Technological Strategy of Using Personal Communications Services (PCS) for Numerous Business and Technical Opportunities

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Abstract

The area of personal and wireless communications is a burgeoning field. Technology advances and new frequency allocations for personal communication services (PCS) are creating numerous business and technical opportunities. It is becoming clear that an essential requirement for exploiting opportunities is the ability to track the dramatic changes in wireless technology. One of the major challenges for future personal communication systems (PCS) and personal communication networks (PCN) is the capacity needed to meet the growing demand. PCS provides the user with an all-in-one wireless phone, paging, messaging, and data service having a greatly improved battery-standby time.

Keywords: *Telecommunications Industry Association (TIA), Analog Control Channel (ACC), Analog Voice Channel (AVC), Digital Traffic Channel (DTC), Time-Division Multiple Access (TDMA).*

1. INTRODUCTION

PCS is a new generation of wireless-phone technology that introduces a range of features and services surpassing those available in analog- and digital-cellular phone systems. PCS provides the user with an all-in-one wireless phone, paging, messaging, and data service having a greatly improved battery-standby time. Personal Communications Service or PCS is the name for the 1900 MHz radio band used for digital mobile phone services in Canada, Mexico and the United States. Code Division Multiple Access (CDMA), GSM, and D-AMPS systems can be used on PCS frequencies. The FCC, as well as Industry Canada, set aside the frequency band of 1850-1990 MHz for mobile phone use in 1994, as the original cellular phone band at 824-894 MHz was becoming overcrowded. Dual-band GSM phones are capable of working in both the 850 and 1900 MHz bands, although they are incompatible with 900 and 1800 MHz European and Asian systems. However, GSM "world phones" (some of which are known as tri-band or quad-band phones, because they operate in three or four different frequency bands, respectively) offered by North American carriers support both European and domestic frequencies. Outside the USA, PCS is used to refer to GSM-1900. In Hong Kong, PCS is used to refer to GSM-1800.

The Telecommunications Industry Association (TIA) IS–136 specification is the basis of the time-division multiple access (TDMA) PCS air-interface technology. IS–136 is designed to operate in both the 800-MHz and the 1900-MHz frequency bands, thus providing seamless operation on cellular and PCS systems [2] [9] [11]-[19].

The **Digital** Control Channel (DCCH)

The DCCH forms the core of the IS–136 specification and is the primary enhancement to TDMA digital-wireless technology. It is a new control-channel mechanism added to the analog control channel (ACC), the analog voice channel (AVC), and the digital traffic channel (DTC) of the TDMA air interface. The IS–136 DCCH TDMA technology provides the platform for PCS, introducing new functionalities and supporting enhanced features that make PCS a powerful digital system.

Dual-Band Dual-Mode Operation

PCS dual-band phones operating at 800 MHz and 1900 MHz enable users to receive full PCS features and services for IS–136 systems wherever they roam. The dual-mode capability provides service continuity and interoperability between analog and digital networks. As a result, a PCS phone can provide access to all outdoor wireless services, be used in a private in-building system, and serve as a flat-rate digital cordless phone at home[1][4]-[11][15][17]-[21].

2. MESSAGING

PCS messaging is a digital SMS feature that allows a wireless phone to receive numeric pages and short text messages. This lets one device do the work of both pager and phone. Users can receive messages on their phone's display screens from a variety of sources: computers, telephones, e-mail, voice mail, and text dispatch (live operators take caller messages and send text messages to the PCS phone).

PCS uses the DCCH and DTCs to deliver the alphanumeric messages to and from the wireless phone. The messages are sent and received via a message center, which is a node on the wireless intelligent network. The messages contain a variety of attributes controlling their delivery, storage, and display behavior.

Message **Architecture**

Each network-originated PCS message consists of the following three basic elements:

- **addressing information—**tells the system to which phone the message is to be delivered
- **alphanumeric text—**the characters that make up the actual text message
- **message attributes—**tell the phone how to handle and display the message when it is received

Message Types

PCS messaging can deliver numeric-callback messages from a phone and alphanumeric messages sent via modem and computer. Examples of PCS messaging include paging and notification of new voice messages and e-mail messages. Messages of up to 239 characters can be sent over the air interface.

Operating Principle

The PCS messaging feature uses a dedicated paging terminal. When the network receives a PCS message, it locates the target phone and delivers the message. The phone notifies the user with a message icon, a beep, or both. The message can then be displayed and read. If users leave a PCS messaging area, the network stores any messages until they return. The network will repeatedly try to deliver a message until the phone is able to receive it.

Message Generation

The following entities can be used for PCS message generation:

- networking from existing paging terminals
- voice-response unit
- live operator text-dispatch service

- dial-up modem
- e-mail gateway
- data information source
- voice-mail system

Figure 1 shows a PCS teleservice messaging scheme in which a message is formulated in a personal computer (PC) and sent to the phone of the message recipient. Phone-screen displays differ depending on model and manufacturer, but they all show the number of new messages.

