ATIS-1000016

SERVICE CONTINUITY BETWEEN ACCESS NETWORKS – USE CASES AND SERVICE REQUIREMENTS

TECHNICAL REPORT

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ATIS-1000016, *Service Continuity Between Access Networks – Use Cases and Service Requirements*

Is an ATIS Standard developed by the **Signaling, Architecture, and Control (SAC)** Working Group under the **ATIS Packet Technologies and Systems Committee (PTSC)**.

ATIS Technical Report on

SERVICE CONTINUITY BETWEEN ACCESS NETWORKS – USE CASES AND SERVICE REQUIREMENTS

Secretariat

Alliance for Telecommunications Industry Solutions

Approved October, 2006

Abstract

This document identifies Use Cases and Service Requirements for Service Continuity between Access Networks, including consideration for the consistent provision of voice, video, data, and multimedia services across diverse access networks and core network domains (e.g., circuit switched and packet).

FOREWORD

The Alliance for Telecommunication Industry Solutions (ATIS) serves the public through improved understanding between carriers, customers, and manufacturers. The PTSC develops and recommends standards and technical reports related to services, architectures, and signaling, in addition to related subjects under consideration in other North American and international standards bodies. The Packet Technologies and Systems Committee:

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Suggestions for improvement of this document are welcome. They should be sent to the Alliance for Telecommunications Industry Solutions, PTSC Secretariat, 1200 G Street NW, Suite 500, Washington, DC 20005.

The Signaling, Architecture, and Control (SAC) Working Group was responsible for the development of this document.

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1 SCOPE, PURPOSE, AND APPLICATION

1.1 Scope

As Next Generation Networks (NGNs) evolve and are deployed, there will increasingly exist a need to provide continuity of service between different types of access networks and a consistent user perspective. To support the needed equipment interworking, standards are needed that specify service requirements, architecture, and signaling interfaces.

The requirements of all forms of access should be considered, including "wired" and "wireless". Fixed, nomadic, and mobile oriented service -- including voice, video, and data -- need to be taken into consideration. However, the initial focus may be constrained to dual mode user equipment (e.g., WLAN/GSM) for Voice services (due to pressing market needs).

> NOTE -- The use cases described in this document are illustrative and not exhaustive. They may be subsequently modified through additions, deletions, and/or other modifications as the standardization process continues through requirements generation and the follow-on architecture and protocol work. These use cases are intended to be an initial list intended solely to progress the initial work in this standardization area.

Areas for consideration include, but are not limited to, the following:

- Seamless handover between different access networks (e.g., Circuit Switched Cellular and IP WLAN) and associated core network interworking (e.g., Circuit Switched and IMS).
- Interoperability between independent IMS and CS core networks.
- Delivery of services needs to be access independent.
- Coordination of service data in and between user equipment, access networks, and core networks for a consistent user experience.
- Flexible subscriber addressing, including multiple directory numbers (e.g., two E.164 numbers).
- Network/Domain selection for originating and terminating calls.
- Supplementary Services support (e.g., Call Forwarding, Call Waiting, Call Hold, etc.).
- Security.
- Quality of Service.
- Multimedia support (e.g., Voice, Video, Data).
- Emergency Call.
- Call Transfer.
- Charging (For the purpose of this document charging is only mentioned to call attention to specific use cases. The future work should consider charging implications in all cases.
- Legal Intercept.

These areas are not all described in this document but should be considered in the future.

1.2   Purpose

The identification of Use Cases is a valuable first step in the specification of standards because they provide a basis for providing guidance in making decisions, determining requirements, and ensuring that the subsequently developed specifications sufficiently enable the implementation of capabilities needed to deploy the envisioned services. This document identifies Use Cases for service continuity between access networks.

Additionally, the identification of Requirements based on Use Cases is important for the design and implementation of interoperable core network, access network, and user equipment. This document is intended to assist in the identification of requirements for service continuity between access networks.

1.3   Application

This report focuses on the identification of initial Use Cases for the provision of service continuity between access networks. It is intended that this capability is provided across a diversity of access networks, including but not limited to:

- ♦ *Cellular Telephony:*
  - o *AMPS (IS-91)*
  - o *GSM/HSPA*
  - o *UMTS*
  - o *CDMA*
- ♦ *Wireless LAN*
  - o *802.11*
- ♦ *Fixed Wireless*
  - o *802.16*
- ♦ *Broadband*
  - o *DSL*
  - o *Fiber*
  - o *Cable*

From a global perspective, there has been great interest in cellular (e.g.,, GSM) and wireless LAN networks. Service continuity between these two access networks is viewed as being important for the business cases of several service providers. Therefore the initial focus of the use cases identified in this report is on service continuity between Cellular and WLAN. However, it is expected that the functionality described in the Use Cases for providing service continuity between these two access networks will also be applicable for interworking between other access network technologies as well, though not specifically described in the initial version of this report.

2 NORMATIVE REFERENCES

The following standards contain provisions which, through reference in this text, constitute provisions of this ATIS Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this ATIS Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below.

[None.]

3 DEFINITIONS, ACRONYMS, & ABBREVIATIONS

3.1 Definitions

3.1.1 Handset – in this document handset refers to the user's wireless device.

3.2 Acronyms & Abbreviations

AMPS	Advanced Mobile Phone Service
CDMA	Code Division Multiple Access
DSL	Digital Subscriber Line
GSM	Global System for Mobiles
HSPA	High Speed Packet Access
IP	Internet Protocol
ISIM	IP Multimedia Service Identity Module
NGN	Next Generation Network
PSAP	(Emergency Call) Public Safety Answering Point
QoS	Quality of Service
UMTS	Universal Mobile Telecommunications Systems
VoIP	Voice over IP
WLAN	Wireless Local Area Network

4 ASSUMPTIONS

For service continuity between access networks, the following assumptions are made with respect to the identification of Use Cases and Service Requirements:

♦ For Cellular/WLAN 'dual mode' service users, users will acquire a 'new' handset capable of providing service over both the cellular communications network (e.g., GSM) and a WLAN.

♦ VoIP over WLAN is supported by a WLAN handset with a VoIP client.

These Use Cases do not assume that handover is initiated by the handset or network.

The handset functions described in this document (e.g., providing signaling tone when switching access network, visual indicator) are illustrative and do not imply a requirement.

5 EXAMPLE USER AND SERVICE PROVIDERS

For the purposes of describing envisioned Use Cases, representative fictional users and service providers are needed. This section describes fictional users and service providers for this purpose. Any resemblance between the users and service providers described and used in this document, and actual users and service providers, is purely coincidental.

