

INFRASTRUCTURE FOR PCS TELEPHONY

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Abstract

This paper discusses infrastructure issues and requirements for the provision of Personal Communications Services (PCS) by non-traditional telephony providers such as cable TV (CATV) operators. PCS infrastructure includes items such as switching, OAM and mobility management. Many non-traditional PCS providers do not currently possess such switching, network and OAM capabilities as are currently in place for LEC and Cellular systems.

INTRODUCTION

The objective of this paper is to discuss the infrastructure requirements for CATV provided wireless telephony, touching briefly upon potential deployment options and evolution strategies. It is important to realize that the North American telecommunications industry is undergoing tremendous change, as PCS spectrum becomes available, as wireless/fiber/coax technologies are deployed, as business alliances occur and as the regulatory environment unfolds. As recent CATV PCS trials and FCC filings have proven, cable TV companies are poised to enter the telephone business.

There are many aspects to providing telephony and PCS services. While PCS is often equated with wireless access,

this is not necessarily the case. Personal Communications Services are oriented towards allowing the user to originate or receive calls anywhere on the network and allowing the user some measure of control over their service parameters. For the new entrant, providing PCS will first involve dealing with basic telephony areas such as acquiring directory numbers, selecting subscriber features, billing and switch operation. PCS is incremental to this basic telephony infrastructure including aspects such as mobility and enhanced service management.

PCS telephony infrastructure can be divided into the areas of switching, OAM (Operations, Administration and Maintenance), mobility management, auxiliary services and 'other'. The switching function requires consideration of PSTN connectivity, routing, directory numbers and features. OAM includes maintenance, provisioning, inventory billing and performance. Mobility management concerns radio handoff between cells as well as tracking the user between switches and across the network. Examples of auxiliary capabilities are directory assistance, voice mail and operator service. 'Other' areas not directly related to making or receiving calls, are overhead activities such as yellow pages, bill collection, staffing and vehicles. All of these infrastructure items may be the direct concern of the CATV PCS provider or handled by

leasing or partnership arrangements. This paper will focus upon the switching, OAM and mobility aspects of PCS infrastructure.

PCS telephony is expected to involve a multiplicity of players, each bringing a different set of advantages and capabilities to the PCS industry. The types of companies expected in the business include Local Exchange Companies (LECs), cellular companies (cellcos), cable TV companies (CATV), Interexchange Carriers (IECs), paging companies and new entrants. Alliances are forming, as could be expected, between players having complementary capabilities. Examples are IEC/cellco/CATV alliances where the IEC provides the toll network, the cellco provides switching and the CATV operator provides the access distribution. A PCS provider may also choose to lease facilities from a non-allied company, perhaps until such time as they could purchase their own facilities.

The multiplicity of players involved in the PCS industry requires capability at several levels. These levels are the access area, the switching area and the network area. See Figure 1. Access providers require wireless, coax, fiber and interface technologies. Switching providers need wireline, wireless, local mobility and possibly partitioning capability. Network providers need PCS databases and inter-switch PCS signaling.

Furthermore, each player in the PCS business will not accept unnecessary dependencies upon other players. For instance, a CATV company will desire the ability to changeout RF technologies without waiting for network standards

development. An optimum partitioning between network, switch and access areas is essential to provide this decoupling. Such a decoupling will allow PCS providers to work with a variety of switch and network configurations, allow multivendor solutions and provide high performance systems. Careful interface definition is critical in this regard.

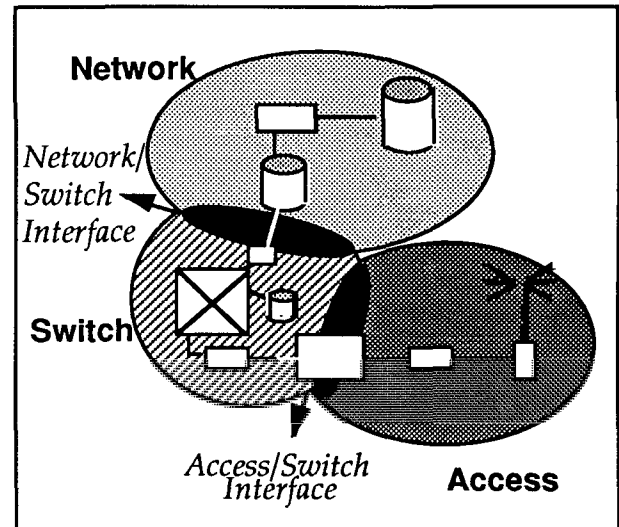


Figure 1. General PCS Architecture

SWITCHING

Switching characteristics (eg. translation, routing, billing and features) for basic telephony are well understood. What is significant are those requirements particular to CATV PCS. An initial view of CATV PCS switching requirements is as follows:

- shareable: there may be several new entrants in a given city who may wish to share the startup costs of a switch or there may be a separate company which would own and partition the switch for interested parties. The switch should also be

shareable in the sense of regulatory colocation.

- scaleable: initial low subscriber penetrations will have a higher per subscriber cost. It would be desirable that this could be mitigated by a modular approach. Initial subscriber densities will be sparse as well which would mean that the switch would be serving a large geographical area.
- wireless service mix: a reasonable subset of the hundreds of residential and business features should be available to the wireless PCS subscriber.
- applicable to both wireline and wireless users: the PCS concept covers both fixed and mobile terminals. Wireline services are still required in those areas where spectrum is not available or where the CATV company is providing services such as high speed data.
- decoupling from access media and air interface detail: the subscriber's switched services should be independent of whether the access backhaul is copper, fiber, coax or wireless. The OAM overlay concerning access hardware detail should be layered away from subscriber services.
- OAM overlay: OAM should be layered and provided via common channel signaling so that the CATV PCS provider is not forced to integrate all OAM (especially access maintenance) with switching. And,
- standard interfaces: switch interfaces should be layered, standardized and use generic modern instruction sets.

