

Adding Seamless Mobility To LTE With Media Independent Handover

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Agenda

- Introduction
- LTE Architecture Review
- Mobility Discussion
- Introducing IEEE 802.21
- Conclusions



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InterDigital Communications Corporation

- InterDigital[®] is a developer of advanced wireless technologies and products
 - Pioneer of innovative approaches to solve problems in advanced wireless communications
 - Lead contributor to the evolution of major wireless standards
 - Baseband products and software for converged devices
- InterDigital[®] is helping to define & drive mobility solutions for convergence
 - InterDigital[®] has been chosen by SK Telecom to develop an advanced 802.21 based mobility solution for session continuity across UMTS and WiBro technologies



Why talk about (heterogeneous) MOBILITY?

- I know something about it
- Makes a change from OFDM/MIMO!
- Nice controversial space with lots of opinions
- But seriously,
- It is important we get it right for LTE sake
- Initial LTE rollouts will inevitably be patchy
- Perceptions may hinge on mobility experience



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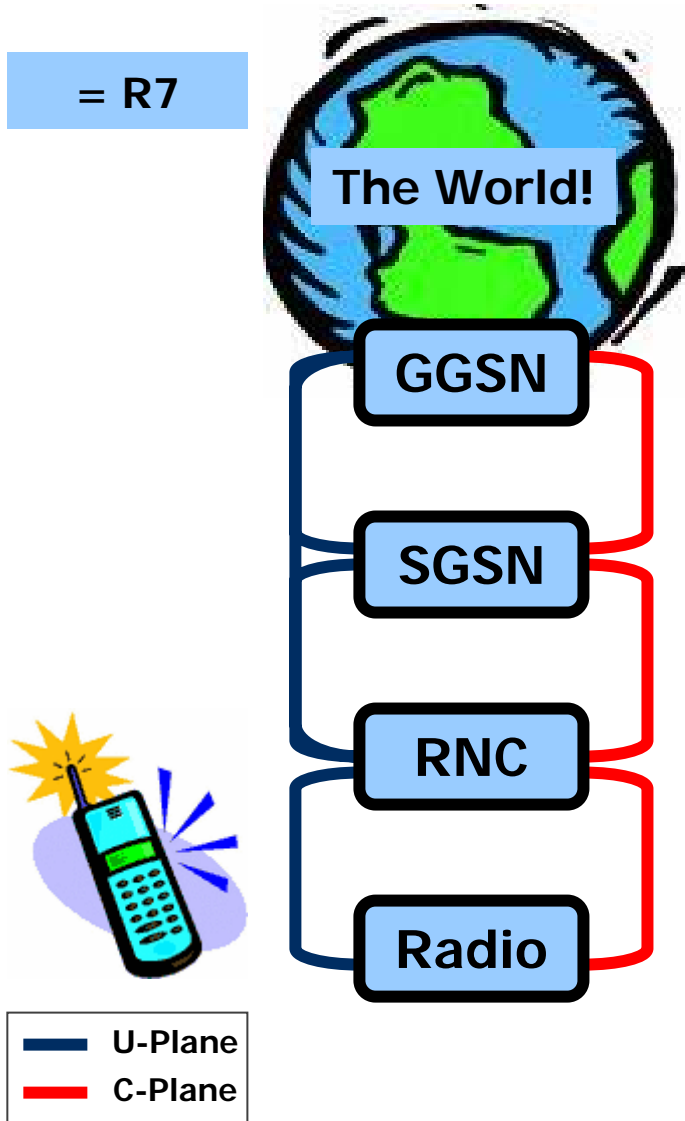


Some grounding material:

- LTE work in 3GPP is proceeding in two parts:
 - The RAN working groups are responsible for the Radio Interface and Access components
 - The SA working groups are defining network aspects or System Architecture Evolution (SAE)
 - Note: This is more a SAE presentation
- SAE overall requirements derived from All-IP network (AIPN) study work
- TR 23.882 defines architectural requirements
 - Key objective is the interworking of 3GPP & Non 3GPP access technologies under a common PS core

Architecture Review: Where are we coming from?

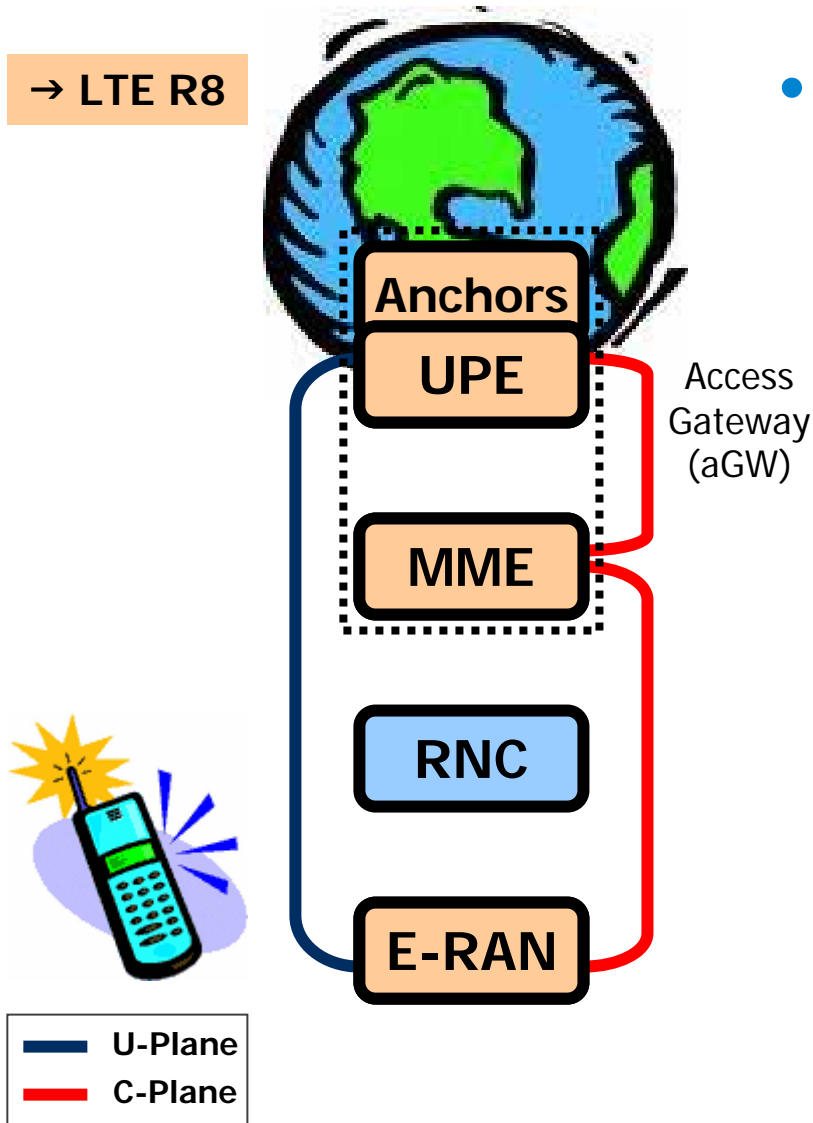
= R7



- In the beginning ($\leq R6$)
 - There was the essential GSM/GPRS architecture
 - Four functional entities providing an elaborate *Access Layer* between your Mobile & *The World!*
 - All realized via 3 standardized User Plane and Control Plane interfaces
- In the middle ($\sim R7$)
 - “One Tunnel” optimization introduced
 - SGSN only deals with Control plane; User plane goes directly between RNC & GGSN
 - Concept extended one step further with the flat HSPA architecture (not shown)