5.1 Fictional Service Providers

5.1.1 Broadband Telco, Ltd. (BTL)

Broadband Telco, Ltd. (BTL) is a 'one stop' communications service provider, offering wired broadband internet (DSL), WLAN home gateways, VoIP (enterprise and consumer), IP-based video, and IP-based multimedia services as well as circuit-switched telephony services.

5.1.2 Cellular, Inc. (CI).

Cellular, Inc. (CI) is a cellular telephony service provider.

5.1.3 Mom and Pop AMPS Cellular, Inc. (MPCI).

Mom and Pop Cellular, Inc. (MPCI) is a (CELLULAR AMPS only) cellular telephony service provider whose coverage area is primarily in very rural areas where no digital cellular coverage is available.

5.1.4 VoIP Corp. (VC)

VoIP Corp. (VC) is a relatively new (wireline) VoIP speech service provider.

5.2 Fictional Users

Fictional users are described below that are intended to represent service users from different market segments and/or with different equipment interworking configurations. They are used in the succeeding sections of this document to illustrate applications of service continuity between access networks.

5.2.1 Kathy

Kathy is a housewife,

- ♦ She has a Cellular/802.11 dual mode handset.
- ♦ All her communication services (wired broadband internet, wired home telephone, broadband television, and cellular) are provided by Broadband Telco, Ltd. (BTL).
- ♦ In her home:
  - o In her basement:
    - She has 802.11 WLAN, no Cellular access.
    - The access point is connected to a DSL modem.

o In her living room:

   - She has Cellular access, no 802.11 WLAN.

Kathy's communications environment is illustrated by the following figure.
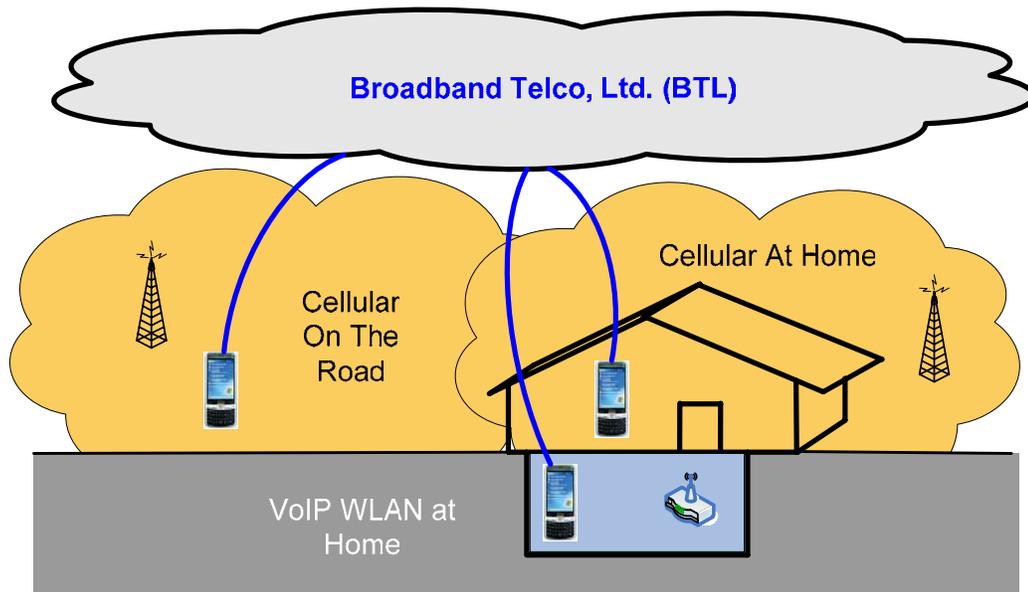
Figure 1 - Kathy's Communication Environment

5.2.2 Joyce

♦ Joyce is a woman who has lived in her community for a number of years.

♦ Her wireline telephony service provider is BTL.

   o She has been receiving service from BTL for a number of years, and her friends, relatives, and acquaintances know her well-established phone number.

♦ Her cellular telephony service provider is Cellular, Inc.:

♦ She has had this service for several years, and many of her friends reach her on her handset.

♦ Her broadband service provider is BTL.

♦ She has had a WLAN installed in her home:

   o It interconnects the hobby room and living room PCs, so she can conveniently check email and shop online in either room.

♦ The Cellular signal is too weak in her bathroom to enable calls:

   o Concerned about being able to communicate if a health or safety emergency should arise, she subscribes to dual mode service.

Joyce's communication environment is illustrated by the following figure.
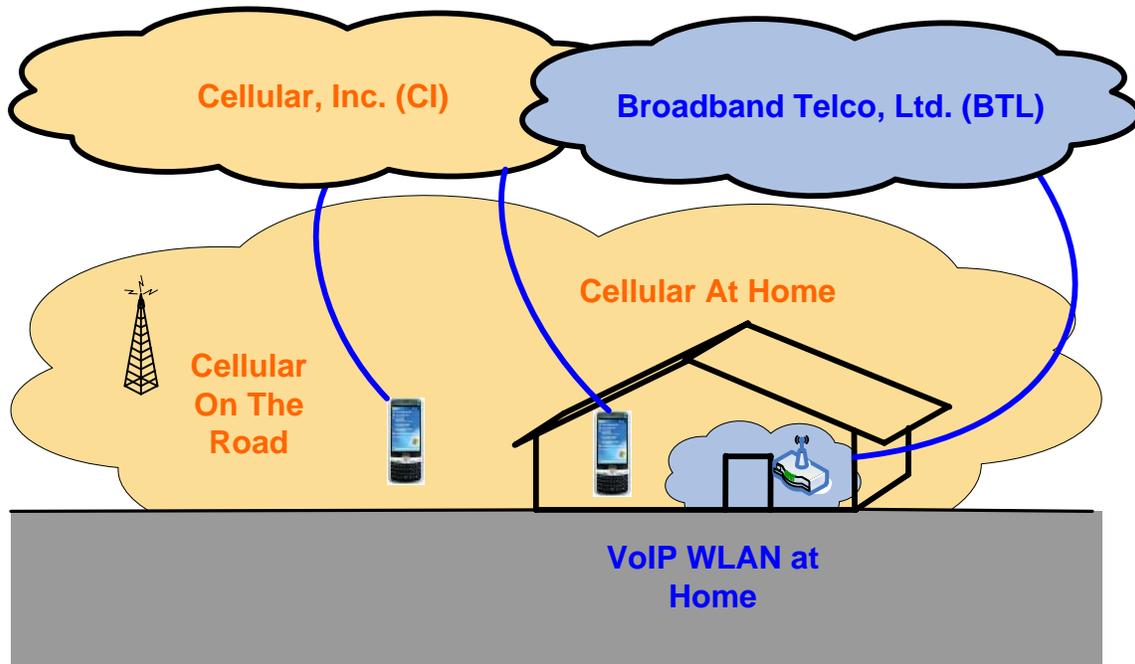
Figure 2 - Joyce's Communication Environment

5.2.3 Luke

♦ Luke has a Cellular/802.11 dual mode handset.

