



CDMA Systems Evolution to VoIP

- Network Migration
- Vocoder Technologies
- Standards Support

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CDG Questions

#15, How could IMS/MMD architecture be leveraged to a competitive advantage ...

#18, What migration strategy would you recommend when transitioning from CS ...

Industry-Wide Convergence



- **Device Convergence**

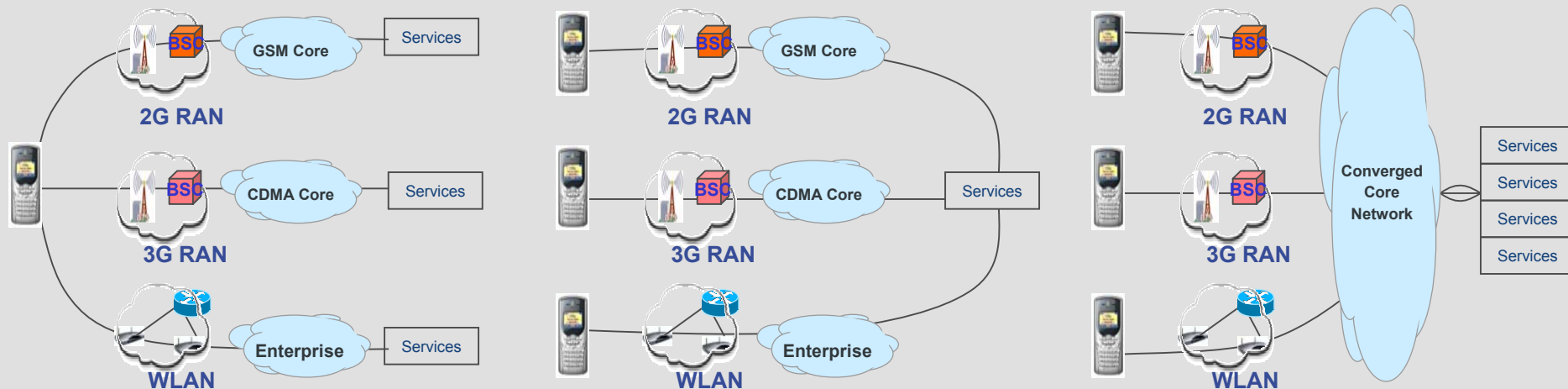
- **1 device**, accessing multiple services, via multiple access technologies

- **Service Convergence**

- **1 service**, serving multiple devices, over multiple access technologies.

- **Network Convergence**

- **1 unified core**, connecting multiple services to multiple devices over multiple access mechanisms





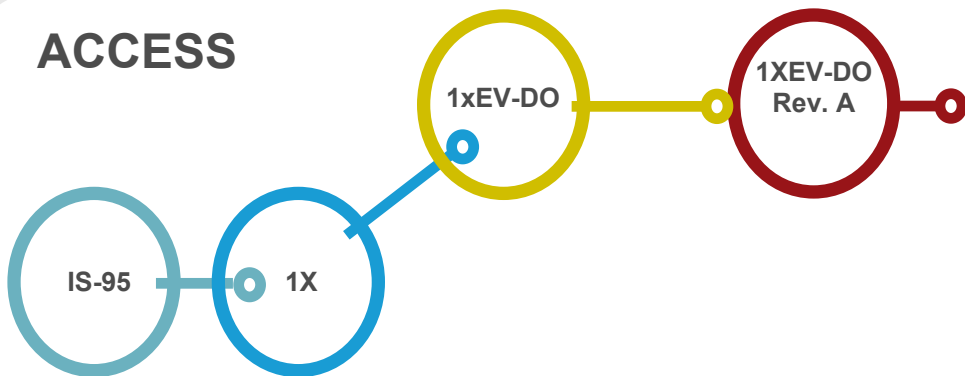
Competitive Advantage through Rich Services & Applications