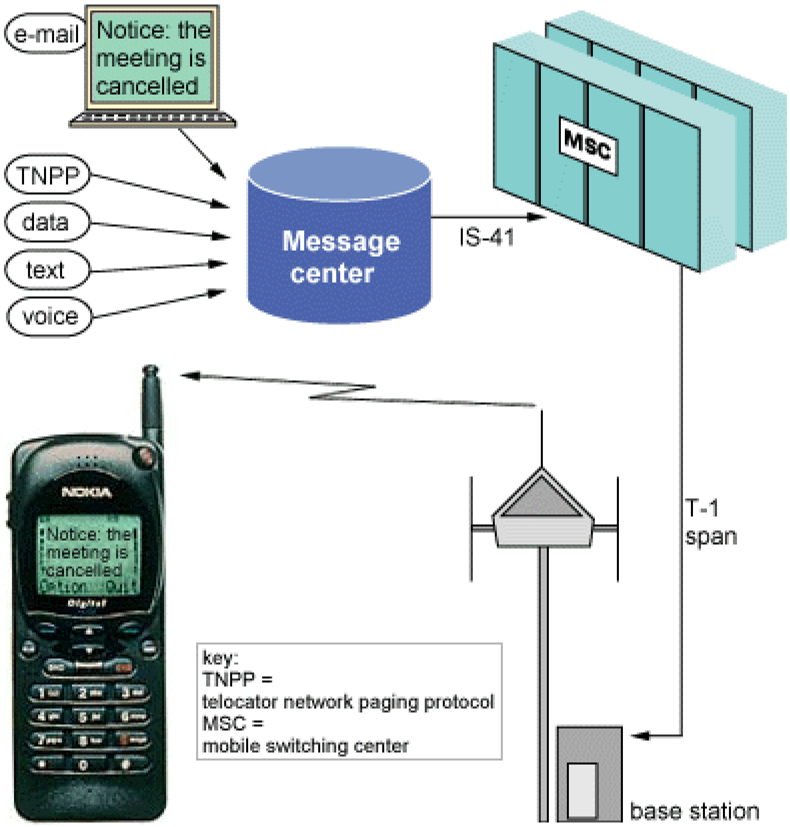

Figure 1. PCS Teleservice Messaging Scheme

Message Delivery

PCS messaging is designed to operate in practical, everyday situations.

- **power on**—If the phone is powered on, the message is available immediately just like a pager.
- **phone engaged**—If the phone is engaged in a voice conversation, the network delivers the message to the phone using the same DTC being used for the conversation.
- **power off**—If the phone is powered off, or the phone is out of a service area, the network message center stores the message for later delivery. As soon as the phone is powered on, the messages are delivered. This way messages are not missed if a phone is off, out of a service area, or in an area with poor reception.
- **voice mail**—When a caller reaches a user's voice mail, the system provides the option to send a callback-number message to the phone or to send an alphanumeric message using special Message Flash software.
- **roaming**—If the user is roaming in an area not supporting PCS messaging, the message center will store the message and deliver it when the phone reenters a PCS–supported area[17][20]-[31].

3. PUBLIC, PRIVATE, AND RESIDENTIAL SYSTEMS

PCS phones can behave differently according to the type of system providing service to the user. For example, phones providing only basic service might not reselect or camp on private cells, thereby improving their time to service. Similarly, phones providing service on a residential system, such as a PBS, might perform different scanning routines in order to find their home system.

Operating Principle

PCS uses IS–136 identity structures to categorize each cell into three basic network types—public, private, or residential—and allows the phone to react to serving cells based on the broadcast identifiers of those network types. In other words, the phone can discriminate between, and access, different network systems and distinguish the types of services available on particular cells. Because a cell can have a mix of network types and subtypes, it can have a mix of services.

Figure 2 shows some network system configurations.