♦ His wired broadband service provider is Broadband Telco, Ltd. (BTL).

♦ His cellular telephony service provider is Cellular, Inc.

♦ Throughout his home:

♦ He has 802.11 WLAN, and Cellular access.

　o He relaxes playing the online interactive games.

o In his office:

o Phone service is provided by Broadband Telco, Ltd. (*with their IP Centrex service offering*).

o He has developed a large number of contacts who communicate with him using his well established professional phone number.

Luke's communication environment is illustrated by the following figure.
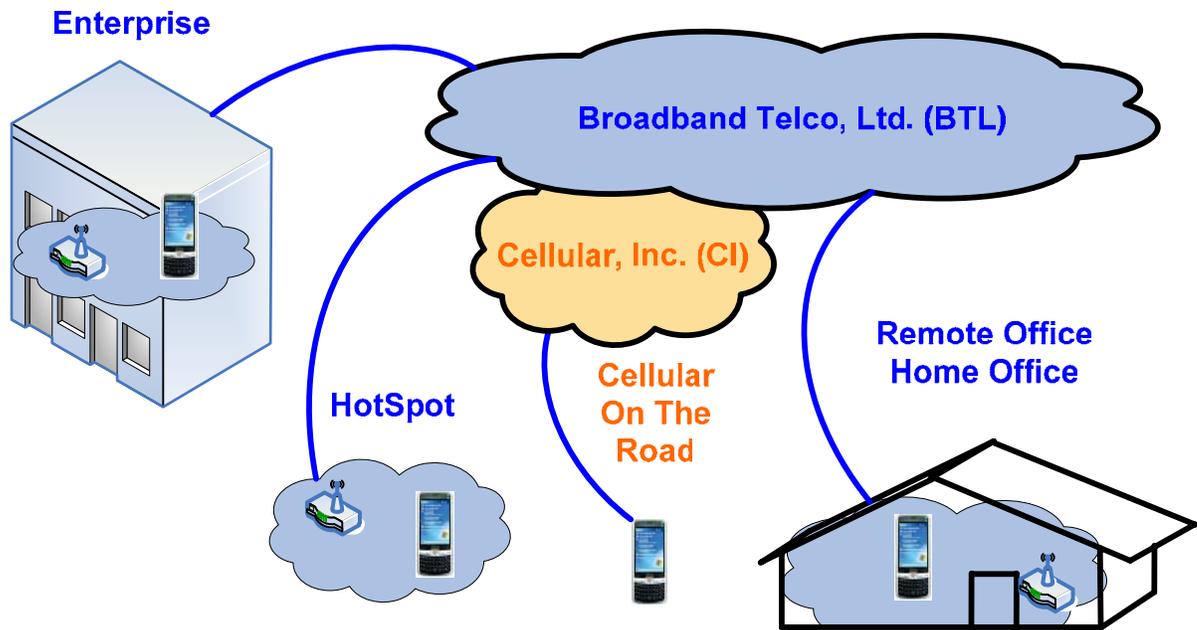
Figure 3 - Luke's Communication Environment

5.2.4 Paul

♦ Paul and his family have recently moved from a metropolitan area to a rural area. Paul still commutes to the metropolitan area every day, but his family does not.

♦ Paul has a CELLULAR (AMPS, DIGITAL)/802.11 dual-mode mode handset.

♦ His wired broadband service provider is Broadband Telco, Ltd. (BTL).

♦ He is a long standing customer of Cellular, Inc.

♦ In his old home in the metropolitan area he had adequate digital coverage from Cellular, Inc.

♦ In his new home in the rural area he has roaming AMPS coverage from Mom and Pop Cellular, Inc.

♦ Throughout his home:

    o He has 802.11 WLAN, and AMPS CELLULAR access.

    o He relaxes playing the online interactive games.

♦ In his office:

    o Phone service is provided by Broadband Telco, Ltd. (*with their IP Centrex service offering*).

    o He has developed a large number of contacts who communicate with him using his well-established professional phone number.

Paul's communication environment is illustrated by the following figure.
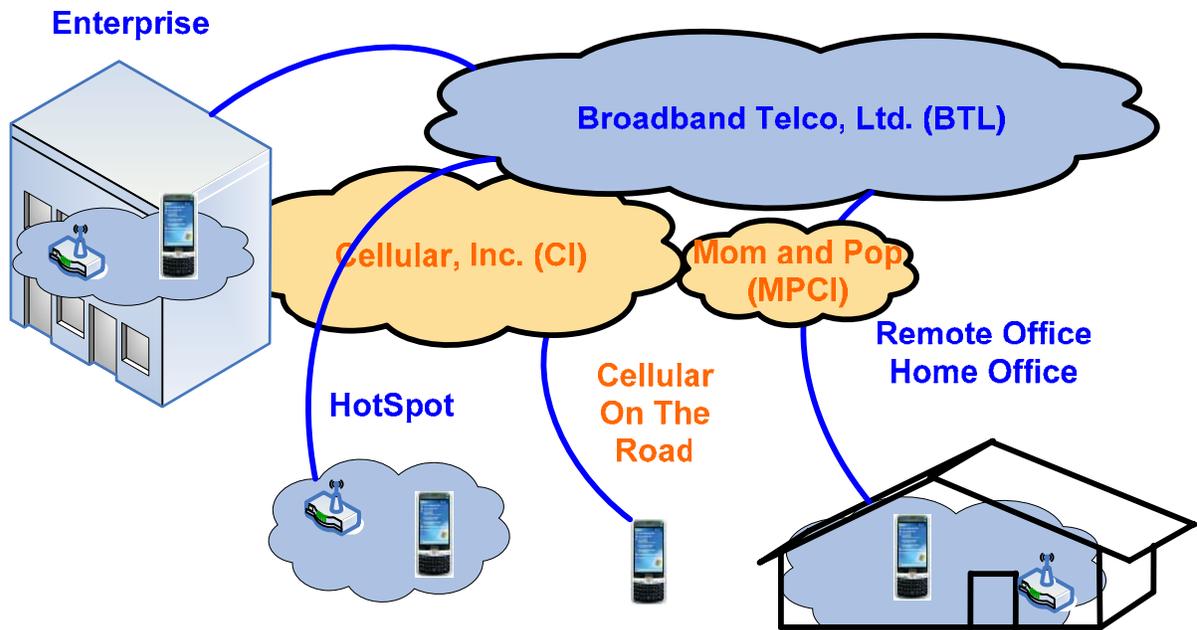
Figure 4 - Paul's Communication Environment

6 VOICE CALL ORIGINATIONS

6.1 WLAN only access

♦ Kathy is in the basement of her home:

  o Kathy's basement has only WLAN radio coverage, not *Cellular*.

  o A visual indicator on her handset shows she has WLAN connectivity.

