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Title	Architectural Attributes of an IP-based Cellular Network, and Their Impact on MBWA Design	
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Re:	IEEE 802.20 Session#1 Call for Contributions	
Abstract	This contribution discusses the architecture of an IP-based cellular network	
Purpose	For informational use only	
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Architectural Attributes of an IP-based Cellular Network, and Their Impact on MBWA Design

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Enabling a Mobile Internet

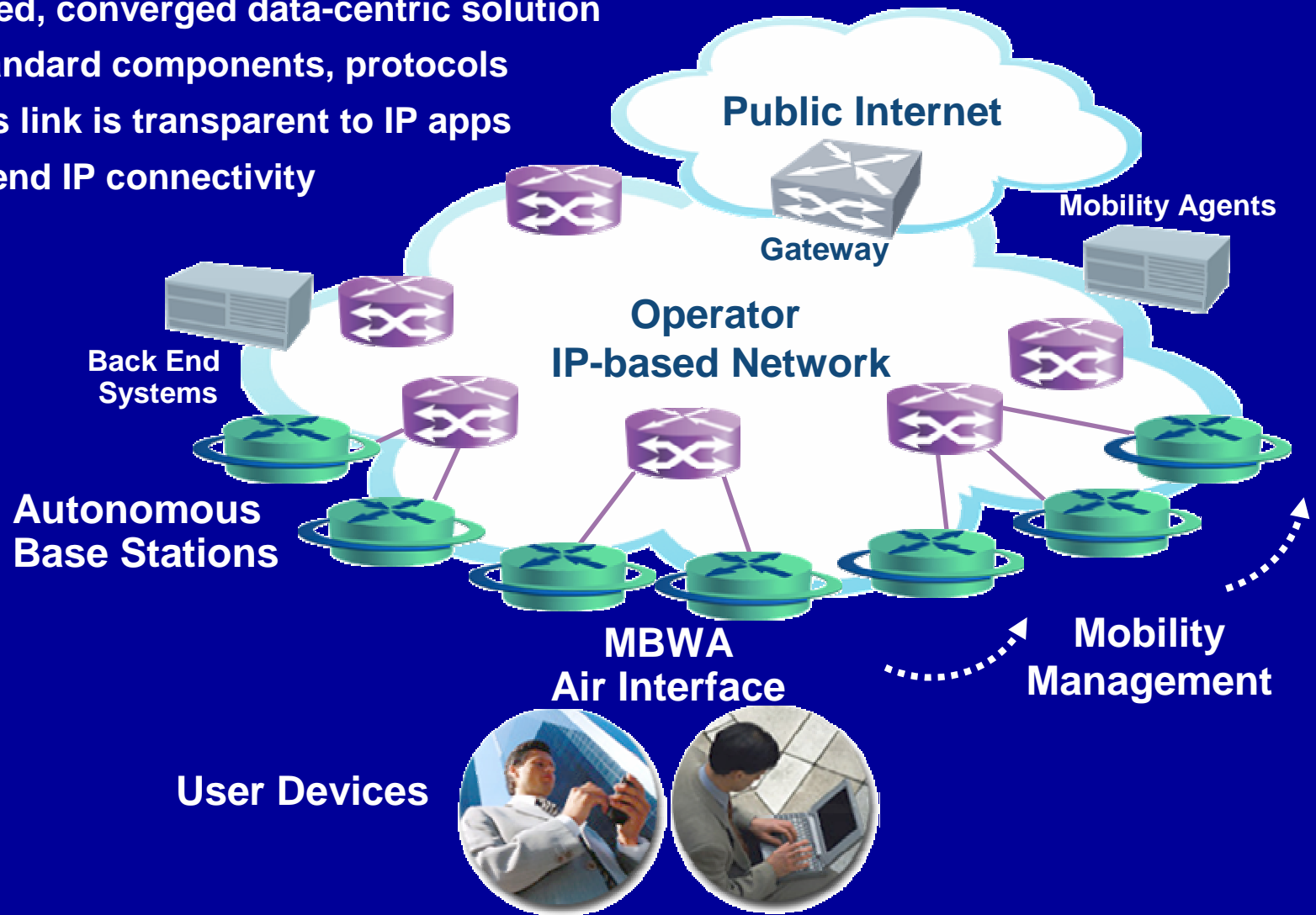
- Enable cellular access to be like any other form of broadband Internet access, e.g.,
 - DSL
 - Cable
 - Leased Lines
 - Ethernet
- Simply allow the Internet Protocol suite to use link layer capabilities and control its resources

