul 2005, 31 pp., http://www.3gcn.org/3gpp2/TSGS/Working/_2005/2005-10-Beijing/Plenary/S00-20051024-041A__21-05-0396-03-0000-AdHoc3GPP2LiasionPackage.pdf

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- Y. Ohba, et al, “Media-Independent Handover Security Tutorial,” IEEE 802 meeting, March 17, 2008, 36 pp., http://ieee802.org/802_tutorials/march08/21-08-0080-01-0sec-security-signaling-during-handovers-tutorial.ppt
- Peretz Feder, "802.21 Liaison - Session #52 Closing Plenary," IEEE 802.16, 8 pp., http://wirelessman.org/liaison/docs/L80216-05_061.pdf

Related Wikipedia Articles

- http://en.wikipedia.org/wiki/IEEE_802.21
- http://en.wikipedia.org/wiki/Media-independent_handover
- http://en.wikipedia.org/wiki/Handoff
- http://en.wikipedia.org/wiki/Soft_handover
- http://en.wikipedia.org/wiki/Vertical_handoff
- http://en.wikipedia.org/wiki/Roaming

Homework 14

- Read the IEEE 802.21 standard. Make a diagram showing general MIHF reference model showing the exchange of MIH information and messages with the remote MIHF.

List of Acronyms

- 3GPP — 3rd Generation Partnership Project
- BSS — Basic Service Set
- CS — Command Service
- ES — Event Service
- IMS — IP Multimedia System
- IS — Information service
- MAC — Media Access Control
- MIH — Media Independent Handover
- MIHF — Media Independent Handover Function
- MIPSHOP — Mobility for IP: Performance, Signaling, and Handoff Optimization
- MS — Mobile Subscriber
- POA — Point of Access
- RAT — Radio access technology
- SDU — Service Data Unit
- WG — Working Group