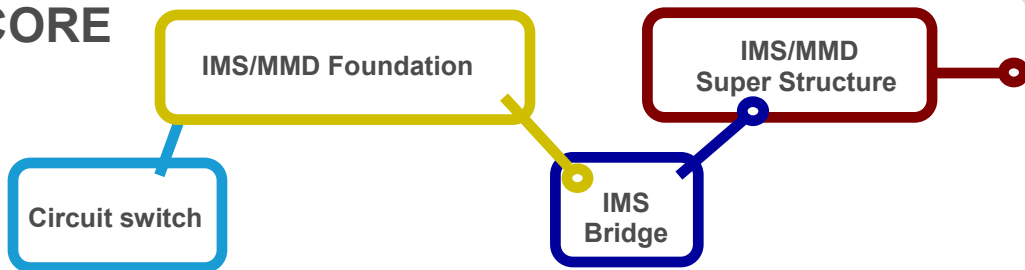
The Evolution to IMS/MMD

Building Rich Services and Applications Every Step of the Way

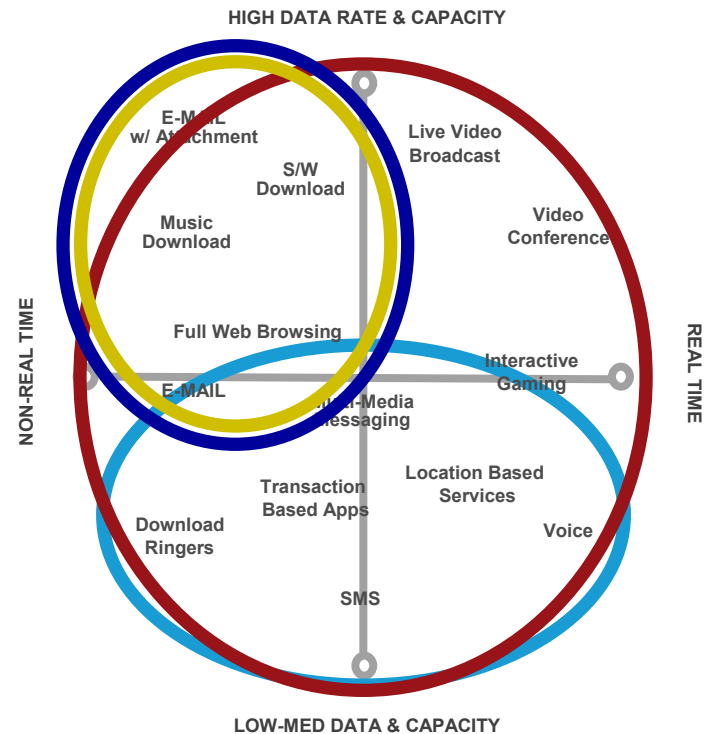
ACCESS



CORE



Applications



Handsets

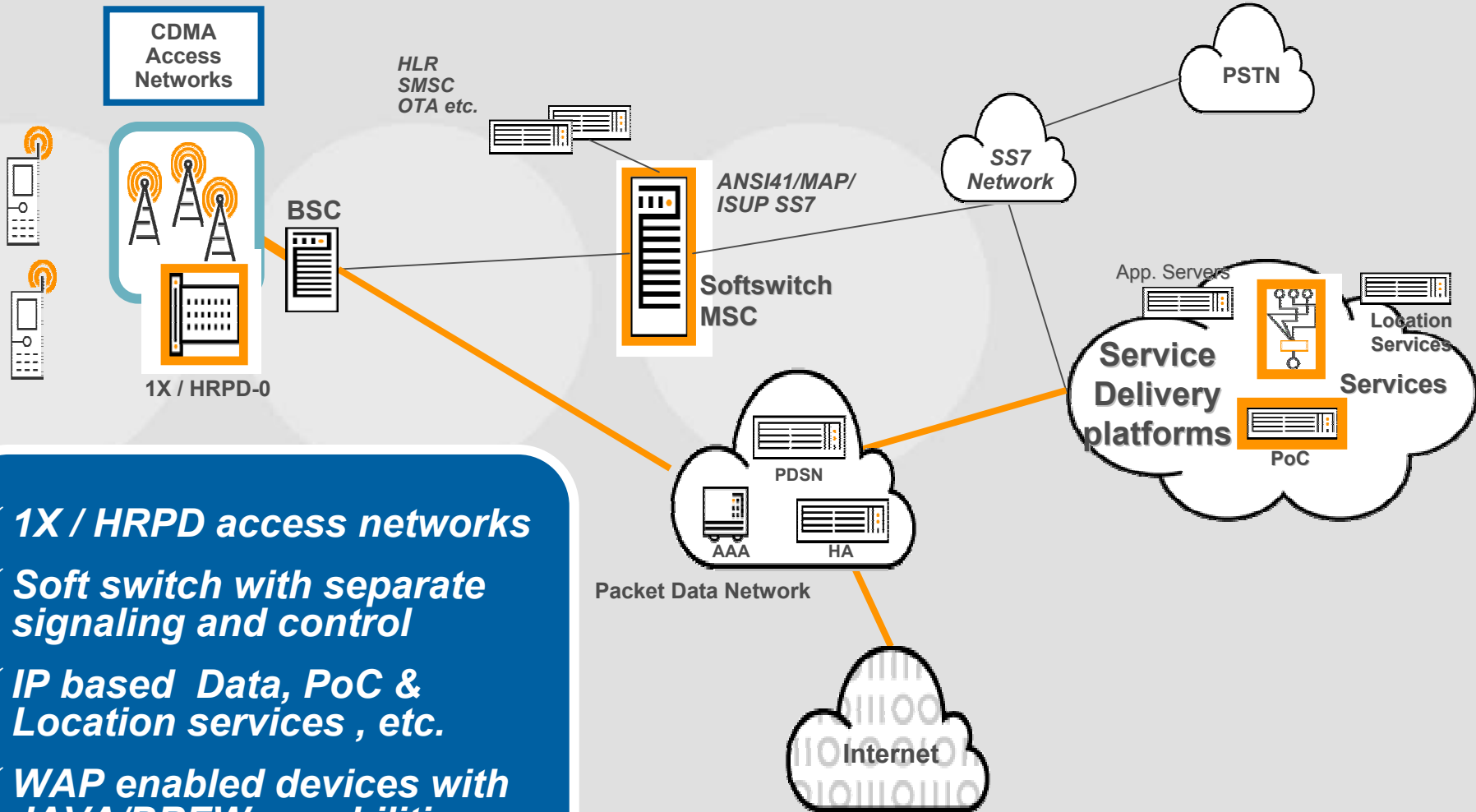
PoC

VoIP for WiFi

