Supplementary Report:

An Engineering Assessment of Select Technical Issues Raised in the 700 MHz Proceeding

Prepared for

Free Press

Media Access Project

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I. Introduction

This Supplementary Report presents the results of an engineering evaluation of some of the issues raised by the Further Notice of Proposed Rule Making with respect to the 700 MHz auction currently under consideration before the Federal Communications Commission.

This Supplementary Report was prepared in July 2007 by Columbia Telecommunications Corporation (CTC) at the request of Free Press and Media Access Project. The Report adds additional analysis to CTC's May 2007 Report, "An Engineering Assessment of Select Technical Issues Raised in the 700 MHz Proceeding" regarding technical issues on how to allocate spectrum in the upper tier of the 700 MHz band to best serve the public interest and to make viable emergence of a "third pipe" broadband alternative to cable modem and digital subscriber line (DSL) services. Specifically, this Supplementary Report:

- Describes how an open access/large channel plan enables higher burst speeds per customer than does a multiple/small channel plan even if the aggregate bandwidth allocation is the same.
- Explains why an Internet Protocol-based open access plan does not limit the number of potential service providers on the single network -- unlike a scheme where separate service providers have a fixed number of finite, separate channel blocks.
- Discusses how open access wireless could enable technical innovation in both services and devices.
- Explains that the open access plan facilitates competitive access by all providers who agree to comply with the selected technical standard, and that industry standards have been used effectively by the Commission in previous matters.

II. A Large Open Access Allocation Will Enable Greater Peak Speeds Than Will Multiple, Smaller Allocations

It is a given that the nature of wireless communications imposes limits on capacity. No technology or configuration, including open access, will remove this limitation or in any way increase potential aggregate capacity relative to a traditional closed platform network. CTC's May 2007 Report was not intended to suggest that this aggregate would be increased.

Rather, it is CTC's engineering analysis that higher burst speeds per customer are possible over a large, open access channel plan than over the same bandwidth allocated into smaller, closed blocks, *even assuming the same number of service providers, same number of customers, and same level of use*.

Put another way, lower burst speeds would be the inevitable result of chopping up the spectrum into narrow single-provider blocks rather than allowing multiple providers to share a larger block of the same aggregate size. An open access plan uses the same aggregate bandwidth and enables the same number of providers to offer services – and simultaneously *maximizes the potential per-customer speeds available over the spectrum*.

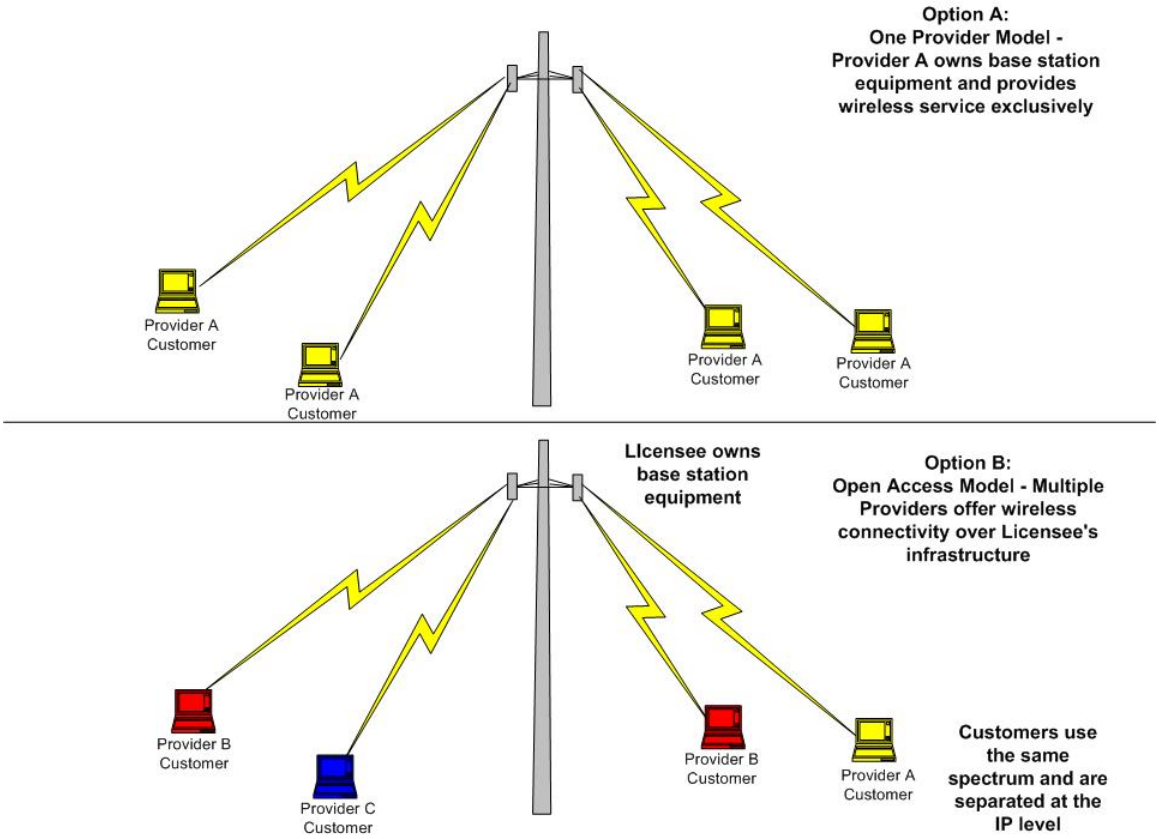
This great benefit is achieved because an open access environment eliminates the need to segment the spectrum into smaller spectral channels to allow multiple providers to use it. With the use of IP technology, a spectrum block can simultaneously be used to serve customers from multiple service providers. Communications to and from customers can each use the entire spectrum block, not segments allocated to individual service providers within the environment. As a result, the burst capacity available to an individual customer will not be sharply reduced relative to a single-provider system, as it would be if the customer's service provider had a smaller channel size.