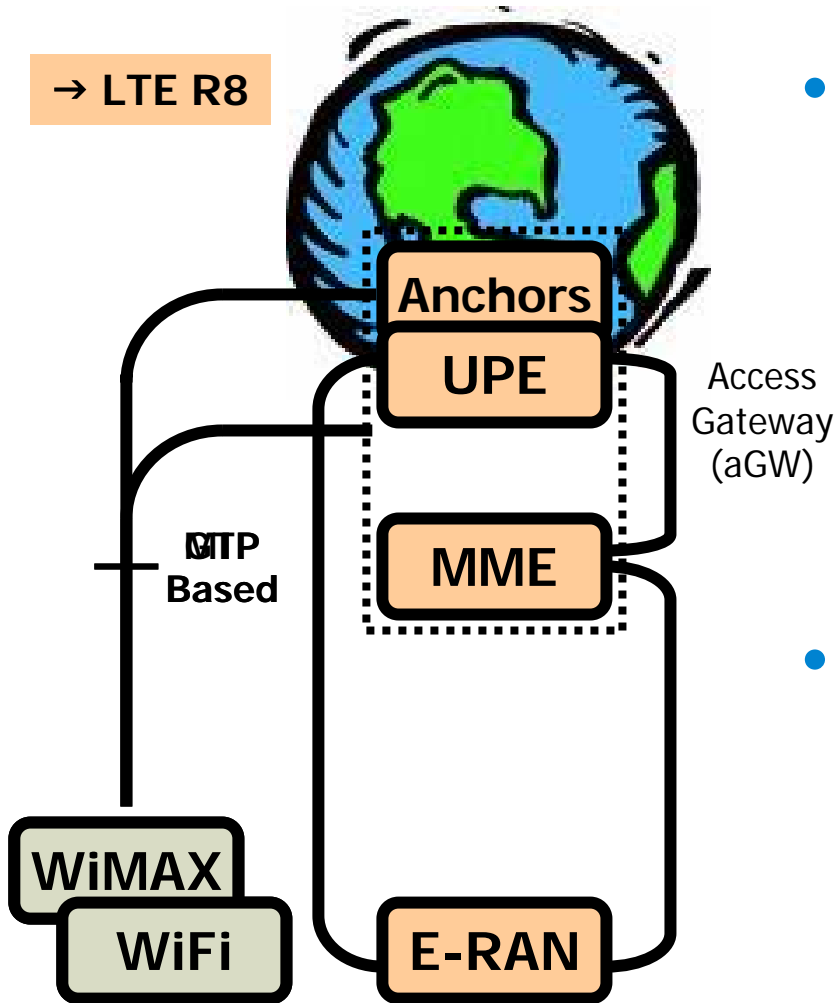
Architecture Review: Where are we going?

→ LTE R8



- In the end? (→ LTE R8)
 - Radio (Node B) and many RNC functions (inc. PDCP) are combined to create the E-RAN or E-Node B
 - SGSN Control plane functions become the Mobility Management Entity (MME)
 - SGSN User plane, GGSN & some RNC functions are incorporated into the User Plane Entity (UPE) & 3GPP Anchor
 - Two Anchor functions introduced for support of Intra-3GPP (3GPP Anchor) & inter-3GPP (SAE Anchor) mobility
 - Physical mappings of functions still undecided; *lots undecided!*

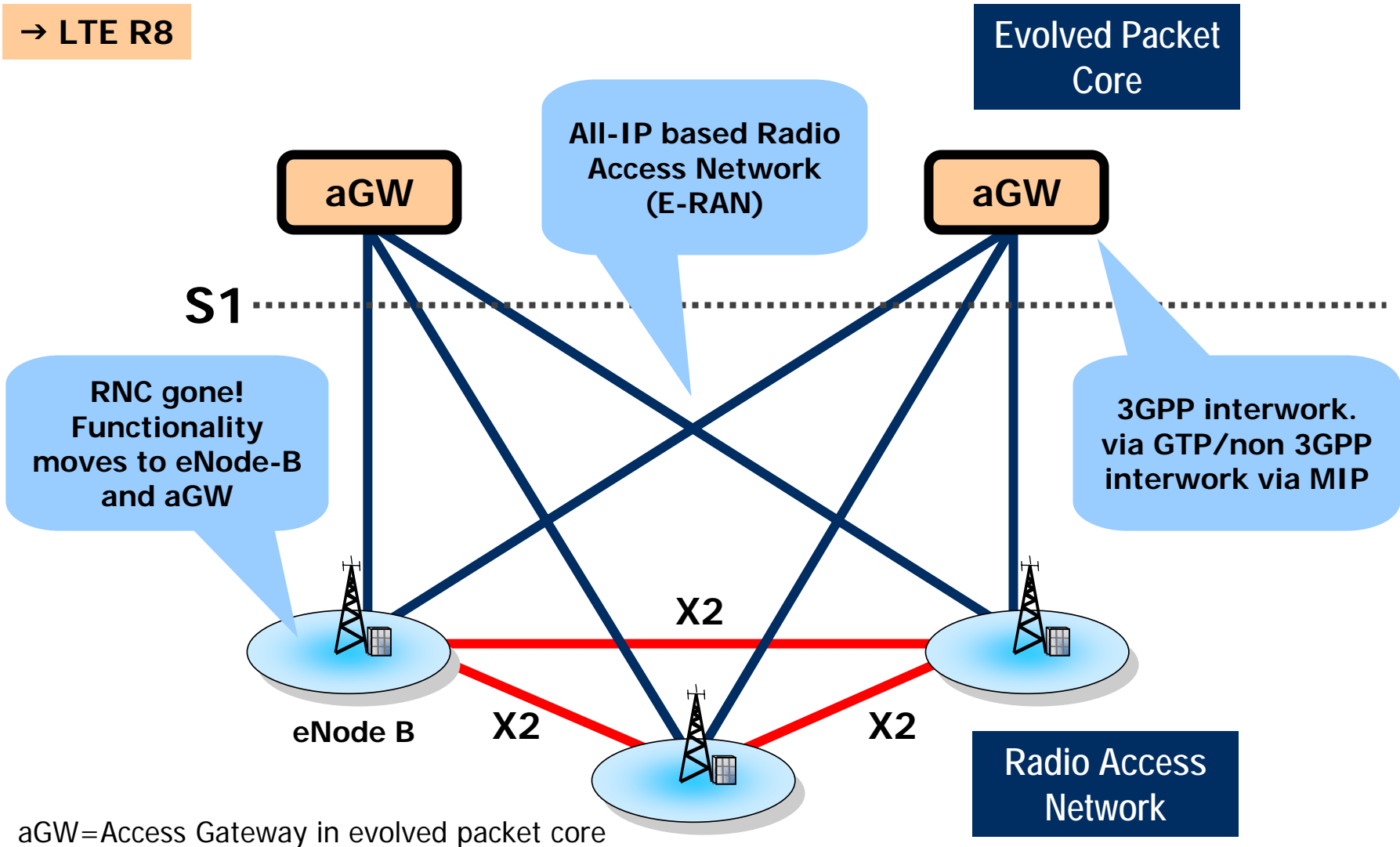
Completing the picture: System interworking