VoIP for CDMA



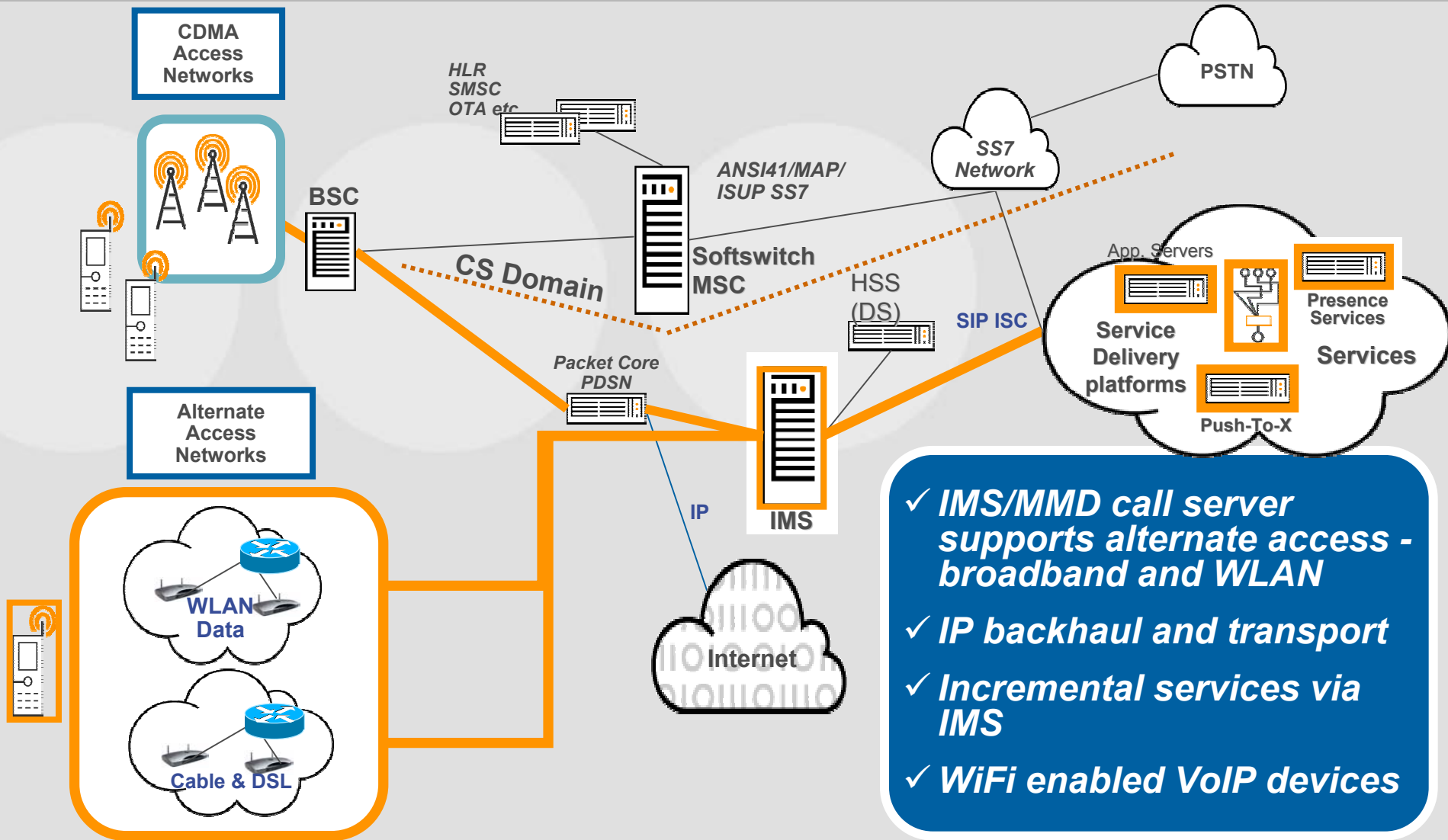
Migration Phase I – Today



- ✓ 1X / HRPD access networks
- ✓ Soft switch with separate signaling and control
- ✓ IP based Data, PoC & Location services , etc.
- ✓ WAP enabled devices with JAVA/BREW capabilities