Simply Deliver Native IP Traffic

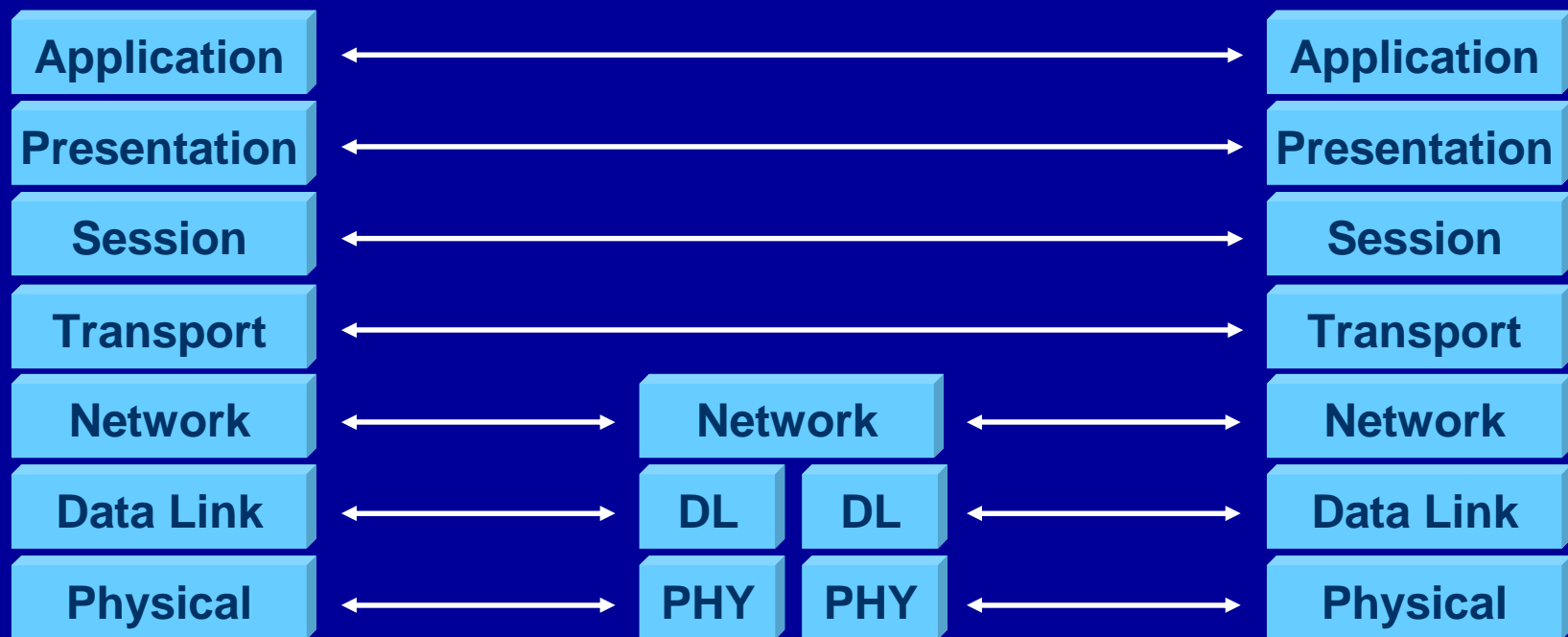
- MBWA air link viewed simply as another link in an IP inter-network
 - Natively carry IP over the MBWA link layer
 - Exploit all existing IP features / capabilities
- IP protocols and apps flow across link without modification, e.g.,
 - TCP works on standard, unmodified IP host stacks as in wired networks
 - No specialized gateways required

A 'True' All-IP Network

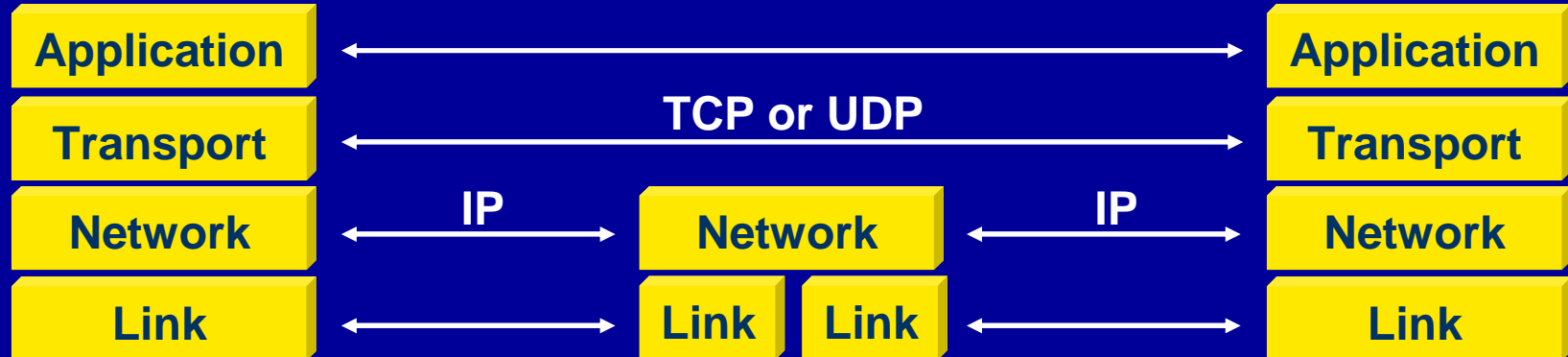
- Optimized, converged data-centric solution
- IETF standard components, protocols
- Wireless link is transparent to IP apps
- End-to-end IP connectivity