♦ Her husband is picking up some groceries on his way home from work, and she realizes he might not get milk. So she calls him, and reminds him. She then hangs up.

  o Kathy can originate voice calls on her handset over her home WLAN.

6.2 Cellular only access

♦ Kathy is in the kitchen of her home:

  o In her kitchen she has only Cellular radio coverage, no WLAN coverage.

  o A visual indicator on her handset indicates she has Cellular access network connectivity.

♦ Her husband is picking up some groceries on his way home from work, and she realizes he might not get milk. So she calls him, and reminds him. She then hangs up.

♦ She can originate voice calls on her handset using the Cellular access network.

♦ Paul is in the barn of his home.

   o In his barn, he has only Roaming CELLULAR radio coverage, no WIFI coverage.

   o A visual indicator on his handset indicates he has CELLULAR access network connectivity.

♦ His wife is picking up some groceries, and he realizes she might not get toothpaste. So he calls her, and reminds her. He then hangs up.

♦ He can originate voice calls on his handset using the CELLULAR access network.

6.3 WLAN & Cellular Access

♦ Joyce is in the kitchen of her home:

   o Her kitchen has both Cellular radio coverage, and WLAN coverage.

   o A visual indicator on her dual mode handset shows she has both Cellular and WLAN connectivity.

♦ Her friend Phyllis was supposed to visit her, and is now late. Joyce, concerned, calls Phyllis.
   o Joyce previously established WLAN call handling as having precedence over Cellular for voice calls when both access networks were available.
   o Based on her user preferences, her call was originated over the WLAN.
   o An indicator on her handset shows this call is using the WLAN.

♦ Phyllis receives the call on her handset, and tells Joyce will be late and should be there in about 5 more minutes. While on the call, a storm comes, the power goes out and she loses the WLAN access.

   o The visual indicator on her dual mode handset shows she has only Cellular connectivity.

   o Joyce continues the call on the Cellular access network. The power comes back on and the call is automatically switched back to the WLAN.

   o Joyce ends the call when Phyllis says she is sitting in her car in Joyce's driveway, waiting for the rain to let up before she runs to the door.

7   VOICE CALL TERMINATIONS

7.1 WLAN Only Access

♦ Kathy is in the basement of her home:
   o Kathy's basement only has WLAN radio coverage, not Cellular.

♦ Her husband calls her from the grocery store on his handset:
   o A visual indicator on her handset shows she has WLAN connectivity.
   o The caller ID display on her handset indicates the call is from her husband.

♦ Kathy sees the call is from her husband and answers the call.
   o She can receive incoming voice calls on her handset over her home WLAN.

♦ Her husband asks if he should pick up milk. Kathy tells him they are nearly out of milk, so please do so. After a few more minutes of conversation she ends the call.

7.2 Cellular Only Access

♦ Kathy is in the kitchen of her home:

  o Kathy's kitchen has only Cellular radio coverage, not WLAN.

♦ Her husband calls her from the grocery store on his handset.

  o A visual indicator on her dual mode handset shows she has cellular telephony connectivity.
  o The caller ID display on her handset indicates the call is from her husband.

♦ Kathy sees the call is from her husband and answers the call.
  o She can receive incoming voice calls on her handset over the Cellular access network.

♦ Her husband asks if he should pick up milk. Kathy tells him they are nearly out of milk, so please do so. After a few more minutes of conversation she ends the call.

♦ Paul is in the barn of his home:

  o Paul's barn has only roaming CELLULAR radio coverage, not WIFI.

♦ His wife calls him from the grocery store on his handset.

  o A visual indicator on his dual mode handset shows he has cellular telephony connectivity.

  o The caller ID display on his handset indicates the call is from his wife.

♦ Paul sees the call is from his wife and answers the call.

  o He can receive incoming voice calls on his handset over the roaming CELLULAR access network.

♦ His wife asks if she should pick up toothpaste. Paul tells her they are nearly out of toothpaste, so please do so. After a few more minutes of conversation he ends the call.

7.3 WLAN & Cellular Access

♦ Joyce is in the kitchen of her home:

  o The kitchen has both Cellular radio coverage, and WLAN coverage.

  o A visual indicator on her dual mode handset shows she has both Cellular and WLAN connectivity.

♦ Her friend Phyllis was supposed to come over, but hasn't come over yet. Joyce's handset rings. Joyce looks at the display, sees the caller ID indicates it is Phyllis, and answers the call.

  o Joyce previously established WLAN call handling as having precedence over Cellular for voice calls when both access networks were available.

- o   The call is received over the WLAN access.

- o   Caller ID provides the identity of the calling party.

♦   Phyllis says she will be late, but should be there soon. After learning about Phyllis, Joyce ends the call.

♦   A storm comes up, and there is a lot of lightning. Joyce is worried an electrical surge will harm her home electronics, so she turns off most of her major electronic devices, including the WLAN access point.

- o   The visual indicator on her dual mode handset shows she has only Cellular connectivity.

♦   Joyce's handset rings again. She looks at the display, sees the caller ID indicates it is Phyllis, and answers the call.

- o   The call is received on the Cellular access network.

- o   Caller ID provides the identity of the calling party.

- o   In the case where the WLAN is good but the broadband connectivity is poor the incoming call will arrive via Cellular.

♦   Phyllis says she is actually sitting in her car in Joyce's driveway waiting for the rain to let up before she runs to the door.

8   VOICE CALL HANDOFF

8.1   Coverage Triggered Handoff

8.1.1   Cellular to WLAN

♦   Kathy is in the living room of her house, talking with her husband on her handset.

- o   Her currently established call is using the Cellular access network.

- o   A visual indicator on her handset shows she has only Cellular connectivity.