- **3GPP Interworking:**
 - **3GPP Anchor** functional entity introduced for handling U-plane mobility between 2G/3G access & LTE
 - Interworking architecture aligned with legacy approaches (i.e. 2G↔3G)
 - Mobility I/F between the 2G/3G SGSN & aGW based on evolved GTP
- **Non-3GPP Interworking:**
 - **SAE Anchor** functional entity introduced for handling U-plane mobility between non-3GPP access & LTE
 - Mobility I/F between non-3GPP access & aGW based on Mobile IP

Architecture summary:

→ LTE R8





So, perhaps more an evolution than revolution

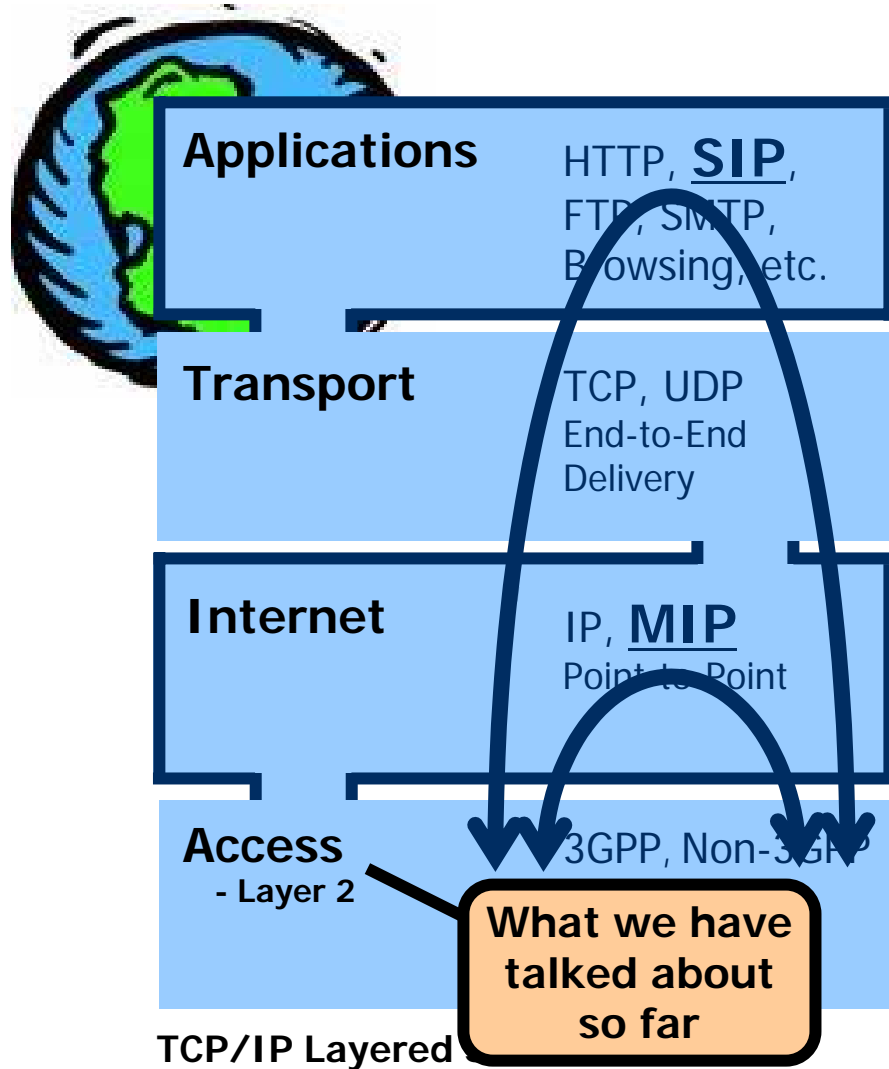
- Should not be a surprise it is in the name after all!
- Many refinements central to LTE/SAE have been trickling in over multiple releases
- Some observations:
 - Architecture is flatter; Not flat
 - Flat = One node between the Radio & the World (think WiFi)
 - Emerging architecture would suggest a multi-node configuration is most likely (think SGSN/GGSN)
 - Architecture is certainly more IP; Not All-IP
 - 3GPP interfaces remain very 3GPP specific (e.g. GTP)
 - Non 3GPP interface support of Mobile IP represents a positive move in a true All-IP direction



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MOBILITY thinking is evolving too



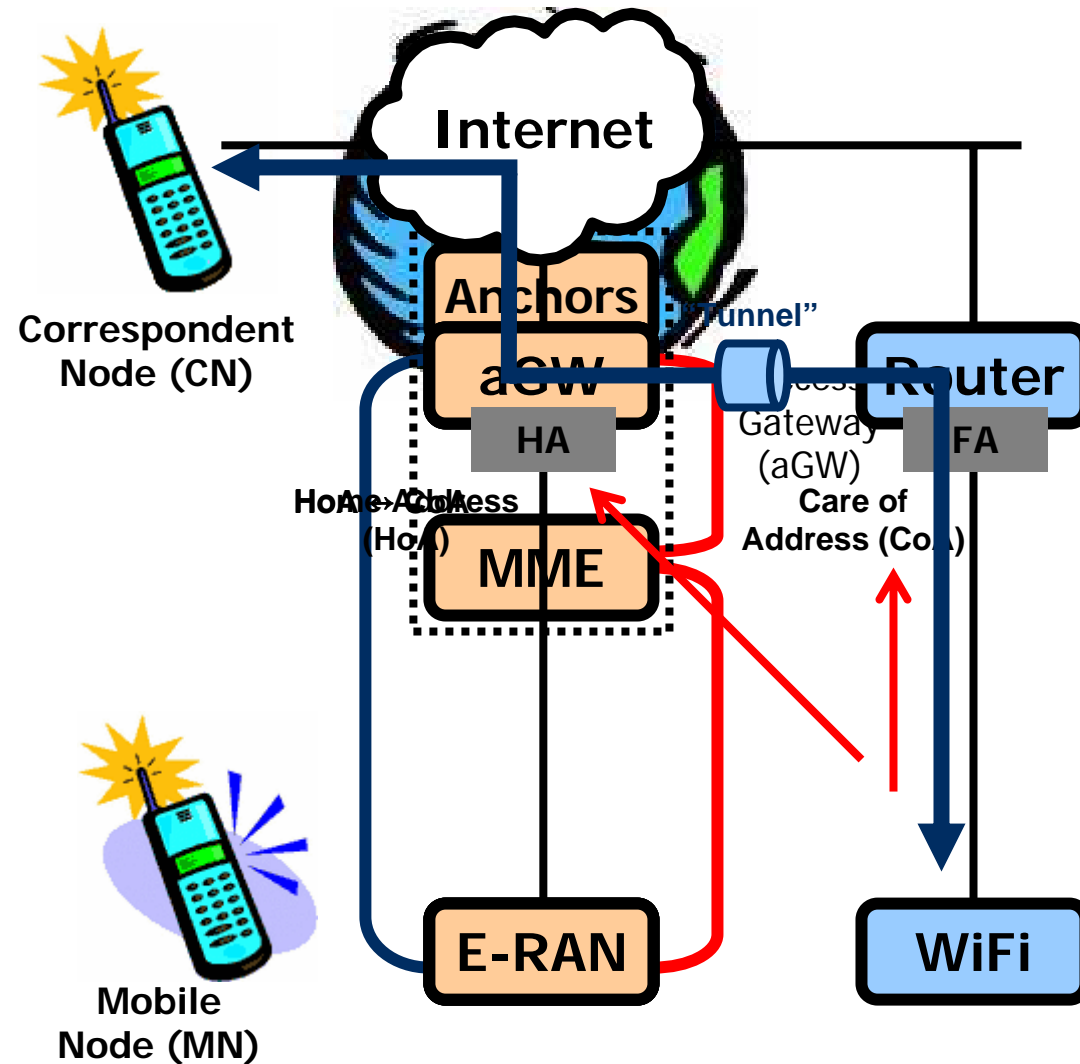
- MIP & SIP will provide core mobility in All-IP world
 - MIP based mobility
 - IP mobility
 - SIP based mobility
 - Personal mobility
 - Not a big leap to IP mobility
 - One big plus -
 - Application knowledge!
 - A bit of both quite likely
 - Challenges similar