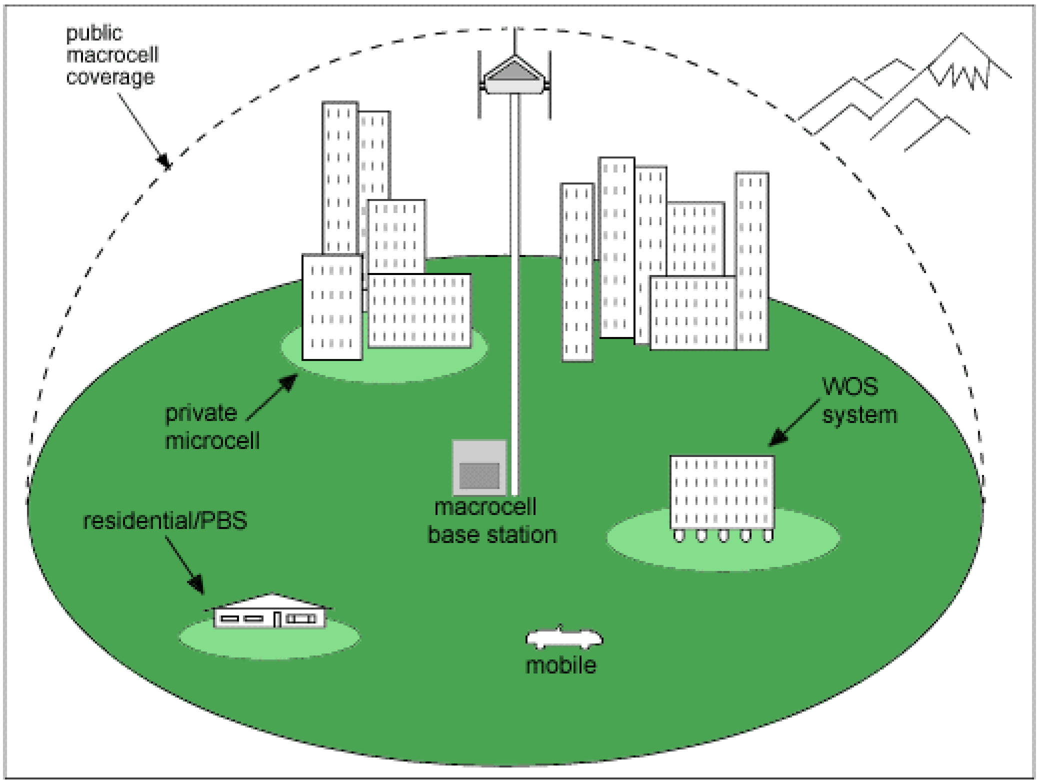

Figure 2. Network System Configurations

Network Types

Designations for the major network types and the subtypes include the following:

- **public**—The public designation refers to cells that provide the same basic cellular service to all customers.
- **private**—These cells provide special services to a predefined group of private or WOS customers only, and do not support public use of that cell. The private designation is used for in-building company systems with specific features.

- **semi-private—**A subtype, these cells provide basic service to all customers and also provide special services to a predefined group of private customers. An example would be a cell providing service to a WOS system as well as to public users.
- **residential—**These cells provide special services to a predefined group of residential customers only, and do not support public use of the cell. The PBS that allows a cellular phone to behave like a cordless home-phone is classed as a residential system.
- **semi-residential—**A subtype, these cells provide basic service to all customers and also provide special services to a predefined group of residential customers. This type is used in a neighborhood where the public macrocell is also providing residential cellular service.
- **autonomous—**These are cells that broadcast a DCCH in the same geographic area as other DCCH systems but are not listed as a neighbor on the neighbor list of the public system. Examples of autonomous systems include the PBS and private systems that are not coordinated with the public system. Phones must perform special frequency-scanning algorithms in order to find autonomous cells [1] [3] [9]-[16].

4. SYSTEM IDENTITIES

A system-identity structure allows PCS phones to distinguish between public, private, semiprivate, and PBSs. This IS–136 feature facilitates the creation of private systems and allows control of phone behavior around a WOS, PBS, or residential service area. The IS–136 technology includes private-system identifiers for marking specific base stations as part of a private system, HCSs for defining cell preferences, and new registration features to complement private systems.

Operating Principle

- **private system identities (PSIDs)—**A PSID is assigned to a specific private system by the system operator to identify it to phones in the coverage area of the system. PSIDs are broadcast so that a phone can determine whether it has special services from a particular cell when reselecting a DCCH.

  PSIDs can be assigned on a sector-by-sector basis within a cell, which allows very small service areas to be defined. Alternatively, many cells, as well as systems, could broadcast the same PSID to create a geographically large virtual private system. Phones that recognize PSIDs notify the system and can activate location ID to inform users that they have entered the private system.

  A single DCCH can broadcast up to 16 PSIDs, allowing the support of up to 16 different private systems on one DCCH. This feature is useful in a technology park or campus where it would not be economical to support a DCCH for each small business requiring WOS features.
- **residential system identities (RSIDs)—**In a manner similar to a PSID, a RSID identifies a residential system within the public cellular and PCS coverage. RSIDs can be used to create residential-service areas or neighborhood residential systems by broadcasting an identifier that is recognized by phones as being at home and therefore receiving special services (for example, billing). A primary use of RSIDs is in the PBS, which allows a cellular or PCS phone to be used like a cordless phone in conjunction with a residential base station [7] [10] [29] [31]-[34].

5. COMPARISON

Figure 3 illustrates the wireless cellular 800-MHz spectrum and the PCS 1900-MHz spectrum.