♦   Kathy's husband asks a question. Kathy realizes that she must go to the basement to find the answer to the question. She goes down into the basement. Her voice call continues the entire time.

- o   As she goes into the basement, she loses Cellular coverage, but enters WLAN coverage.

- o   Her call is seamlessly handed over from Cellular to WLAN.

- o   A visual indicator on her handset indicates she has only WLAN connectivity.

- o   She hears a signal tone indicating she has changed access networks.

♦   She finds the answer to the question, conveys it to her husband, and ends the call.

8.1.2   Cellular to WLAN Voice and back to Cellular

♦   Kathy makes a voice call while in the living room of her house.

♦   She goes down the stairs into her basement, while talking the whole time.

♦   She hears a notification tone when the radio changes.

♦ After a short time, she goes up the stairs into her living room, while talking the whole time.

♦ She hears a notification tone when the radio changes.

♦ After talking awhile longer, she ends the call.

  o Each radio transition was seamless and transparent (e.g., no noticeable change in voice quality or service availability)

♦ When she gets her bill, it shows different charging applied for the WLAN and Cellular portions of the call.

> NOTE -- This scenario is similar to the previous scenario, except the call is seamlessly transferred from Cellular to WLAN and back to Cellular.

♦ Paul receives an important call in his garage from one of his clients right before he leaves for his office.

♦ He then drives to his office while discussing business with his client.

♦ On the way his client asks him to bring some blueprints for a face to face meeting later in the day.

♦ Paul turns around and drives back to his house.

♦ He retrieves the blueprints and drives back to the office.

> NOTE -- This call originated as a VoIP WIFI voice call, was handed off to the MPCI AMPS CELLULAR access network, then to the CI Digital CELLULAR access network, then was handed back again to the MPCI network, and then again to the WIFI access network. As Paul drove to his office, the call was again handed off to the CELLULAR access network.

8.1.3 WLAN to Cellular

♦ Kathy is in the basement of her house, talking with her husband on her handset.

  o Her established call is using the WLAN access network.

  o A visual indicator on her handset shows she has only WLAN connectivity.

♦ Kathy's husband asks a question. Kathy realizes she must go to the kitchen to get the answer. She goes up into the kitchen to find the answer. Her voice call continues the entire time.

  o As she goes out of the basement, she looses WLAN coverage, but enters Cellular coverage.

  o Her call is seamlessly handed over from WLAN to Cellular.

  o A visual indicator on her handset indicates she has only Cellular connectivity.

  o She hears a signal tone indicating she has changed access networks.

  o She finds the answer to the question, conveys the answer to her husband, and ends the call.

8.1.4 WLAN to Cellular Voice and back to WLAN

♦ Kathy makes a voice call while in the basement.

♦ She walks up the stairs into her living room, while talking the whole time.

  o She hears a notification tone when the radio changes.

♦ After a short time, she goes down the stairs into her basement, while talking the whole time.

  o She hears a notification tone when the radio changes.

♦ After talking awhile longer, she ends the call.

  o When she gets her bill, it shows different charging applied for the WLAN and Cellular portions of the call. (The notification tone that the access network changes and an indication that different charges may apply.)

  o Each radio transition was seamless and transparent (e.g., no noticeable change in voice quality or service availability).

  NOTE -- This call originated as a VoIP WLAN voice call, was handed off to the Cellular access network, then was handed back again to the WLAN access network.

8.2   QoS Triggered Handoff

8.2.1   Cellular to WLAN

♦ Joyce is sitting on the porch of her home. She begins to go into the house, and as she does, her handset rings.

  o A visual indicator on her handset shows she has both WLAN and Cellular connectivity.

  o The Cellular signal is strong, but the WLAN signal is very weak.

  o The caller ID display on her handset indicates the call is from her daughter.

♦ Joyce sees the call is from her daughter and answers the call.

  o She receives the incoming call over the Cellular access network.

♦ Joyce's daughter asks Joyce a question. They discuss it as Joyce crosses the living room of her house.

  o A visual indicator on her dual mode handset shows she has both WLAN and Cellular connectivity.

  o Both the Cellular and WLAN signals are strong.

  o The voice call remains on the Cellular access network.

♦ She continues walking through the house while continuing to talk to her daughter.

  o The Cellular radio signal deteriorates substantially, while the WLAN radio signal remains strong.

  o For QoS reasons the call is seamlessly handed over to the WLAN access network.

  o She hears a notification tone when the radio changes.

  o Joyce did not experience a service interruption.

♦ The conversation ends, and Joyce ends the call.

8.2.2 WLAN to Cellular

♦ Joyce is sitting in the living room of her home. She is having a conversation with a friend using her handset.

   o A visual indicator on her dual mode handset shows she has both Cellular and WLAN connectivity.

   o Both the WLAN and Cellular signals are strong.

   o The established call is using the WLAN access.

♦ Joyce hears a noise on the porch, and goes out on the porch to investigate, while continuing to talk to her friend.

   o A visual indicator on her dual mode handset shows she has both Cellular and WLAN connectivity.

   o The WLAN signal is very weak while the Cellular signal is very strong.

   o For QoS reasons the call is seamlessly handed over to the Cellular access network.

   o She hears a notification tone when the radio changes.

   o Joyce did not experience a service interruption.

   o After arriving on the porch, Joyce finishes her conversation and ends the call.

8.3 Congestion Triggered Handoff

8.3.1 Cellular to WLAN

♦ Joyce is sitting on the porch of her home, using her handset to talk to her friend.

   o A visual indicator on Joyce's dual mode handset shows she has both WLAN and Cellular connectivity.

   o Both the Cellular and WLAN signals are strong.

   o The call is currently established using the Cellular access network.

♦ An emergency occurs nearby, and a number of cellular subscribers begin to use their handsets to make calls to emergency services.

   o Demand for Cellular radio resources spikes, network congestion occurs.

   o Joyce's call is seamlessly handed over from Cellular to WLAN.

   o She hears a notification tone when the radio changes.

   o Cellular radio resources become less congested.

8.3.2 WLAN to Cellular

♦ Joyce is sitting in her home, using her handset to talk to her friend.

- o A visual indicator on Joyce's dual mode handset shows she has both WLAN and Cellular connectivity.

- o Both the Cellular and WLAN signals are strong.

- o The call is currently established using the WLAN access network.

♦ In her house, radio interference begins, and results in greatly reduced WLAN bandwidth.

- o The ability of the WLAN to support the call degrades, and voice quality degrades to an unacceptable level.