Protocol Layering: ISO OSI 7-Layer Model

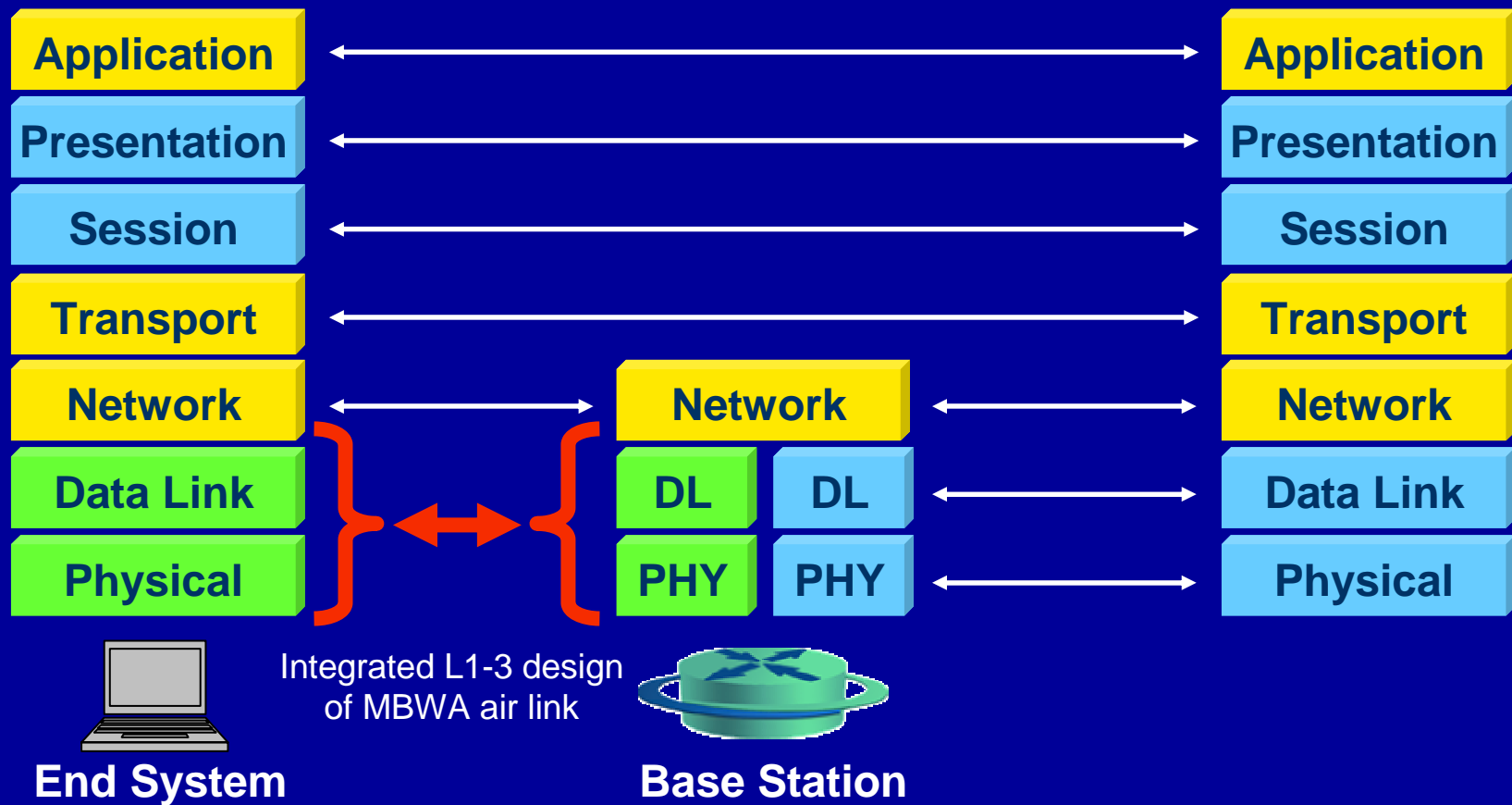


Protocol Layering: TCP/IP 4-Layer Model



Optimized Layering for MBWA

- Vertically-integrated 'design' of Layers 1 to 3
- Respect horizontal layering above IP layer



Base Station as IP Access Router



Notes:

- 1) IP flows are *unidirectional*
- 2) IP links operate *independently*

- The base station should be an IP Router
 - One or more wireless interfaces (carriers/sectors)
 - One or more wired interfaces (backhaul/sidehaul)
 - Controls network access to IP services
 - IP QoS directly on air and backhaul interfaces
 - Native IP multicast delivery to base station and over the air
- Flexible, scalable architecture
- Enables backhaul-agnostic base stations!