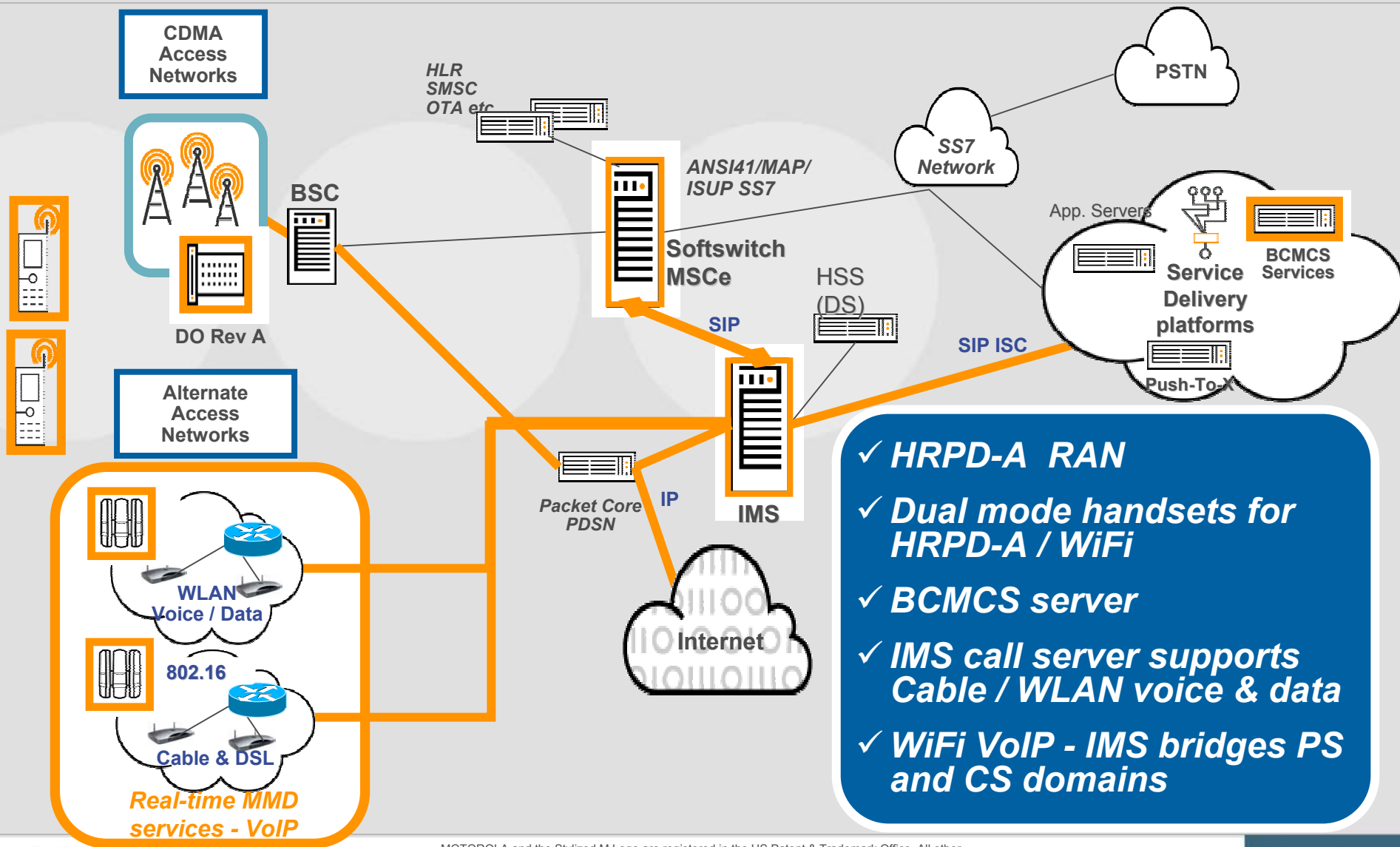
Migration Phase II – IMS/MMD Foundation - Starting in 2005



- ✓ *IMS/MMD call server supports alternate access - broadband and WLAN*
- ✓ *IP backhaul and transport*
- ✓ *Incremental services via IMS*
- ✓ *WiFi enabled VoIP devices*