- o Joyce's call is seamlessly handed over from WLAN to Cellular.

- o She hears a notification tone when the radio changes.

- o Joyce's call continues without disruption.

♦ This use case assumes that there is no admission control on the WLAN access.

♦ Other use cases could be due to WLAN congestion when overload conditions exist, and there is no admission control.

8.4 User Preferences Triggered Handoff

8.4.1 Cellular to WLAN

♦ Joyce is sitting on the porch of her home.

- o She previously set her user preferences as WLAN preferred over Cellular connectivity.

- o A visual indicator on her handset shows she has only Cellular connectivity.

♦ Her handset rings and she answers the handset.

- o She receives the incoming call over the Cellular access network.

♦ During the ensuing conversation, Joyce goes into the house.

- o A visual indicator on her dual mode handset shows she has both WLAN and Cellular connectivity.

- o Both the Cellular and WLAN signals are strong.

- o The voice call switches to the WLAN access network due to Joyce's user preferences.

- o She hears a notification tone when the radio changes.

- o Joyce does not experience a service interruption.

♦ When the conversation is finished, Joyce ends the call.

8.4.2 WLAN to Cellular

♦ Joyce is in the basement of her house.

- o She previously set her user preferences for Cellular to be preferred over WLAN connectivity.

- o A visual indicator on her dual mode handset shows she has only WLAN connectivity.

♦ Her handset rings and she answers the handset.

- o She receives the incoming call over the WLAN access network.

♦ While carrying on the conversation, Joyce goes up into the living room.

- o A visual indicator on her dual mode handset shows she has both WLAN and Cellular connectivity.

- o Both the Cellular and WLAN signals are strong.

- o The voice call switches to the Cellular access network due to Joyce's user preferences.

- o She hears a notification tone when the radio changes.

- o Joyce does not experience a service interruption.

♦ Joyce continues the conversation until it is finished; she then ends the call.

9 ENTERPRISE INTERWORKING - IP CENTREX

NOTE -- All of the entities in this document are completely fictional, and any resemblance to any existing entities is completely coincidental.

Luke, as an employee of Acme, Inc. (AI) has an office in the corporation's downtown complex. AI provides its employees with advanced IP-based Centrex services from BTL.

Due to his profession, Luke has a need for anywhere, anytime communication capability. AI has provided Luke with a dual mode handset, which he uses for all his communication needs.

♦ Using AI's Centrex features, Luke speed dials a colleague to obtain the answer to a question. The colleague is out of the office, but his secretary promises he will call back as soon as he returns.

- o Luke's dual mode handset established a WLAN VoIP connection over AI's enterprise intranet.

♦ Luke goes to a nearby coffee shop. The coffee shop provides a BTL WLAN hotspot. As Luke walks into the coffee shop, it occurs to him he is late for a conference call. Using AI's Centrex features he bridges onto the call. As he is participating on the call, Luke leaves the coffee shop.

- o Luke's dual mode handset established a WLAN VoIP connection over the public hotspot WLAN at the coffee shop, and Luke was able to use AI's Centrex features.

♦ Luke continues to participate in the conference call. He walks to his apartment. While walking along, he continues to participate in the conference call.

- o Luke's call is seamlessly handed over from the WLAN access network to the Cellular access network.

♦ Luke enters his apartment, continuing to participate in the call.

- o Luke's call is seamlessly handed over from the Cellular access network to the home WLAN access network, even though the enterprise WLAN and the home WLAN have different encryption keys.

♦ The conference call ends, and Luke terminates the call. As he's doing so, he notices the Call Waiting Indicator on his handset is alerting him of a missed call. He checks and discovers that a colleague has called back and left a message.

- o Luke's Centrex features, including call waiting indication, work over his 'home office' WLAN.

♦ Using AI's Centrex features, Luke speed dials his colleague, and completes a call to the colleague.

- o Luke's call origination Centrex features work over his 'home office' WLAN.

10 MULTIPLE IDENTITIES / SERVICE PROFILES

10.1 Service Profile Handling

10.1.1 Wireline Based Service Profile

♦ Joyce has wireline communications service from BTL, and wireless communications service from Cellular, Inc. She is in the mall, and sees a BTL kiosk where a new 'dual mode' wireless/wireline combined service offering is being promoted.

♦ After discussing various aspects of the service (e.g., coverage, costs, handset issues), she subscribes to the service.

- o Her service profile is based on her current wireline service profile with BT.

- o She gets a new 'dual mode' handset with Cellular and WLAN connection capability.

- o She gets a new ISIM for her handset.

NOTE -- Assuming the appropriate business and technical arrangements exist between BTL and Cellular, Inc., her wireless/wireline combined service profile could be based on either of her existing service profiles.

10.1.2 Wireless Based Service Profile

♦ Joyce has wireline communications service from BTL, and wireless communications service from Cellular, Inc. She is in the mall, and sees a Cellular, Inc. kiosk where a new 'dual mode' wireless/wireline combined service offering is being promoted.

♦ After discussing various aspects of the service (e.g., coverage, costs, handset issues), she signs up for the service

- o Her service profile is based on her current wireless service profile with Cellular, Inc.

- o She gets a new 'dual mode' handset with Cellular and WLAN connection capability.

- o She gets a new ISIM for her handset.

NOTE -- Assuming the appropriate business and technical arrangements exist between BTL and Cellular, Inc., her wireless/wireline combined service profile could be based on either of her existing service profiles.

10.1.3   Legacy Wireless & Wireline Personal Numbers

Joyce is a socially active citizen with a large pool of friends and acquaintances with whom she frequently communicates. She has a well-established wireline phone number (assigned by BTL) that many of her friends have used to stay in touch with her.

Additionally, she also has a cellular phone service from Cellular, Inc., and a large number of friends only know how to reach her by calling her cell phone number.

It's important to Joyce that friends are able to reach her by calling either of the contact numbers by which she is already known.

Joyce has noticed that, through some sort of business relationship, Cellular, Inc. and BTL are now offering a 'dual mode' service where she can get a handset that will work both on her WLAN at home, and through the cellular telephony access network while she is outside shopping or driving.

- When Joyce got the service, she was able to keep both of her 'old' phone numbers.

- Joyce is shopping in a local store. Her dual mode handset rings. It's a friend, Lee, who needs to ask Joyce a question.

    o Lee dialed her handset and was able to reach her in the supermarket (over the cellular network).

- After Joyce ends her call with Lee, the handset rings again. It's Joyce's sister, who needs to speak with Joyce.

    o Joyce's sister dialed Joyce's wireline number, but reached Joyce on her dual mode handset over the cellular telephony access network.