Mobile as IP Host



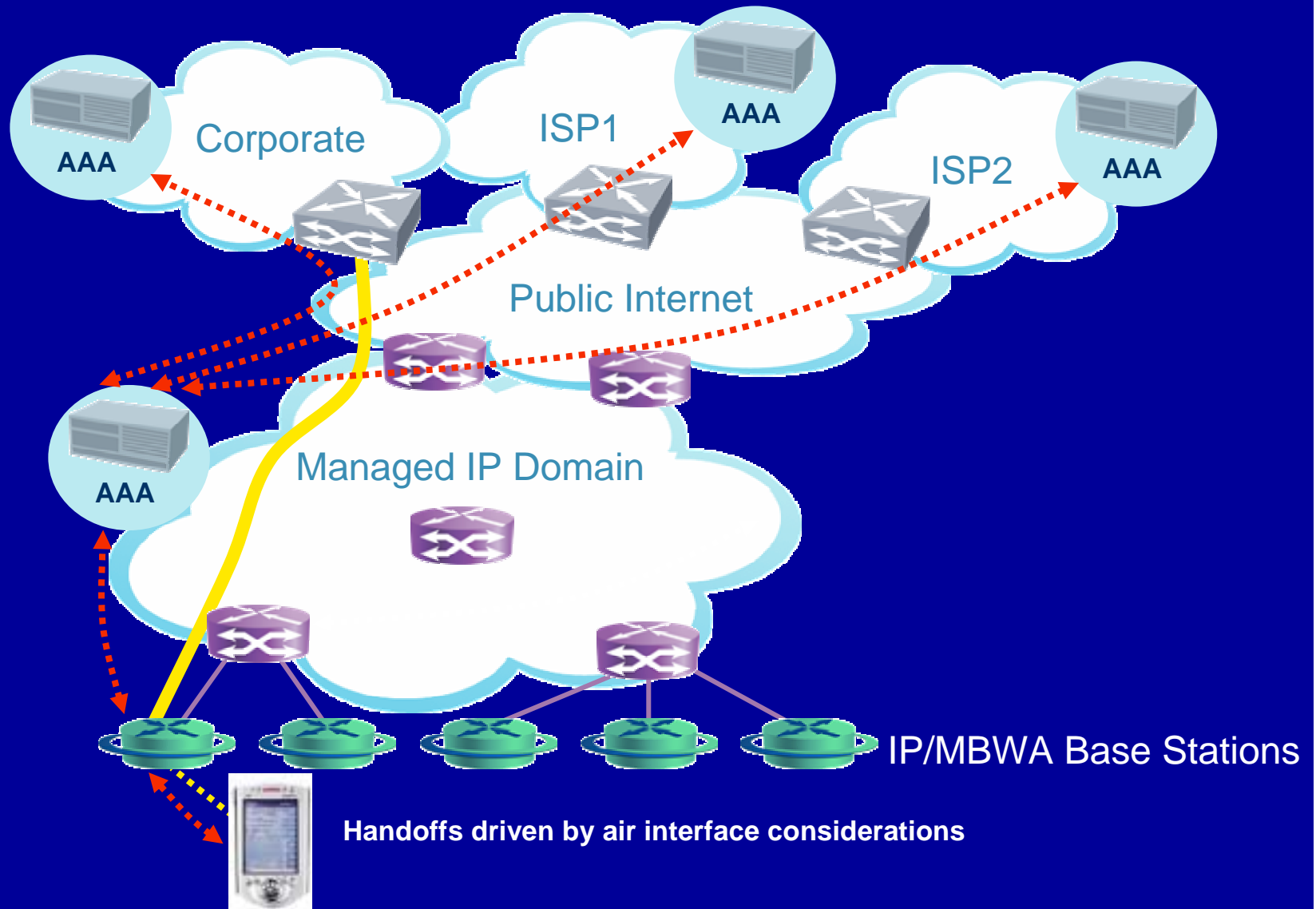
Note: IP design paradigm puts *complexity in end system* (i.e., host) as opposed to network

- The mobile should be an IP Host
 - Intelligent mobile
 - Mobile controlled handoff
 - Applications may or may not be mobility-aware
- Link layer triggers
 - Enhance higher layer mobility control and handoff mechanisms
 - Enables mobility-aware applications