Digging a little deeper with Mobile IP

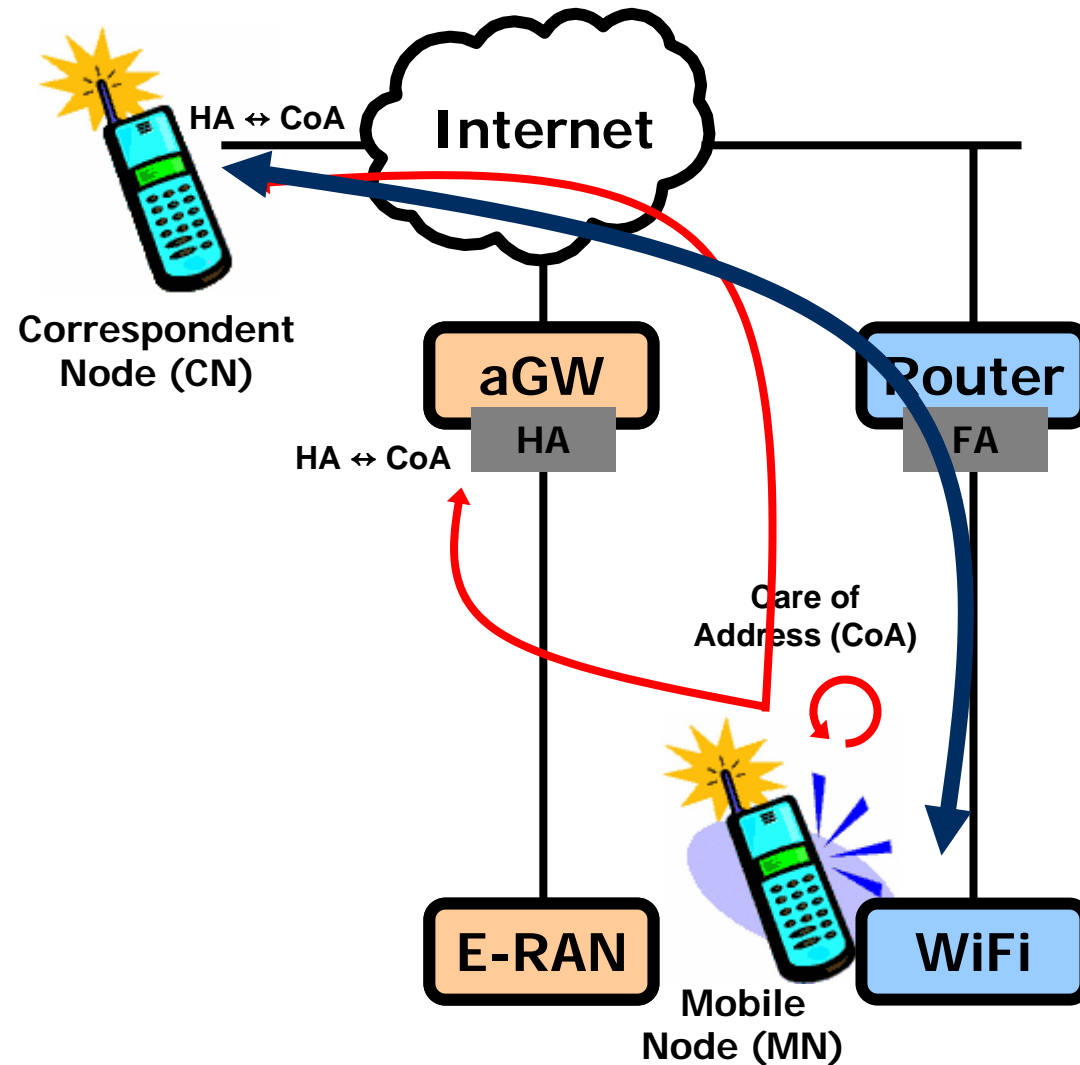
- **Network layer** solution to mobility on internet
 - Mobile node & Mobility servers handle mobility
 - Intermediate nodes are not involved
 - Corresponding nodes run normal IPv4 or IPv6 stacks
 - Independent of Access technology
 - Used in conjunction with link layer mobility
- Two flavors: Mobile IPv4 & Mobile IPv6
 - MIPv6 fixes the bigger problems with MIPv4
 - *Devil is in the details; not going there today!*
- Not designed to solve all mobility problems
 - QoS support not part of MIP; Any flavor

Digging a little deeper with Mobile IP (v4)