- After Joyce arrives home, her dual mode handset rings again. It's Lee again, with another question.

    o As before, Lee dialed Joyce's cell phone number, but this time the call was routed over Joyce's home WLAN.

- Soon the handset rings again. This time its Joyce's sister again, who needs to give Joyce some important information.

    o Her sister dialed Joyce's legacy wireline number and this time reached Joyce on her dual mode handset over the WLAN in her home.

- *Joyce's Experience*: She can be reached at either of two phone numbers, over different access networks.

10.2   Two Numbers, Two Service Profiles

User scenarios involving two service profiles are outside the scope of the initial version of this document, and are for further study.

11   VOICE EMERGENCY CALL

11.1   Kathy

Kathy enjoys the extended communication capability provided by her Voice Call Continuity service which is marketed by BTL as a 'dual mode' service that enables continuous seamless voice continuity

across their WLAN and Cellular access networks. She appreciates having wireless voice call continuity throughout her house, from the home theater in the basement, to the kitchen, and the living room upstairs. She expects emergency calls to work under similar conditions as voice calls, although she realizes that there are no guarantees that calls will always work.

♦ One day, her friend comes to visit. During the visit, they both go down to the basement.

♦ Suddenly, Kathy's friend faints.

♦ Kathy has her dual mode handset with her, and immediately dials 911.

♦ Kathy gets connected with a Public Safety Answering Point (PSAP). The PSAP responder asks Kathy to go find some smelling salts (ammonia).

♦ While talking to the PSAP responder, she runs upstairs, gets the smelling salts, and returns to the basement. The responder instructs Kathy on how to use smelling salts. Kathy's friend responds and is revived. Kathy thanks the responder, and ends the call.

11.1.1 PSAP Call Control

♦ One day, her friend comes to visit. During the visit, they both go down to the basement.

♦ Suddenly, Kathy's friend faints.

♦ Kathy has her dual mode handset with her, and immediately dials 911.

♦ Kathy gets connected with a PSAP. The PSAP responder asks Kathy to go find some smelling salts.

♦ While about to go upstairs to pickup smelling salts, Kathy accidentally hangs up, but runs upstairs with the phone anyway.

♦ Once upstairs, Kathy goes off-hook and asks the responder how to use the smelling salts. She thanks the responder and ends the call.

11.1.2 PSAP Ring Back Capability

♦ One day, her friend comes to visit. During the visit, they both go down to the basement.

♦ Suddenly, Kathy's friend faints.

♦ Kathy has her dual mode handset with her, and immediately dials 911.

♦ Kathy gets connected with a PSAP. The PSAP responder asks Kathy to go find some smelling salts.

♦ While about to go upstairs to pickup smelling salts, she accidentally hangs up. But, she runs upstairs with the phone any way.

♦ The PSAP responder hears Kathy hang-up and calls her back (via ring back capability), and is connected to Kathy via the Cellular network The PSAP responder tells Kathy how to use the smelling salts and disconnects the call.

11.1.3 Emergency Call Handover

♦ One day, her friend comes to visit. During the visit, they both go down to the basement.

♦ Suddenly, Kathy's friend faints.

♦ Kathy has her dual mode handset with her, and immediately dials 911.

♦ Kathy gets connected with a PSAP. The PSAP responder asks Kathy to go find some smelling salts.

♦ At this time, there is a power failure, and Kathy runs upstairs to continue her conversation with the PSAP responder.

♦ *Kathy's Experience*: Voice call continuity is provided for emergency calls, employing the PSAP capabilities in a similar manner as that for 'normal' voice calls.

12 VOICE SUPPLEMENTARY SERVICES

From the user's perspective, voice call supplementary service continuity between access networks should be consistently provided in the same manner as for voice calls. Supplementary services should work across access networks in the same manner as voice calls.

This section provides use cases illustrating supplementary service continuity for WLAN to Cellular access network cases. The same functionality is applicable in the Cellular to WLAN access direction, though such cases are not additionally articulated.

12.1 Call on Hold

♦ Kathy is in the local coffee shop.

   o She has Cellular and WLAN coverage.

   o An indicator on her handset indicates she has coverage for Cellular and WLAN.

♦ Her handset rings, she looks at the display, sees it's from her daughter, and answers the call. Her daughter is concerned about a rash that has mysteriously appeared on her foot, and she would like Joyce to come over and look at it.

   o She receives the call over the public WLAN access point in the coffee shop

♦ As Kathy is talking to her daughter, she gets another incoming call from her doctor. She hastily apologizes to her daughter, puts her on hold, and picks up the new incoming call. The doctor wants to discuss recent test results.

   o She has an active call and a call on hold.

♦ The background noise in the coffee shop is making it hard for her to hear what the doctor is saying. So she steps out of the coffee shop and walks across the street to the park where it is quieter, talking to the doctor the entire time.

   o As she leaves the coffee shop, she leaves the coverage area of the WLAN.

   o The indicator on her handset shows she has only Cellular coverage.

   o Her active voice call is handed over from the WLAN access to Cellular access.

   o She does not experience a service interruption .

♦ She finishes her conversation with the doctor, ends the call, and picks up her call on hold.

   o The call on hold was also handed over from the WLAN access to Cellular access.

♦ She agrees to go see her daughter, and concludes the call.

12.2 Call Waiting

♦ Kathy is in the local coffee shop.

   o She has Cellular and WLAN coverage.

   o An indicator on her handset indicates she has coverage for Cellular and WLAN.

♦ She is expecting an important call from her doctor. Her handset rings, she looks at the display, sees it's from her daughter (caller ID), and answers the call. Her daughter wants to ask Kathy a question.

   o She receives the call over the public WLAN access point in the coffee shop.

♦ As she is talking to her daughter, she gets another incoming call, and hears a Call Waiting tone. She looks at the display, and sees the call is from her doctor. She leaves the coffee shop to a quieter environment.

   o As she leaves the coffee shop, she leaves the coverage area of the WLAN.

   o The indicator on her handset shows she has only Cellular coverage.

   o Her active voice call is handed over from the WLAN access to Cellular access.

   o She does not experience a service interruption.

♦ She tells her daughter she'll call back as soon as possible, and picks up the waiting call.

   o The waiting call was also handed over from the WLAN access to Cellular access.

♦ She speaks with the doctor, and then afterwards calls her daughter back.