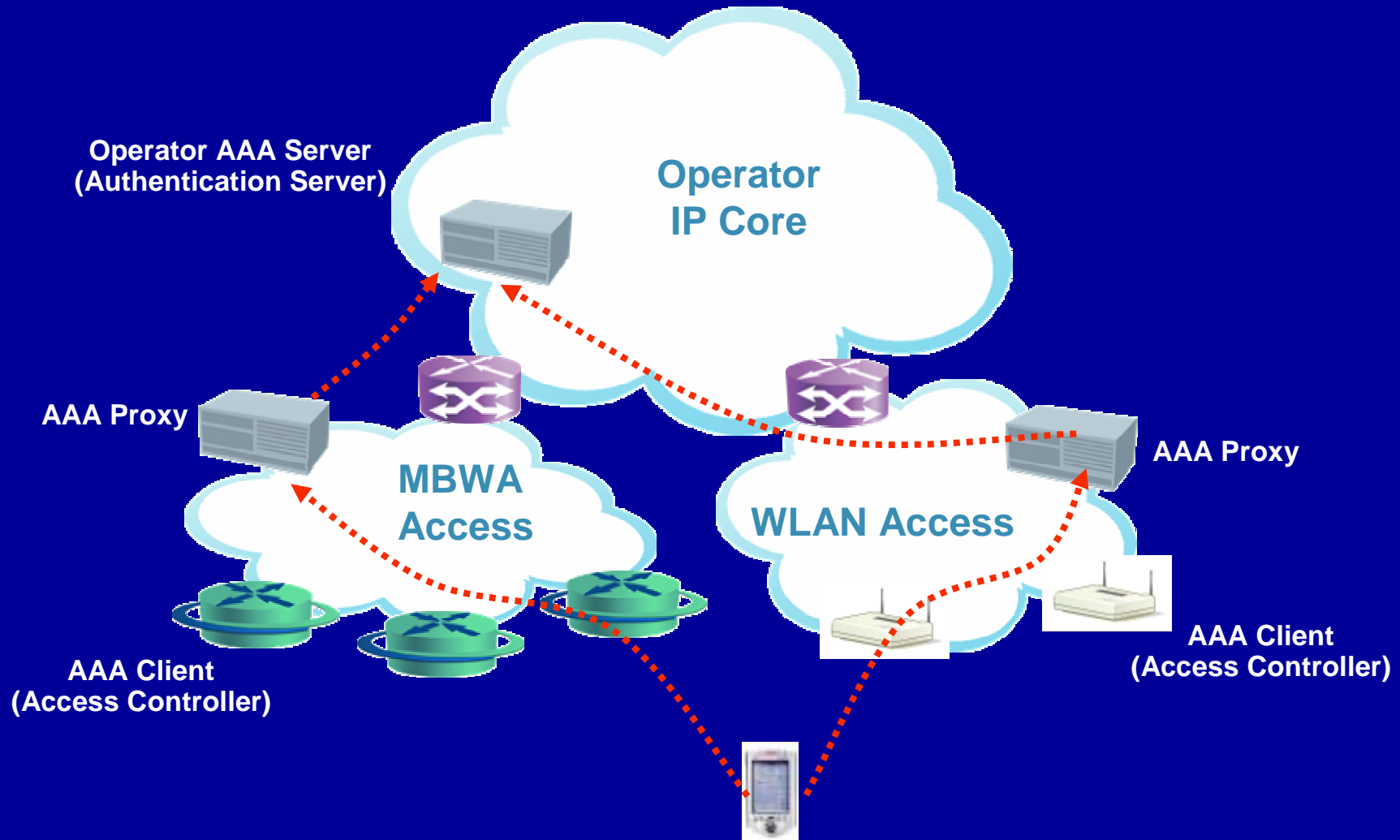
AAA Access Control Advantages

- AAA-based Control plane
 - Globally deployed
 - Enables inter-technology, inter-domain, inter-operator roaming/service control
- Extensible Authentication Protocol (EAP)
 - Applicable to variety of link layer technologies
 - Provides flexibility for incorporating existing and future security algorithms
 - Need support for EAP encapsulation over MBWA air link