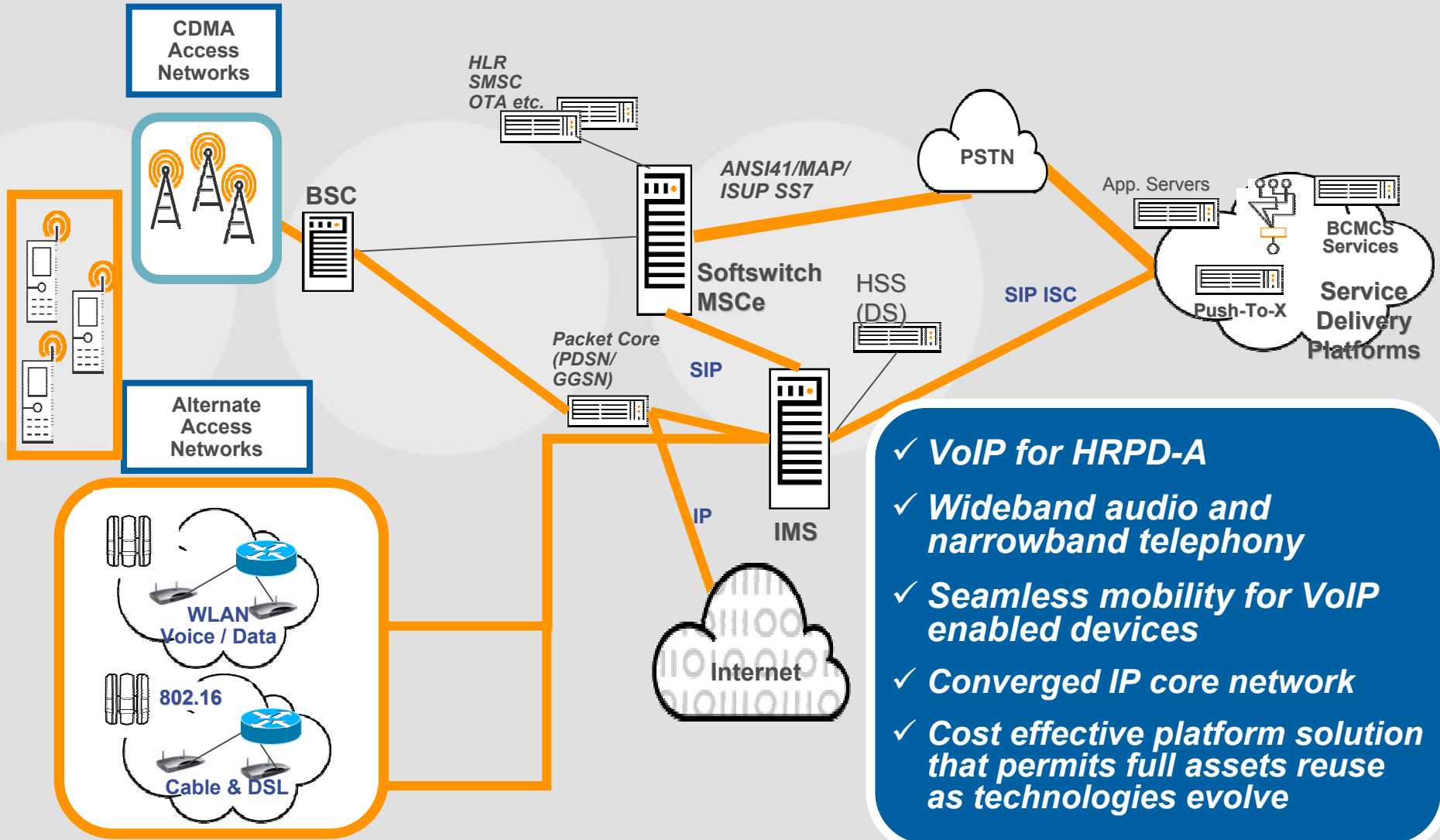


Migration Phase III - IMS Bridge - Starting in 2006





Migration Phase IV – IMS/MMD Super Structure - Starting in 2007



- ✓ *VoIP for HRPD-A*
- ✓ *Wideband audio and narrowband telephony*
- ✓ *Seamless mobility for VoIP enabled devices*
- ✓ *Converged IP core network*
- ✓ *Cost effective platform solution that permits full assets reuse as technologies evolve*



CDG Questions

#4, Can VoIP match Voice quality and Performance of a Circuit Switched Network

...

#5, What impact will VoIP have on CDMA capacity for mixed voice and data traffic ...