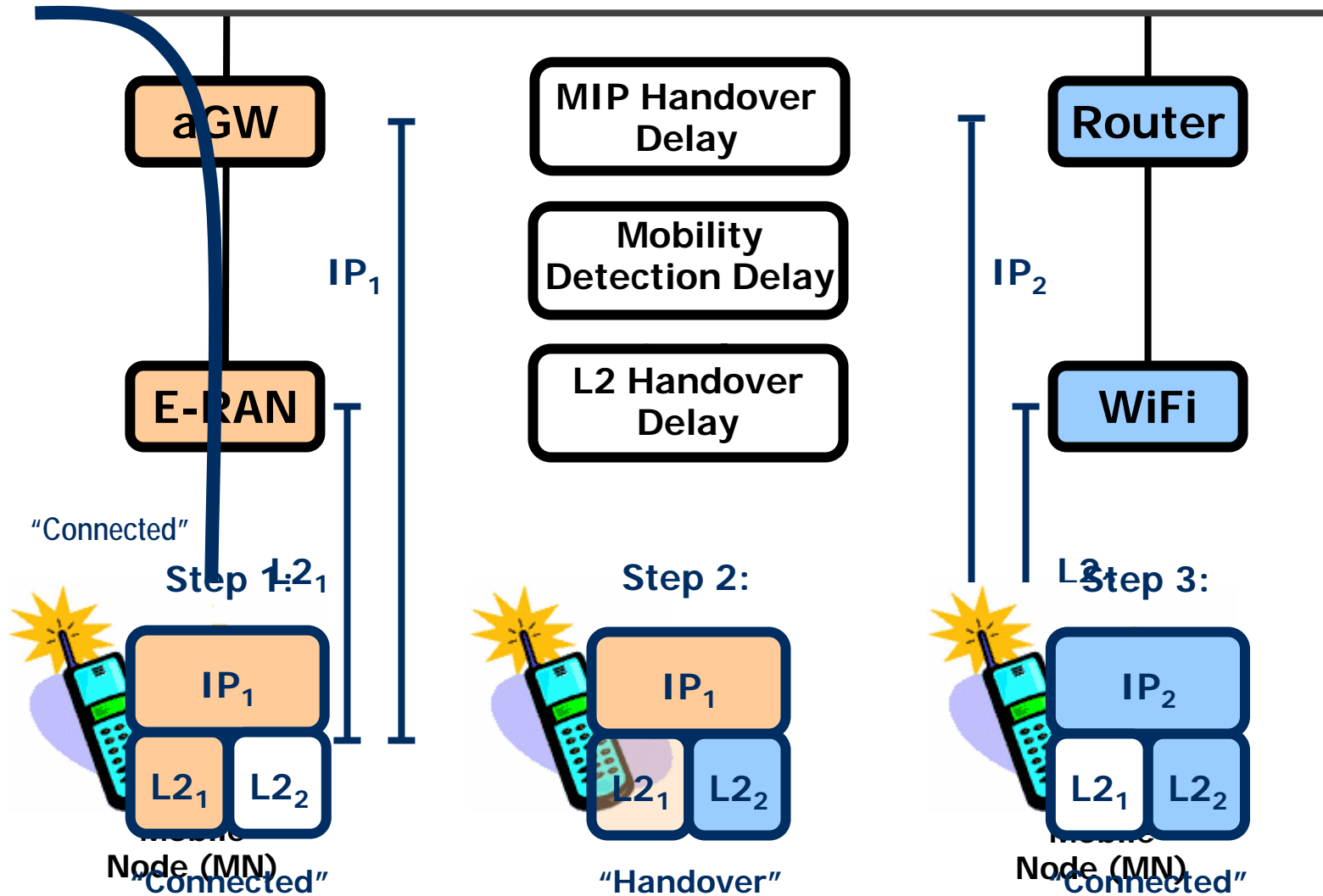
- Basic MIPv4 issues:
 - Triangular routing
 - All traffic routed through Home Agent
 - Delay/ Point of failure
 - Reverse Tunneling
 - Firewalls force uplink traffic back through HA
 - Foreign Agent
 - Functionality overhead
 - Handover delay
 - Some problems in scope
 - Others not

Mobile IP v6 fixes the bigger problems but not all



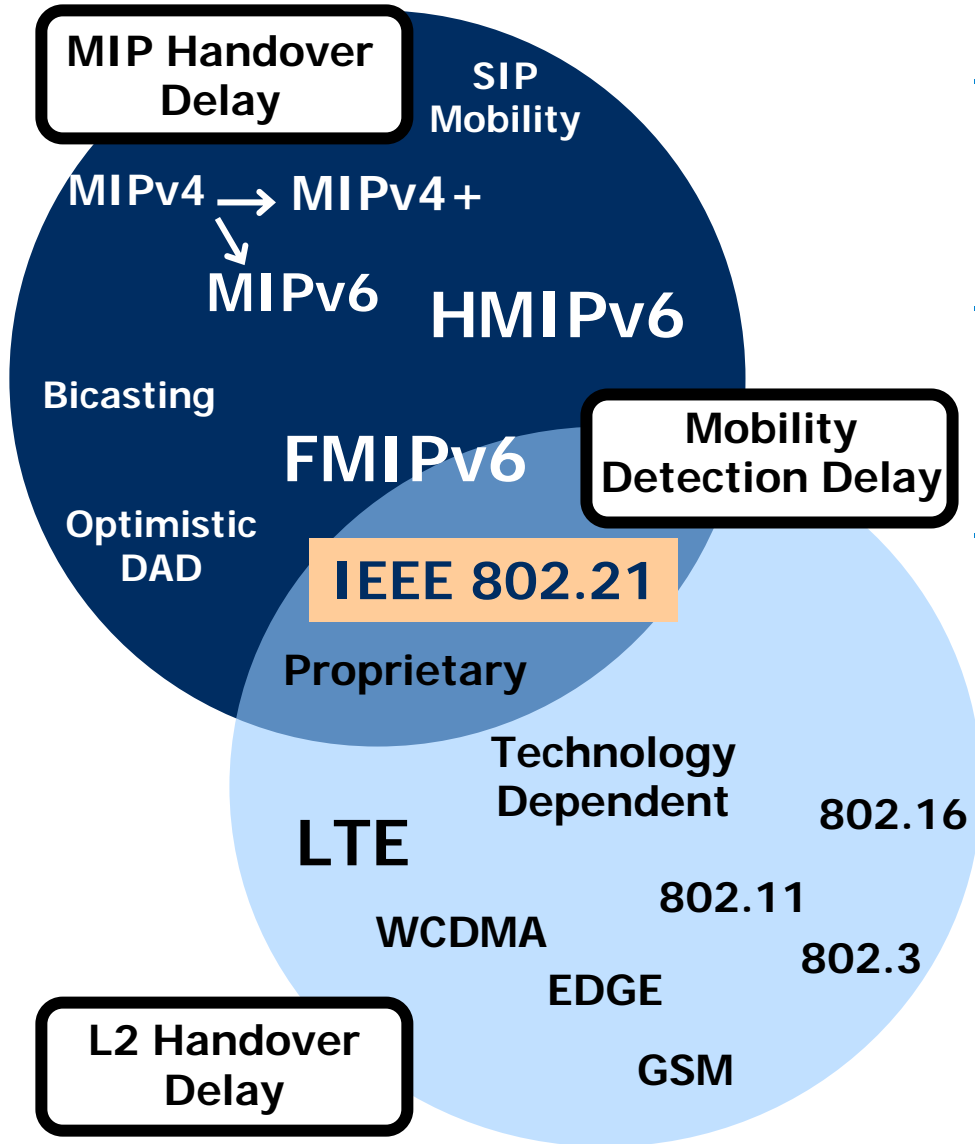
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Understanding the handover delay challenge





A taxonomy of solutions with one gap



- L2 Handover delay
 - Time to bring target link layer into service
- Mobility detection
 - Time to detect movement & form/test new CoA
- MIP Handover delay
 - Time to register new CoA with Home Agent & Correspondent Node