AAA Roaming/Mobility Models



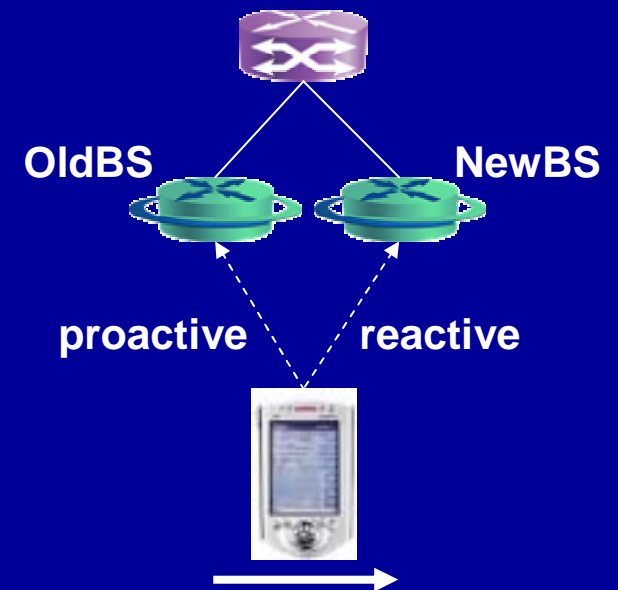
Inter-technology AAA Roaming



Typically 'policy-based' handoffs

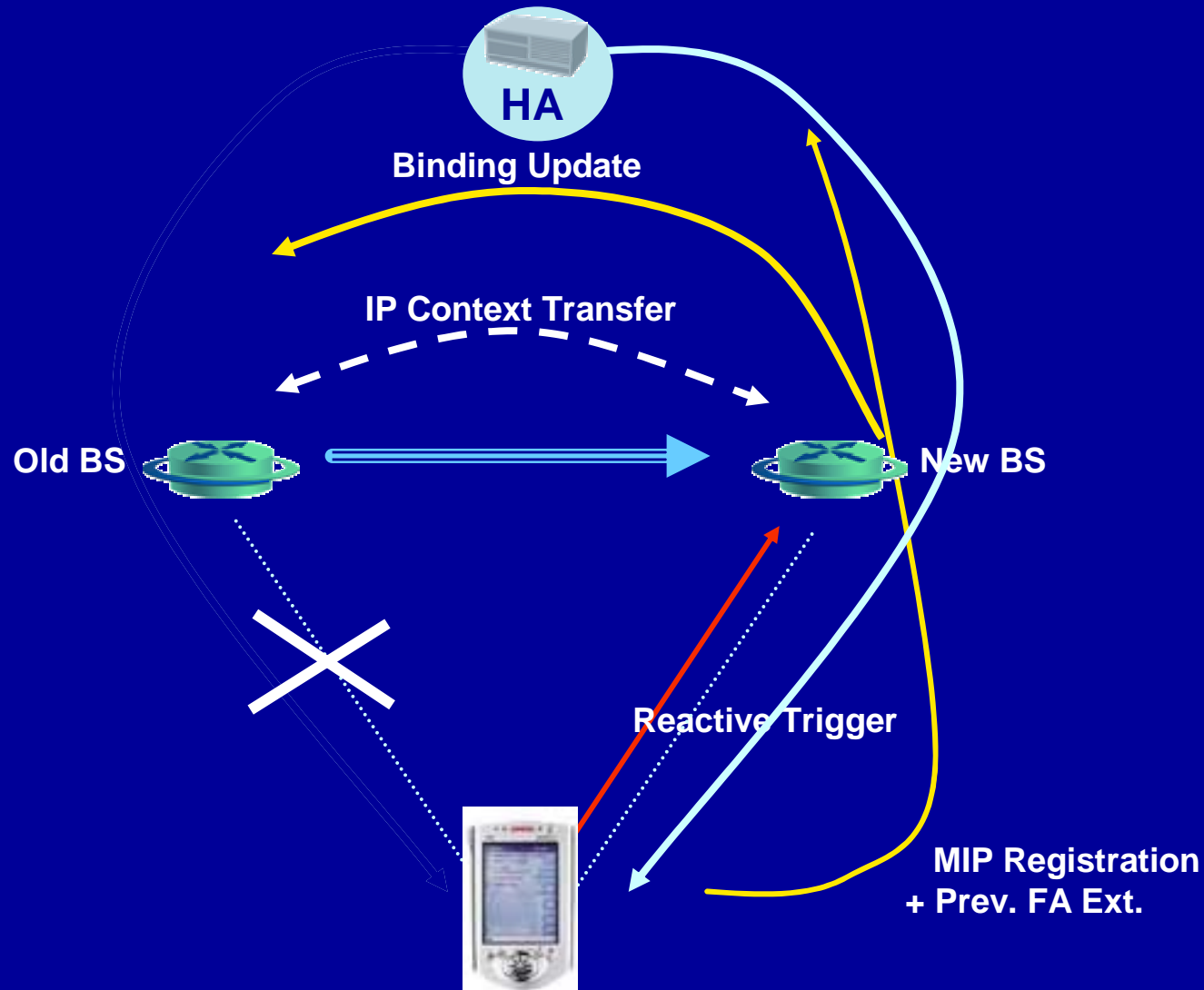
IP Mobility Management

- Base station as IP router implies:
 - Inter-BS signaling and forwarding via IP
 - Inter-BS Handoff at IP layer
 - Mobile IP near-term solution
 - Alternatives emerging (e.g., host routing)
 - Inter-BS Context Transfer at IP layer
- Mobile as IP host implies:
 - Mobile controlled handoff
- Link layer handoff triggers
 - Enable enhanced handoff
 - Proactive trigger at Old BS
 - Reactive trigger at New BS



An Enhanced MIP-Based Handoff

Reactive Make-Before-Break



Motivation for Paging

Small
lightweight
devices



Long
operational
lifetime



Power
Conservation



Always-on
reachability



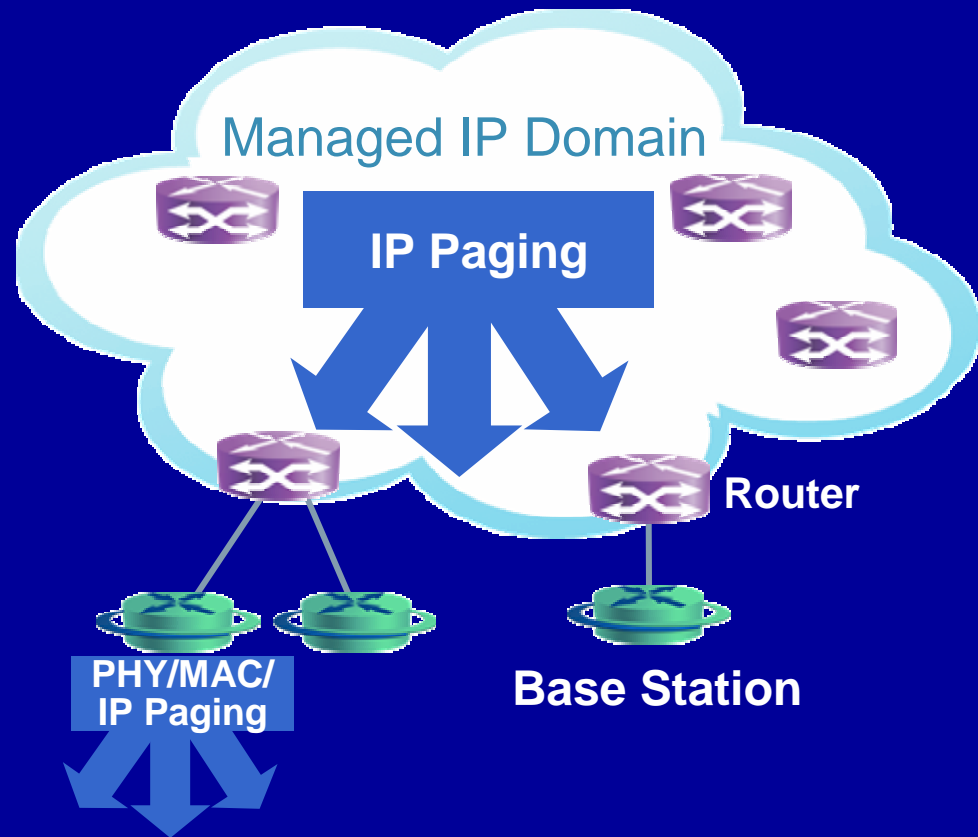
Paging
Support



How do you
like my new
wireless PDA?