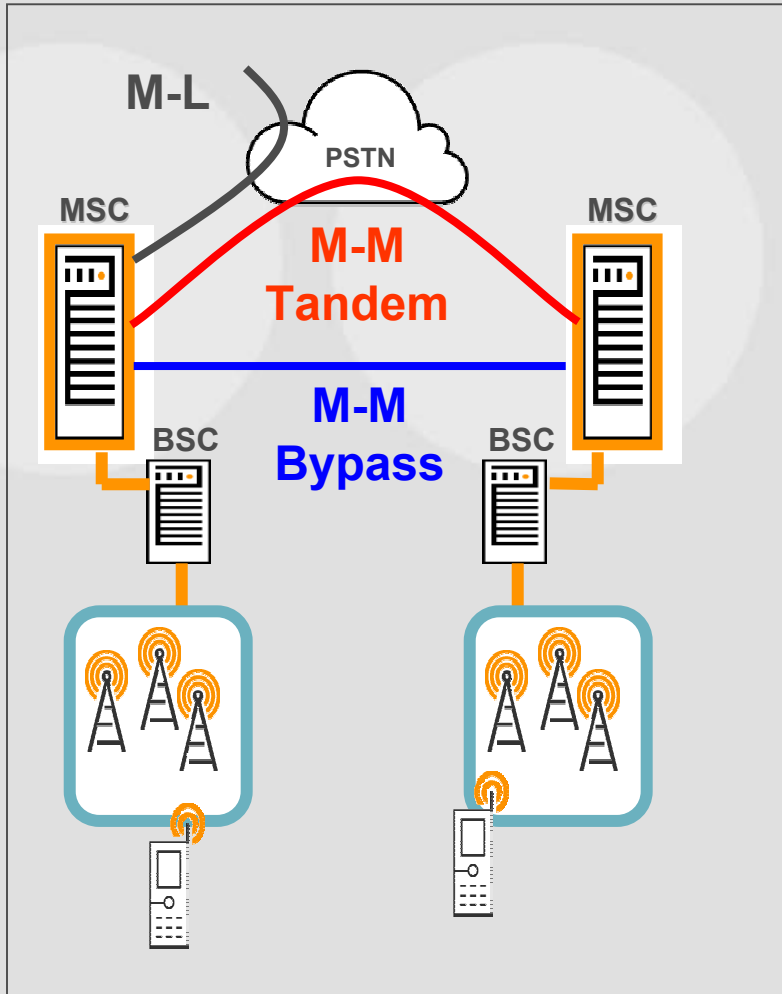
#6, What are the tradeoffs between system capacity, voice quality, QoS and other parameters ...



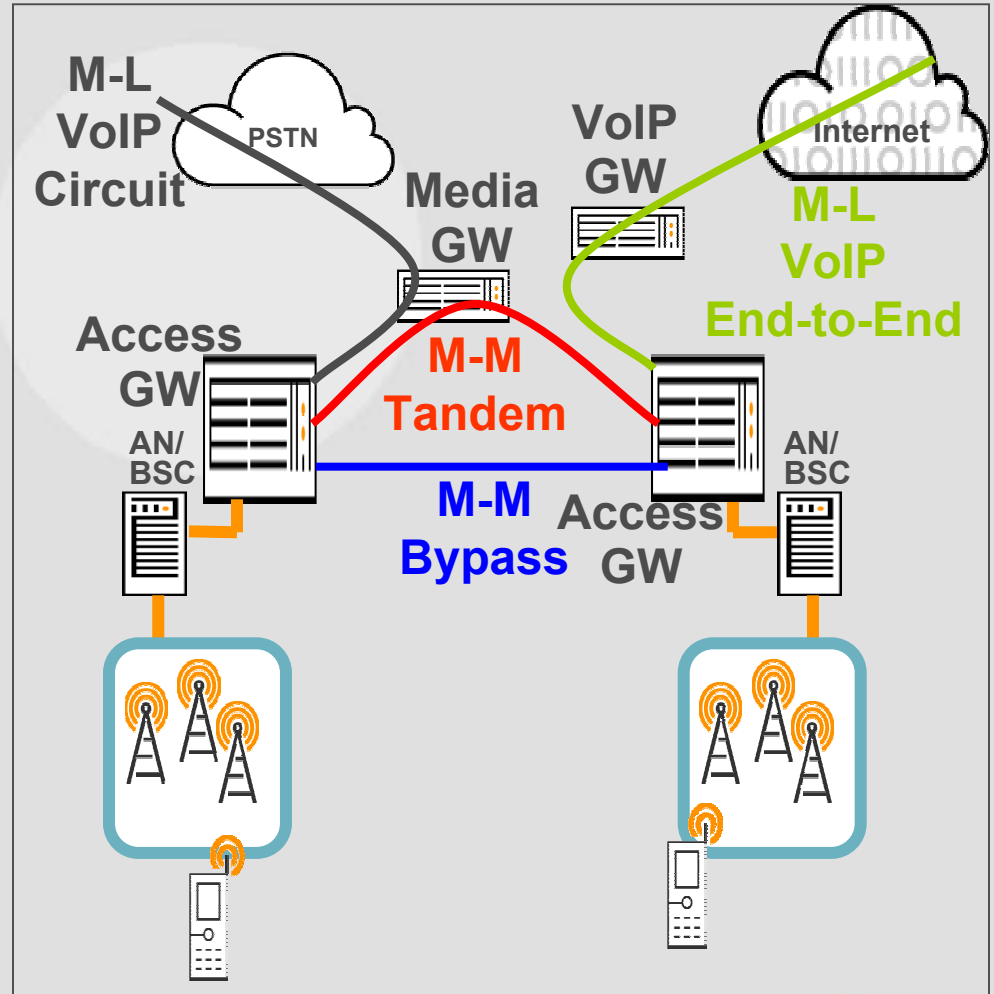
Voice Bearer Path Reference



Circuit Switched



VoIP via IMS/MMD





Voice Quality by Call Type



Call Type (Bearer Path)	Narrowband Vocoder (Eg, EVRC)	Wideband Vocoder (Eg, VMR-WB)
Circuit M-L, M-M Tandem (DCH air, PCM network)	Good (Baseline)	Good+ (NB; + if RS2)
Circuit M-M Vocoder Bypass (DCH air, Circuit data network)	Better (NB; tandem free)	Best (WB; tandem free)
VoIP M-L, M-M Tandem (SCH air, PCM network)	Good (= baseline if QoS)	Good+ (NB; + if RS2)
VoIP E2E, M-M Vocoder Bypass (SCH air, IP network)	Better (NB; tandem free)	Best (WB; tandem free)