MOBILITY

PCS mobility is complex. However, there are still fundamental requirements which can be derived.

Mobility should be layered. There are three general layers:

- i) mobility inherent in radio management: this is neighborhood handoff. It may be caused by the user moving between adjacent cells of the same base station, by shadowing (eg. a truck drives between handset and primary antenna) or by interference. Such handoffs may occur rapidly and their messaging does not generally percolate up to the switching layer.
- ii) access mobility: handoff where more intelligence is required because the user is moving between some sort of system boundaries although still subtending a single switch/PBX. An example would be campus mobility. And,
- iii) network mobility: handoff between switches which involves the use of network level protocols and databases.

Mobility should be provided via optional layered modules. For instance, a PCS provider may not choose to provide network level mobility as a service but may very well wish to acquire neighborhood or campus mobility products. It should be realized that network and national mobility are not synonymous. Interswitch mobility within a single large city would still require network level signaling.

OAM

Operations, administration and maintenance (OAM) involves all aspects of running the system to provide service. Operations includes items such as customer management, installation and performance monitoring. Administration includes functions such as provisioning service, provisioning equipment, inventory and billing. Maintenance includes repair and preventative activities.

The extent of PCS OAM performed by the CATV company depends upon the access implementation chosen as well as by the CATV company's decision to operate their own switching and auxiliary functions. For instance, choosing to provide in-home cordless telephone coverage would require dedicated attention on a per household basis, whereas outdoor shared neighborhood coverage would involve a reduced number of units to administer. However outdoor units, subject to weather, could be individually more expensive to maintain.

OAM is computing intensive. The ability of CATV PCS platforms to evolve and to interwork with those of potential business partners is critical. Standards and layered implementations are required. Common channel signaling (CCS) is required so that OAM messages specific to a given service/transport provider can be routed to the appropriate center. CCS based OAM also allows the CATV company some autonomy as opposed to being locked into one vendor or partner's OAM system.

ECONOMICS

Economics for CATV PCS are based upon figures from several sources. Many models are available to determine PCS system costs. Relative values illustrated in Figure 2 are based upon average representative figures.

Switching

One of the initial questions which the PCS provider must decide is whether to buy or lease local switching products. Leasing is assumed to be from a non-affiliated company.

An examination of public domain telecommunication company annual report data (ie. LEC or cellco) provides one with some of the inputs which would be required to decide what potential leasing charges would be. Parameters such as the Cost of Goods and Services (COGS) provide the operating costs which a lessor would hope to recoup. It is critical to consider whether the lessor would provide OAM and other overhead services as these are costs which the CATV company would itself have to absorb anyway. It is also important to consider the different traffic rates that CATV PCS may load onto a given type of switch as well as the increased OAM that may be associated with sophisticated PCS services.

OAM

OAM costs were based upon an average of public domain annual report data and other literature. This includes functions related to the cost of providing service and does not include other per

subscriber expenses such as depreciation.

One should be aware that literature showing wireless OAM costs to be lower than existing wireline does not take into account the additional investment and education that the new entrant would have to incur. Many overhead activities such as those mentioned in the introduction are required in order to become a telephony provider.

Mobility

Costs for mobility are extremely variable as they depend upon the architecture chosen. The degree of layering between access, switch and network mobility functions will determine the amount of messaging, processing and speeds required. Even the particular air protocol chosen impacts the cost of mobility as a comparison between AMPS and GSM interfaces will show.

Mobility costs were divided into access mobility and network mobility. Access mobility is that subtended by a single switch. Network mobility is interswitch. The model chosen assumed that access mobility did not interact with the network. This is not necessarily the case with some systems currently under standards development.

Economics Conclusions

A comparison of cost components for CATV PCS is shown in Figure 2. The key result is that switching and OAM costs are, in general equal to or greater than the access portion. Mobility is a smaller cost element and could perhaps

be left as a service option until revenues are sufficient to drive this additional investment.

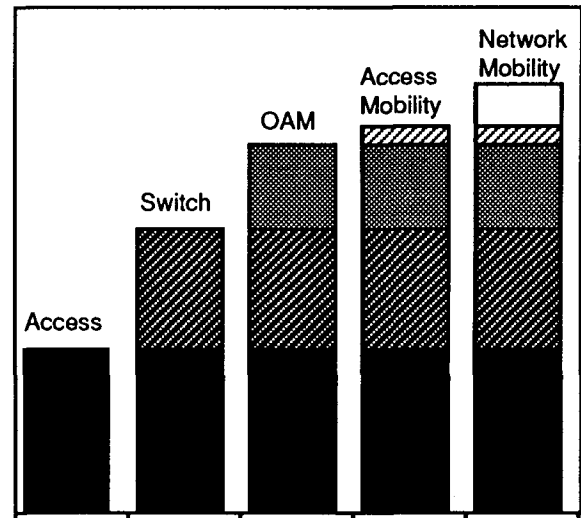


Figure 2 - Relative Cost Components per Subscriber

General Conclusions

Conclusions arising from an examination of the infrastructure requirements for new entrants in PCS telephony are that:

- the cost of switching and OAM could be greater than or equal to the access hardware capital investment.
- standard PCS switch interfaces are essential.
- the feasibility of switch ownership during initial deployment will depend upon the lessor's strategy to recoup investment and offer overhead services.
- the OAM costs of PCS for a new entrant could potentially be lower than existing wireline. However, PCS services will require more intensive administration and the new entrant will

have to learn overhead activities associated with telephony service. And,

- mobility capability should be layered, optional and standardized.

References

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