System Level Paging Architecture

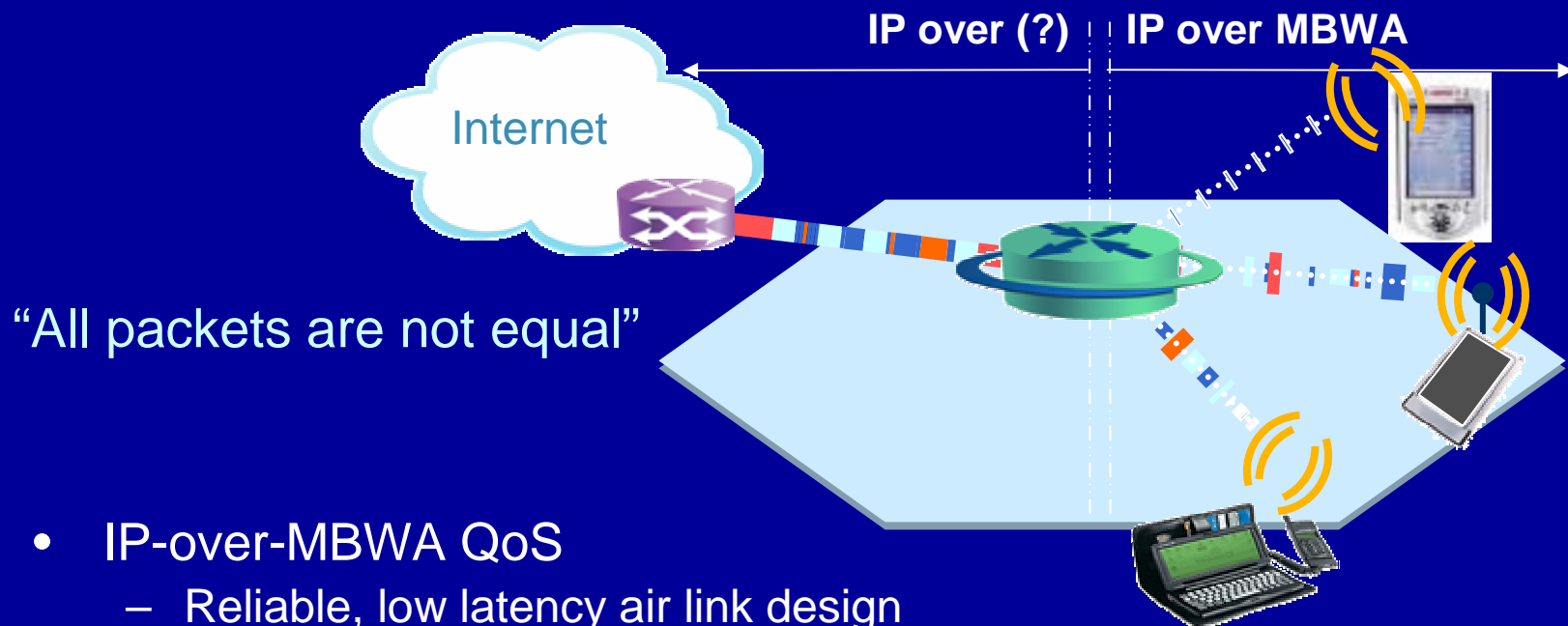
- IP-based page signaling to/from base stations
- IP/MAC/PHY layer paging within a cell/sector
 - Efficient yet flexible MAC/PHY paging mechanisms
 - Support IP-based paging policies



MBWA Paging Characteristics

- Between “Active” sessions, mobile should enter “Sleep” mode to reduce power consumption.
- While in Sleep mode, mobile should periodically listen for pages that indicate need to return to Active mode.
- Should support flexibility regarding system level paging architecture, e.g.,
 - Support IP-based paging policies
 - Mapping of higher layer identifiers to MBWA paging IDs