Voice Performance by Call Type



Call Type (Bearer Path)	Delay	Jitter	Frame Loss
Circuit M-L, M-M Tandem (DCH air, PCM network)	Best Good	Best	Best Good
Circuit M-M Vocoder Bypass (DCH air, Circuit data network)	Better (tandem free)	Best	Good (2 RF links)
VoIP M-L, M-M Tandem (SCH air, PCM network)	Better Good	Better	Better Good
VoIP E2E, M-M Vocoder Bypass (SCH air, IP network)	Better (tandem free)	Good	Good

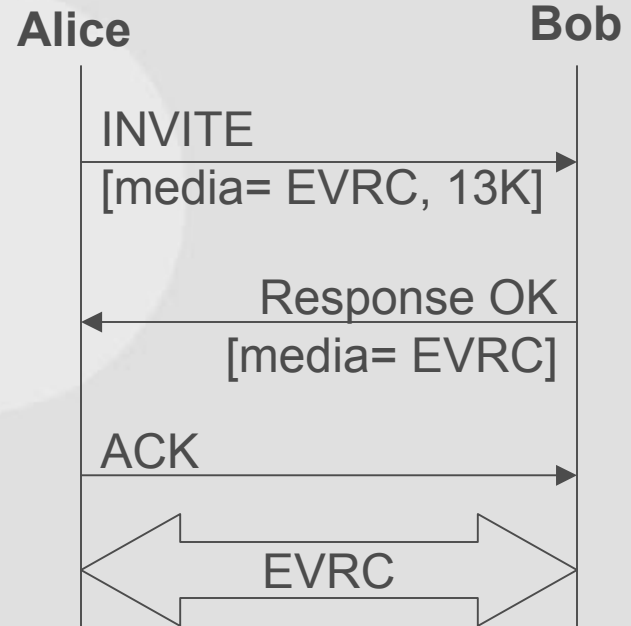
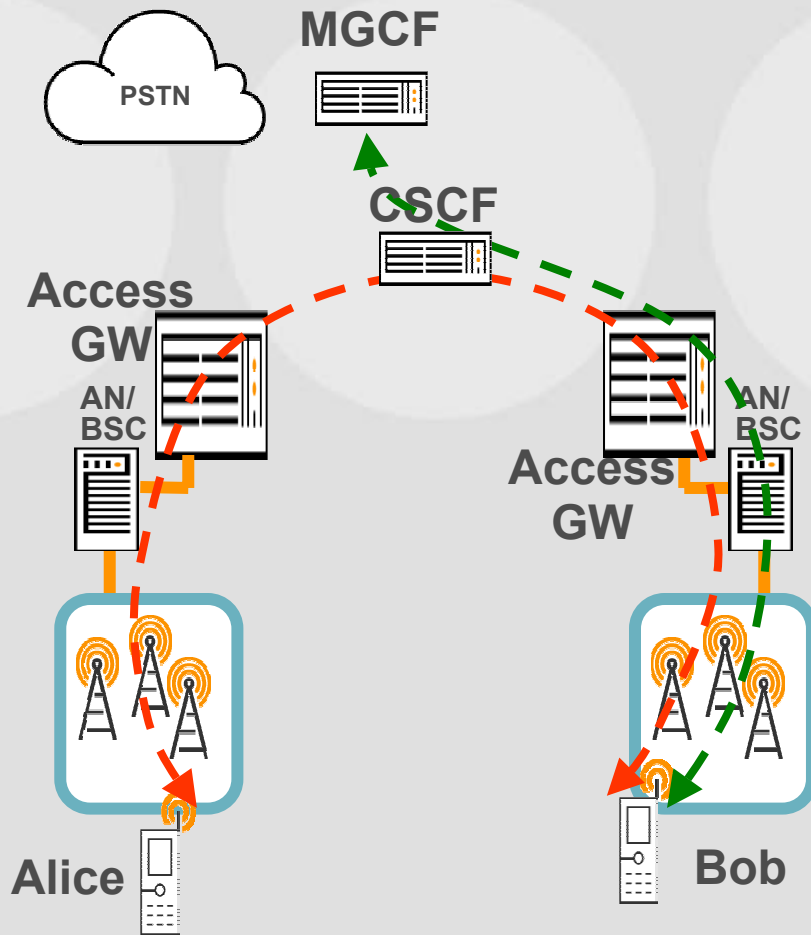
Good: 250 ms end-to-end delay, 20ms jitter, 2% end-to-end frame loss
 Best: 150ms end-to-end delay, 0.5ms jitter, 1% end-to-end frame loss



Vocoder Negotiation in IMS/MMD



The Session Initiation Protocol (SIP) and Session Description Protocol (SDP) enable end-to-end, prioritized, media (eg, vocoder) type negotiation.