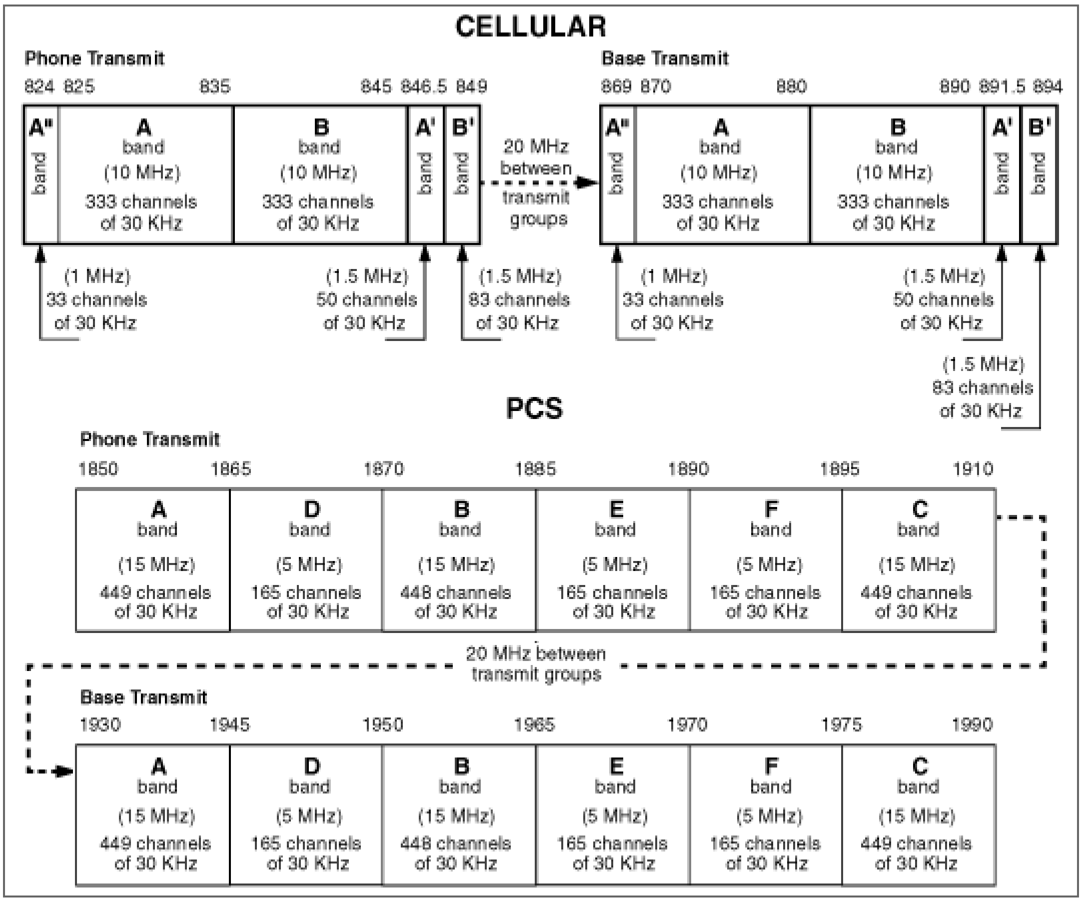

Figure 3. Comparison of Cellular and PCS Spectrums

6. FEATURES AND CAPABILITIES

Table 1 shows important PCS features and capabilities.

Feature	**Capability**
sleep mode	extends phone standby time and enhances battery life
short message service (SMS)	transfers alphanumeric messages to and from cellular and PCS phones
voice and data privacy	increases resistance to eavesdropping
superior voice quality	results in less background noise and fewer dropped calls
hierarchical environment	provides support for macrocell-microcell operation
intelligent rescan	allows tighter control of system selection
private and residential system IDs	provide more simplified and controlled wireless office service (WOS) and personal base station (PBS) features
seamless roaming	enables roaming between frequencies using dual-band phones and provides support for international roaming

circuit-switched data support	provides highly reliable data transmission for wireless e-mail, faxing, and Internet access
authentication	increases phone security and resistance to cloning
calling number identification (CNI)	allows callers to be identified before answering
message waiting indicator (MWI)	notifies users that they have voice-mail messages
text dispatch service	Live operators take caller messages and send text messages to the PCS phone.

Table 1. PCS Features and Capabilities

7. CONCLUSION

All PCS phones display the name of the wireless carrier providing service. If a phone also has WOS coverage, the location ID feature can display a company name or a system banner to inform subscribers that they have entered their private system. This can be particularly important when there is a billing or service difference that should be indicated to the subscriber. The identifying name or banner is removed from the display when the subscriber leaves the WOS coverage. A non-subscriber entering a WOS service area would continue to have only the wireless carrier name displayed.

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Article received: **2009-03-01**