QoS: Maximizing Spectrum Utility



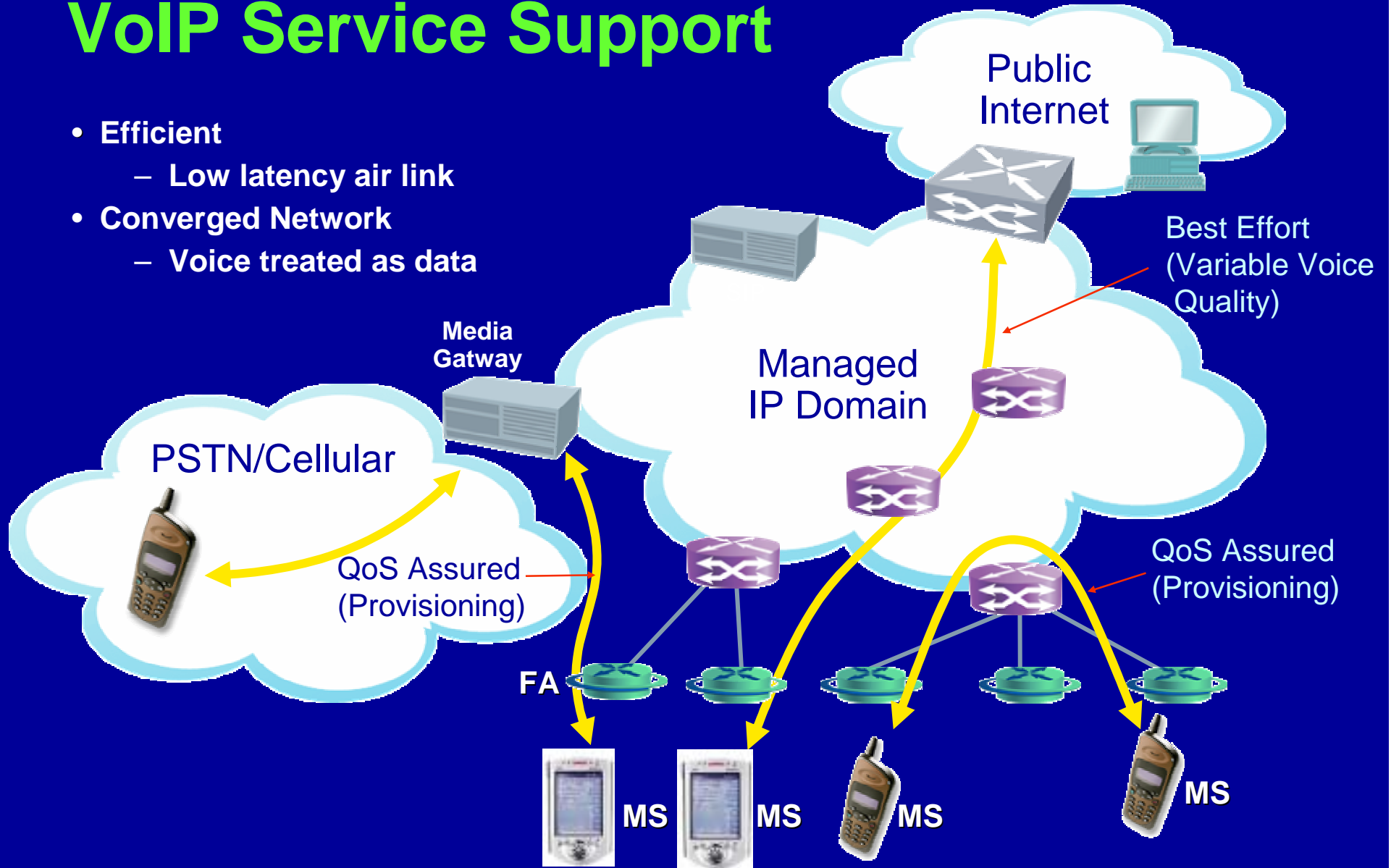
- IP-over-MBWA QoS
 - Reliable, low latency air link design
 - Fully-scheduled, air link resource
 - Packet-aware air link interface
 - Joint optimization of IP service admission control/QoS scheduling across IP, MAC and PHY layer constraints
- Differentiated Services (DiffServ) model
 - Flexibility to implement various Per Hop Behaviors (PHBs)
 - Maximize spectrum utility, not just bits/hertz

IP Application Trends and Impact on MBWA Design

- Trend toward 'converged' networks
 - Data-centric
 - Voice as Data
- Trend towards 'peer-to-peer' IP apps
 - E.g., voice, push-to-talk, instant messaging, gaming, etc.
 - Suggest down/up ratio should be reasonably symmetric
- Continuing need for 'real-time' communications
 - 'Interactive' data exchange
 - Reliable delivery at very low latency (real-time)

VoIP Service Support

- Efficient
 - Low latency air link
- Converged Network
 - Voice treated as data



IP Multicast Delivery Support



Reliable Unicast(s)



Broadcast/Multicast



Mixed Delivery

- IP Multicast ideal for push-to-talk, interactive gaming, video, focused advertisements, subscription/location based services, etc.
- MBWA IP multicast service delivery options
 - Reliable unicasts (point-to-multipoint)
 - Low-loss multicast (broadcast)
- MBWA multicast (broadcast) support
 - Multicast/broadcast MAC address space
 - Sufficient reliability of broadcast transmission
 - Scheduling freedom (simultaneous unicast/multicast delivery)

Architectural Attributes

- Optimized layering design
- Base stations are IP routers
- Mobiles are IP hosts
- AAA-based access control
- IP handoff & context transfer
- Combination of IP and MBWA paging
- MBWA support for key IP features...
 - IP QoS
 - IP multicast delivery

Summary

- True IP-based Cellular Network:
 - Enable use of standard IP technology
 - Adapt Wireless to the Internet (not vice-versa)
 - Mobile and fixed Internet components unchanged
 - Existing IP protocols/apps work without modification
 - Converged Network
- Mobile controlled IP handoff
- Enable key IP features (e.g., QoS, multicast)
- Maximize spectrum utility, not just bits/hertz

A Final Thought...

Many have tried to adapt IP for wireless links with only limited success...

given the choice, its better to design a wireless link that is well-suited for IP.



Questions?