12.3 Call Forwarding

♦ Kathy is about to leave to visit her friend. There is no cellular radio coverage where her friend lives, and her friend also doesn't have broadband internet access, only wireline telephone service. Kathy doesn't want to miss her calls while she is at her friend's. She is currently in the basement of her home, and activates call forwarding (all calls) to her friend's phone number.

   o An indicator on her handset shows she has only WLAN coverage.

   o Call forwarding is successfully activated.

♦ While visiting her friend, her friend's handset rings. It's Kathy's friend, who needs to ask her a question.

   o Kathy's calls are forwarded to her friend's house.

   NOTE -- Kathy could have activated call forwarding, and any of the variants of call forwarding while attached to either the Cellular or WLAN access networks.

12.4 Three Way Call

♦ Kathy is in the local coffee shop.

     o She has Cellular and WLAN coverage.

     o An indicator on her handset indicates she has coverage for Cellular and WLAN.

♦ Her handset rings, she looks at the display, sees it's from her daughter (caller ID), and answers the call. Her daughter has an urgent medical question.

     o Kathy receives the call over the public WLAN access point in the coffee shop.

♦ Kathy remembers that her mother (Joyce) might know the answer to the question. She suggests they make a three way call to talk about it. She activates three way calling and establishes a call with both her daughter and mother at the same time. However, the noise in the coffee shop is making it difficult to hear, so she goes outside and crosses the street into the quieter environment.

     o As she leaves the coffee shop she leaves the coverage area of the WLAN.

     o The indicator on her handset shows she has only Cellular coverage.

     o Both of the active voice call legs are handed over from the WLAN access to Cellular access.

     o She does not experience a service interruption.

♦ After discussing and answering the question, Kathy ends the call.

     o Both legs of the three way call are disconnected.

12.5 Calling Line Identity Presentation

♦ Kathy is in the local coffee shop.

     o She has Cellular and WLAN coverage.

     o An indicator on her handset indicates she has coverage for Cellular and WLAN.

♦ Her handset rings, she looks at the display, sees it's from her daughter (caller ID), and answers the call. Her daughter has an urgent medical question.

     o Kathy receives the call over the public WLAN access point in the coffee shop.

     o Calling Line Id works.

♦ After talking about it, Kathy indicates that she does not know the answer to the question. Kathy ends the call. Kathy then leaves the shop and heads down the street.

     o She leaves the area of WLAN coverage and now has only Cellular coverage.

     o An indicator on her handset shows she has coverage for Cellular only.

♦ Her handset rings, she looks at the display, sees it's from her daughter (caller ID), and answers the call.

     o Kathy receives the call over the Cellular access network.

- o Calling Line Id works.

♦ Her daughter tells Kathy that a friend has answered the question. Her daughter ends the call.

12.6 Voice Mail Indicator

♦ Kathy is taking a shower. She gets an incoming call. Since she cannot answer the call, the caller leaves a message on her voice mail.

♦ Kathy has a dual mode handset and another phone that has only WLAN access. The voice mail indicator (visual message indicator) is seen on her dual mode handset as well as her other WLAN-only phone.

♦ She does not have time to retrieve the voice mail at home. She retrieves the voice mail on the road. The visual message indicator goes away on her dual mode phone. When she returns home, she does not see any visual message indicators on her WLAN-only phone.

13 VIDEO

From the end user perspective, service continuity between access networks should be provided for video services in a similar manner as is provided for speech services (to the degree such services are supportable by the underlying access network technology).

In the following use cases it's assumed that the circuit-switched cellular radio access network is not capable of supporting video services. However, an established CS voice call should be capable of becoming an IP multimedia service with support for service continuity.

13.1 Video Addition to Voice Call

♦ Luke is on his way to an important meeting with a client.

♦ His phone rings, looking at the calling name display he sees it's his boss (calling from the office) and he answers the phone.

- o He receives the call over the Cellular access network.

♦ His boss tells him the client is going to want to discuss their new advertising video. He has a copy and needs to discuss key points.

- o The Cellular connection does not support video transmission.

♦ Luke tells his boss that would be great, and he steps into a nearby coffee shop that offers public WLAN broadband connection.

- o A broadband connection is established, and Luke's speech call is handed over to the WLAN access network.

♦ Luke's boss runs the video application on his desktop PC, and initiates transmission of the advertisement.

♦ Luke runs the video application on his handset.

- o An IP session is established between the PC and handset, and Luke begins to receive the video.

♦ Luke and his boss discuss the advertisement. Luke gains insight into the key aspects, and is now prepared for the meeting.

    o Luke terminates the connection.

For Further Consideration:

♦ If a user is in an area with overlapping Cellular/WLAN radio coverage, and has an established Cellular connection, but not an established WLAN connection, can the user manually request a transition from CS to IP to enable video reception?

♦ Can the application request a CS to IP transition?

♦ Can the CS (e.g., Cellular) connection be maintained for speech while simultaneously establishing an IP (e.g., WLAN) connection for video transmission?

14 MULTIMEDIA

Consideration needs to be given to the desired behavior of applications from the end user and service provider perspectives when a multimedia session can no longer be sustained, but a single media session can be supported. This situation arises for example, when a user has an established WLAN IP based multimedia session, and moves out of the range of the WLAN into an area of Cellular coverage.

14.1 IP Multimedia to CS Speech

♦ Luke is in the coffee shop, and realizes the video conference call with his client has just started. He dials in, and joins the conference. The display on Luke's handset displays the figures and diagrams the client is discussing, Luke can hear what is being said, and provide comments.

    o Luke's connection is based on an IP multimedia session over the public WLAN.

♦ Luke tells his clients he will be there in five minutes (the client's office is close by), and he heads out of the coffee shop.

    o Luke leaves the coverage area of the WLAN, but has Cellular coverage.

    o The speech component of his multimedia session is seamlessly handed over.

    o The video component of his multimedia session is terminated (not supported by the new access network).

♦ Luke's video ends, but he is able to continue to participating in the conference call's dialog.

♦ He arrives at the client's site and continues the discussions, up to speed on the initial discussion.

For Further Consideration:

♦ What if a user has a laptop with both WLAN and wired Ethernet connectivity, has a multiplayer real time game established on his wired laptop, and the wired connection is terminated (due to mobility or accidental disconnections)? Can service continuity be provided between the wired connection and the wireless access network (WLAN)?

♦ What if a user has an established multiplayer real time game established over WLAN on his handset, walks into his house, and wishes to transfer the multimedia session to his PC without service interruption? Can wireless – wireline service continuity be provided?

♦ Should further consideration be given in general to wired Ethernet/ wireless LAN service continuity scenarios?