The end result is that customers will be able to receive a level of capacity from the spectrum *comparable to what they would be able to receive if the entire block were allocated to a single service provider*. The open access environment will not necessarily cause a customer to receive a "partial" experience simply because his/her service provider shares the spectrum with others.

Similarly, a given sector of a wireless system will serve approximately the same total number of customers as if it were only serving customers of a single provider. In the open access environment, some of these customers will receive service from one provider (Provider A), some from another (Provider B), and so on. There is no free lunch, however—the best way to think about it is that the total number of customers in an open access environment (Provider A + Provider B + . . . + Provider Z) would be roughly

equal to the total number of customers served by a single provider using the same spectrum, protocols, and approximate mix of services (Figure 1) .

Figure 1: Operation of Licensee Architecture in an Open Access Environment



III. IP-Based Open Access Does Not Impose Technical Limits on the Number of Service Providers

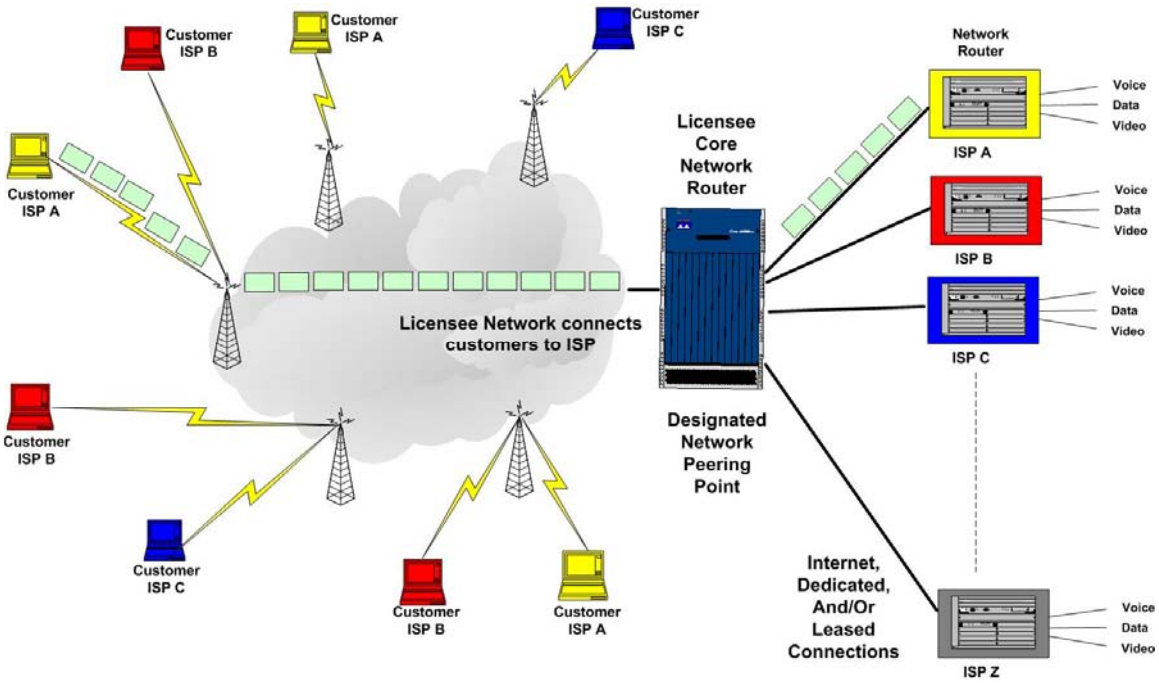
Significantly, the open access plan, which uses Internet Protocol (IP), does not impose a technical limit on the number of providers on the system. IP enables routing of customers to separate service providers on the shared radio network operated by the Licensee. Unlike a scheme where separate service providers have a fixed number of finite, separate channel blocks, the IP technology imposes no built-in limit on the number of potential service providers.