Vocoder type and Transcoding location are dependent on terminal device capabilities and intermediate Gateway capabilities



VoIP Vocoder Summary



VoIP can offer same voice quality as circuit for M-L and M-M tandem call types

VoIP can offer higher voice quality for M-M and end-to-end M-L IP

- *Effectively supports vocoder bypass & negotiation*
- *Enables higher quality wideband vocoders*

VoIP can approach typical circuit switched voice performance

- *Requires effective QoS*
- *Requires well-engineered transport networks*

SIP /SDP protocols enable scalable vocoder negotiation & technology insertion

IMS/MMD architecture enables centralized and distributed transcoder locations



CDG Questions

#3, Do current standards fully support Network VoIP implementation

#10, Can VoIP provide seamless handoff mobility management ...



VOIP Standards in Progress

Multiple packet connections in HRPD

- *Required to support simultaneous VoIP and data sessions*
- *TIA-2000-C (Multiple service instances) and C.S0063 (Multi-Flow Packet Application) complete*
- *TIA-835-D (QoS), HRPD-IOS-A (Multi-Flow Packet Application), IOS v5.1 (QoS), TIA-856-A Addendum (minor enhancements) in progress*

Intra-technology HRPD Active Hard Handoff Support

- *Required to prevent VoIP service interruption during handoff*
- *HRPD IOS Rev A or Rev A Addendum in progress*
- *Fast Handoff support (TBD)*



VOIP Standards Gaps Not Yet Targeted for a Release

Inter-technology Handoff between HRPD and 1X

- *Required for VoIP-to-VoIP and 1X Circuit-to-VoIP handoff triggered by coverage boundaries*
- *Enhancements to TIA-873 (MMD), TIA-2000, TIA-856, HRPD IOS, and TIA-835 are needed*

Inter-technology Redirection between HRPD and 1X

- *Required for VoIP-to-VoIP and 1X Circuit-to-VoIP handoff triggered by network events and preferences*
- *Examples: overload control, preferred network available, etc.*
- *Enhancements to TIA-873 (MMD), TIA-2000, TIA-856, HRPD IOS, and TIA-835 are needed*



Recommend 3GPP2 prioritize work to close standards gaps

- *Motorola, Sprint and US Cellular jointly introduced a work item (3GPP2-0094) to support these features*
- *Specifications in progress complete in 05'*
- *Specifications involving call terminations, originations and intra-technology active handoffs is possible in 05'*
- *Inter-technology active handoff work is possible in 06'*



Backup Material



Acronyms & Definitions



<i>CSCF</i>	<i>Call Session Control Function</i>
<i>DCH</i>	<i>Dedicated Channel – Eg, 1X Fundamental Channel</i>
<i>MGCF</i>	<i>Media Gateway Control Function</i>
<i>M-L</i>	<i>Mobile to Land call</i>
<i>M-M Tandem</i>	<i>Mobile to Mobile call involving more than one vocoder stage in the bearer path</i>
<i>M-M Vocoder Bypass</i>	<i>Mobile to Mobile call involving one vocoder stage in the bearer path</i>
<i>Narrowband (NB)</i>	<i>Audio signal bandwidth 200-3500 Hz; requires 8 KHz PCM sampling</i>
<i>SCH</i>	<i>Shared Channel – Eg, HRPD Traffic Channel</i>
<i>VoIP End-to-End</i>	<i>M-L or M-M call supporting RTP/IP bearer between terminal devices</i>
<i>Wideband (WB)</i>	<i>Audio signal bandwidth 50-7000 Hz; requires 16 KHz PCM sampling</i>



Wideband Vocoder Overview



Higher fidelity than Narrowband (eg, EVRC) vocoders

- *Wideband audio bandwidth 50-7000 Hz (16 KHz sampling)*
- *Narrowband audio bandwidth 200-3500 Hz (8 KHz sampling)*

Wideband ↔ Narrowband Interworking

- *Enables circuit switched M-L and M-M Tandem calls with wideband service option assigned to mobiles*

Current technology requires Rate Set 2 (14.4 kbps) radio channel for highest voice quality

- *Rate Set 2 enables higher average data rate (ADR)*
- *Higher ADR enables better recovery in frame error/loss conditions*

Vocoder technology improvements enable Rate Set 1 (9.6 kbps) to be used with very good voice quality

- *Rate Set 1 quality is expected to be near Rate Set 2 quality in low frame error/loss conditions*



Delay factors

- *Number of Vocoder stages in path*
- *Dedicated circuit vs. shared packet links*

Jitter factors

- *Dedicated circuit vs. shared packet links*
- *Number of shared packet links in path*

Frame Loss factors

- *Number of air interface links in path*
- *Dedicated circuit vs. shared packet links*