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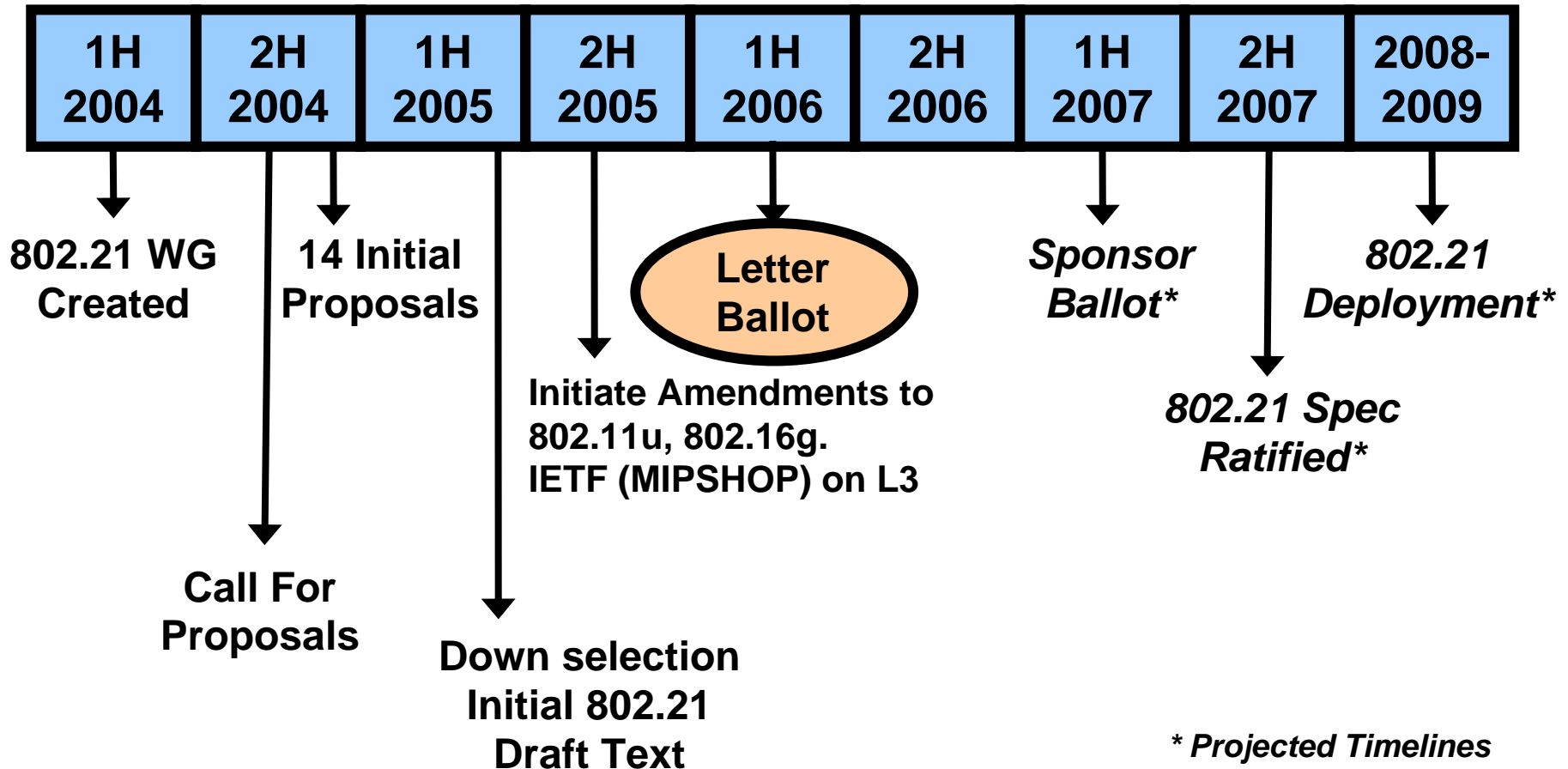
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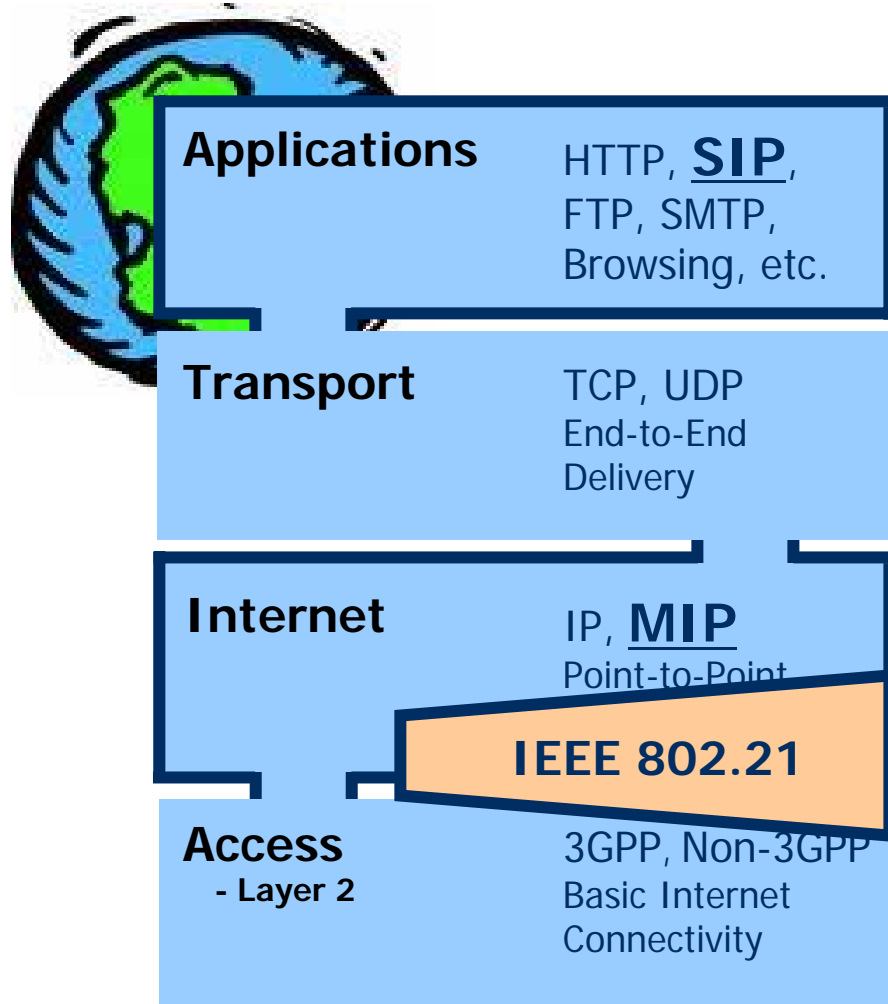
IEEE 802.21: Media Independent Handover

- My favorite one line descriptions:
 - 802.21 is an **enabler** technology to make Mobile IP work faster
 - It is a **toolbox** standard for enabling seamless mobility in All-IP networks
 - 802.21 is an **abstraction** layer between the access technology & the global mobility solution
 - It is a media independent **trigger model** to drive handover in heterogeneous systems

IEEE 802.21: Quick history lesson



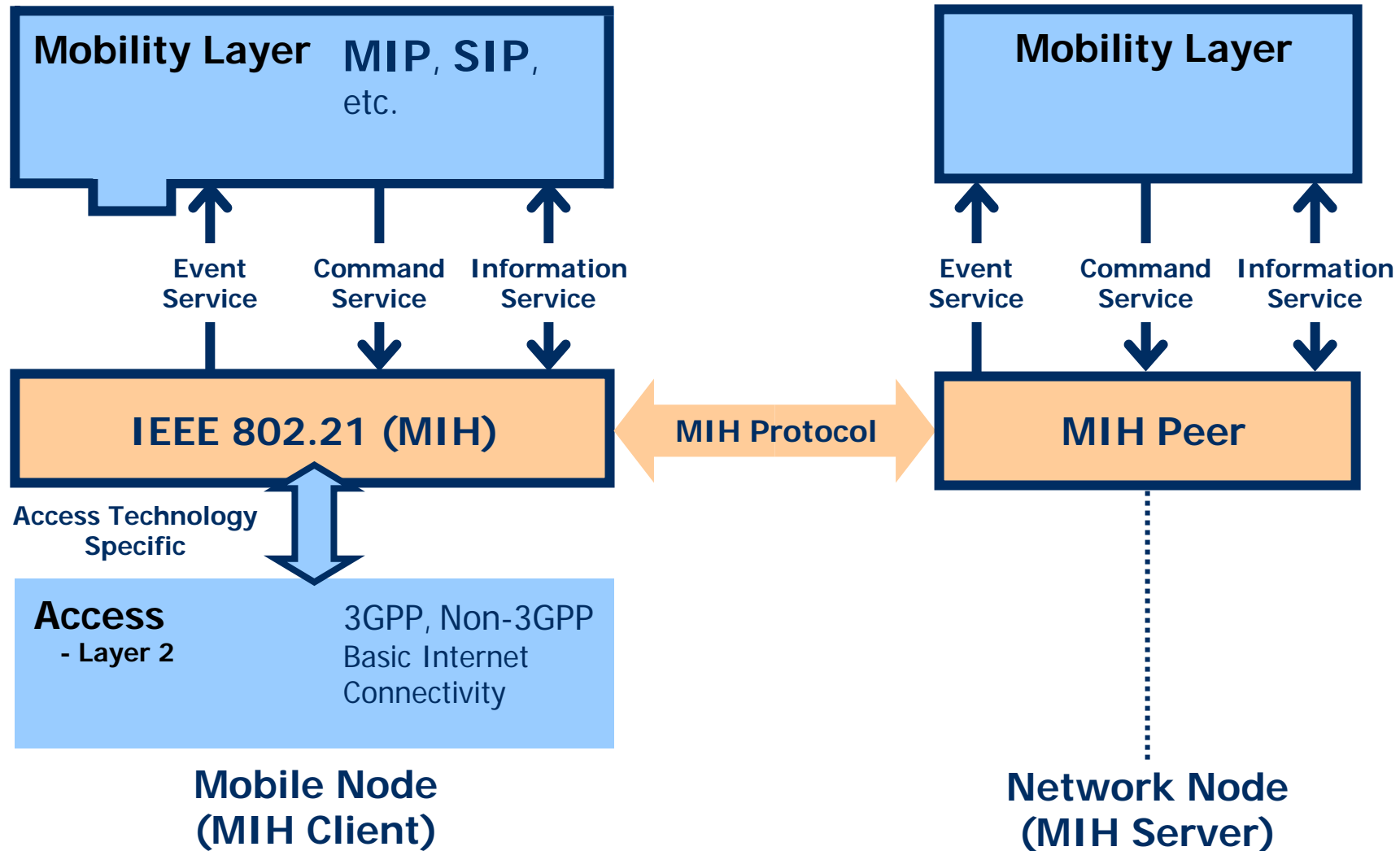
IEEE 802.21: A bit more than mobility detection



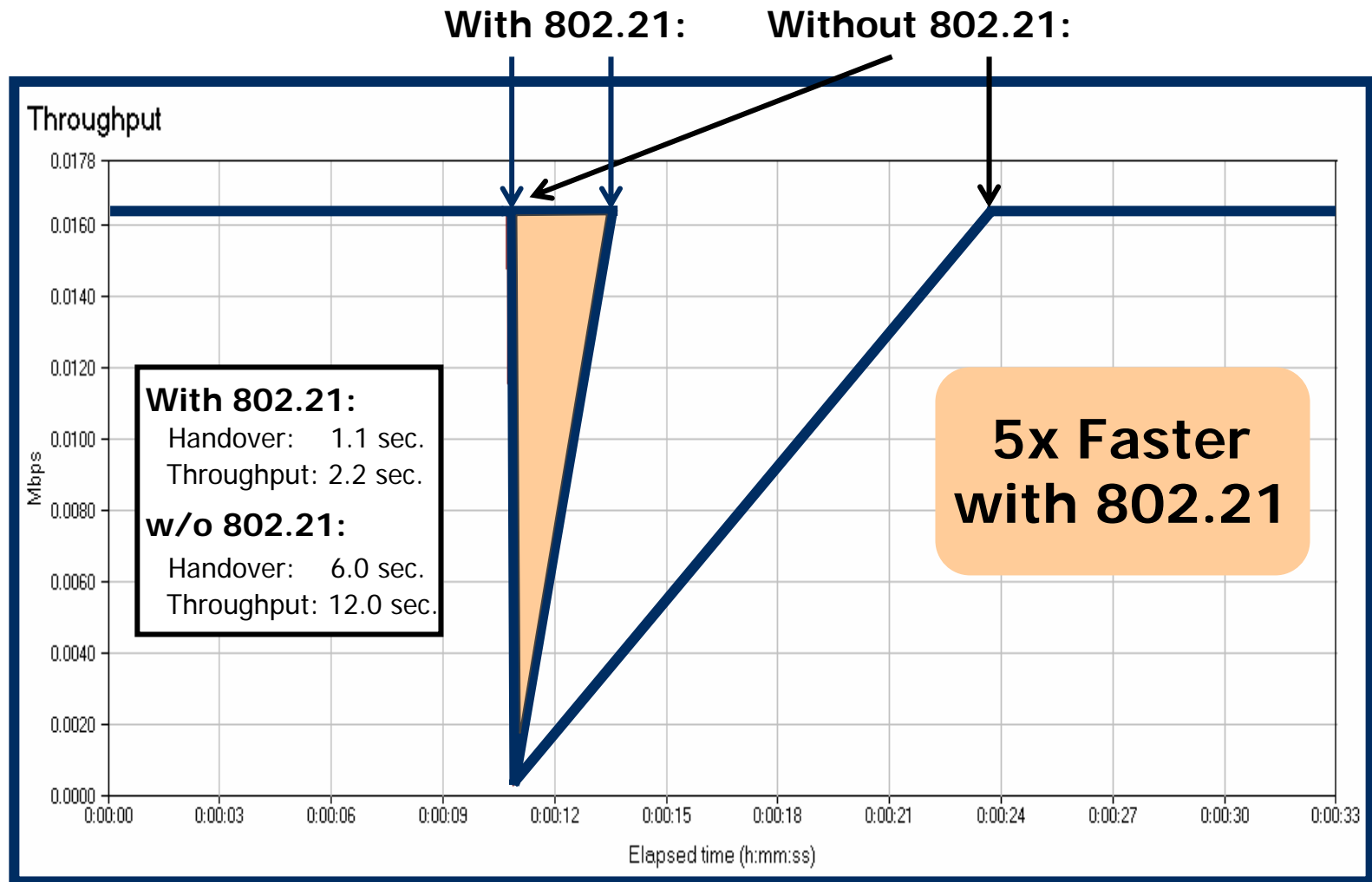
TCP/IP Layered Stack Model

- Services to upper layers
 - Event service
 - Prediction, *Detection*
 - Link failing, link down
 - Command service
 - Configuration, Control
 - Scan link, Switch link
 - Information service
 - Discovery, Selection
 - Network info, PoA info

IEEE 802.21: Architectural basics

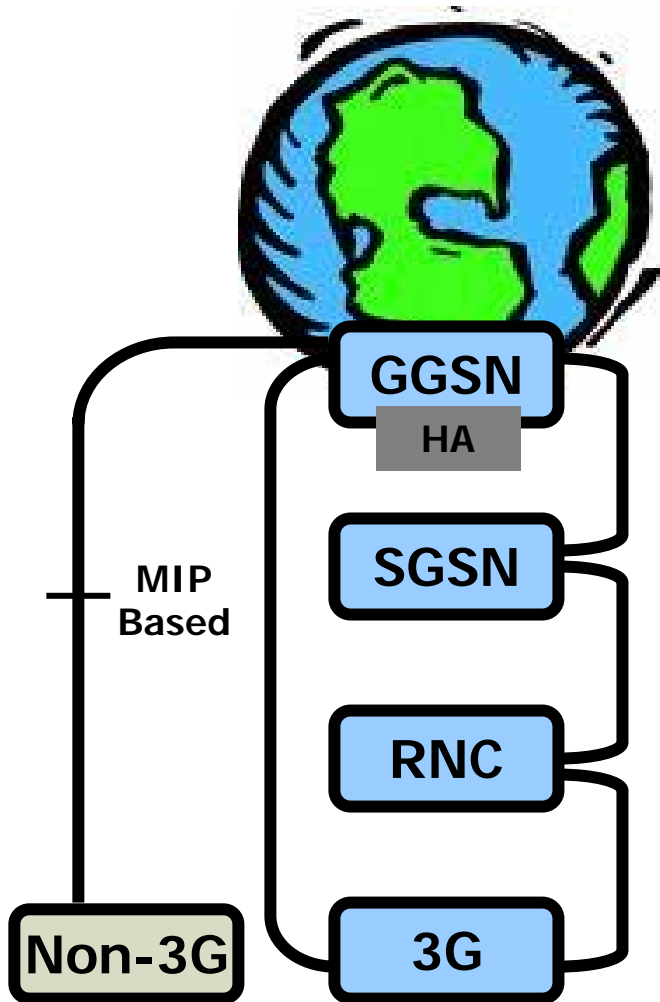


IEEE 802.21: Dramatic performance improvement



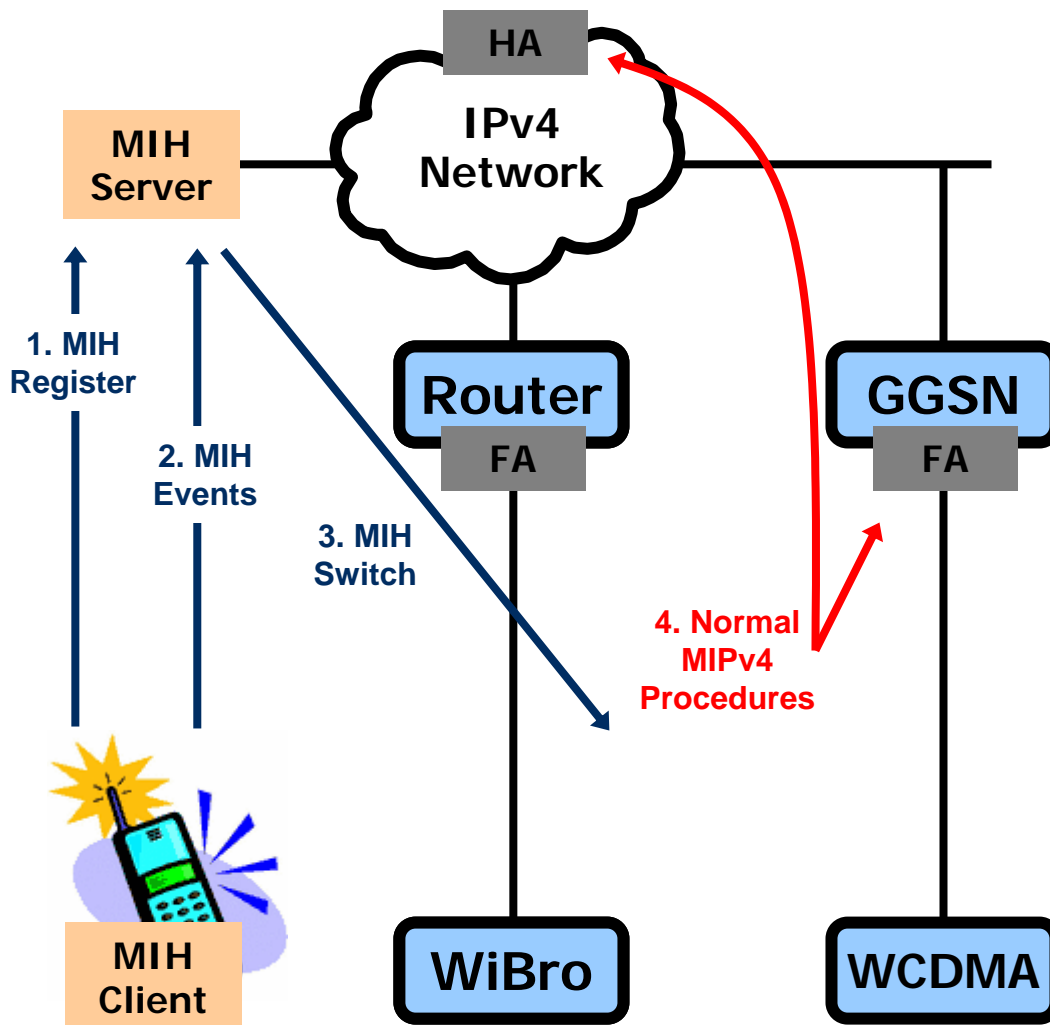
MIPv6 break-before-make handover Lab experiment

IEEE 802.21: Not just a solution for LTE



- Recall, a lot of LTE/SAE is now!
- MIP/SIP based interworking of non-3GPP technologies quite common e.g.
 - I-WLAN, VCC
- IEEE 802.21 can bring significant performance improvements
- InterDigital® is working with SK Telecom on such a mobility solution for WCDMA-WiBro session continuity

IEEE 802.21: InterDigital[®] working with SKT



- Network controlled mode:
 - At startup MIH-Client registers with MIH-server
 - MIH-server provides Client with a L2 event report policy
 - Upon policy threshold event MIH-server sends handover command
 - MIPv4 procedures triggered via WCDMA so minimizing “detection delay”



IEEE 802.21: Benefits summary

- Standardized solution
 - Fills an important “gap” in the All-IP systems taxonomy
- Enhanced user experience
 - Minimizes service interruption
 - Provides QoS continuity
- Ease of implementation
 - Thin software client on terminals
 - Lots of options for the server component
- Deployment flexibility
 - Network or client controlled modes
 - No radio access network modifications



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Conclusions/Key takeaways

- Mobility is evolving with LTE
 - Homogenous path – more of the same
 - Heterogeneous path – embracing All-IP direction
- Path to seamless will be a bumpy one
 - Lots of technologies & SDO coordination required
- 802.21 is an important part of this effort
 - Not a mainstream LTE block - doesn't have to be!
 - Significant performance improvements possible now
 - Carriers: Ask about 802.21 in your MIP/SIP mobility solutions
 - Vendors: Ask how can you differentiate with 802.21



Thank You

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