Under the open access plan envisioned here and in CTC's May 2007 Report, the Licensee network provides the communications link between the customer and the customer's service provider. IP routing technology directs the packets based on the source address of the customer or other identifying information. Transmissions through the Licensee network can be prioritized and can be carried through secure tunnels. Service providers

can connect to the Licensee network at one or more designated peering points. The service providers can connect at the peering point using a range of methods, such as leased communications, dedicated fiber optic links, or the Internet (see Figure 2).

This proposed setup is based on tried, extensively-used technologies. IP technology is the basis of Internet and private intranet communications and has been extensively tested in lab and field environments. Facilities-based ISPs are effectively using IP to enable customer access to multiple ISPs. For example, Time Warner Cable systems provide access to Earthlink and other ISPs through the Time Warner cable modem network. Similarly, the TacomaClick! network in Tacoma, Washington provides access to several local ISPs over its network using IP as the mechanism. In the wireless IP open access area, Earthlink operates networks in Anaheim and Philadelphia, among other places, that enable customers to reach multiple retail service providers that contract with Earthlink, which provides the wholesale service. These and other providers have effectively accomplished open access using existing IP technologies such as source-based routing, virtual local area networks (VLANs), virtual private networks (VPNs), and multi-protocol label switching (MPLS). Each of these technologies is widely used in public and enterprise networks.

Figure 2: Licensee Provides IP Packet Transport Between Customer and Service Provider



IV. Open Access Enables Device and Service Innovation

From a technical standpoint, an open access network could stimulate valuable additions to the existing types of broadband wireless devices and services. Within the parameters

of a designated standard technology,[1] retail service providers and equipment manufacturers could innovate with a range of services and consumer electronics. The explosive growth of WiFi standard equipment, now embedded in most new laptop and PDA devices, as well as cameras and home electronics, is a useful example of the degree of engineering innovation possible. Ideally, the technical innovation could be pursued by any service provider, content provider, or technology entrepreneur -- regardless of whether they are affiliated with the Licensee or any incumbent service provider.

Device innovation could impact development of common devices such as PC cards, embedded devices in laptops and PDAs, and telephones. Innovation may also stretch to less traditional devices such as cameras, heavy appliances, utility meters, medical devices, IP radios, and alarms.

Traditional service providers could continue to provide existing data and voice services, which would not be precluded by the open access configuration. And in addition, both incumbents and new entrants would have opportunity and incentive to innovate to provide new services. Service innovation could arise such new entrants as medical institutions, educational institutions, banks, utility companies, community organizations, and security companies—entities that do not have access to existing wireless broadband spectrum.

V. The Licensee can Use Industry Standards to Facilitate Effective Spectrum Use – as the FCC Has Mandated in Other Cases

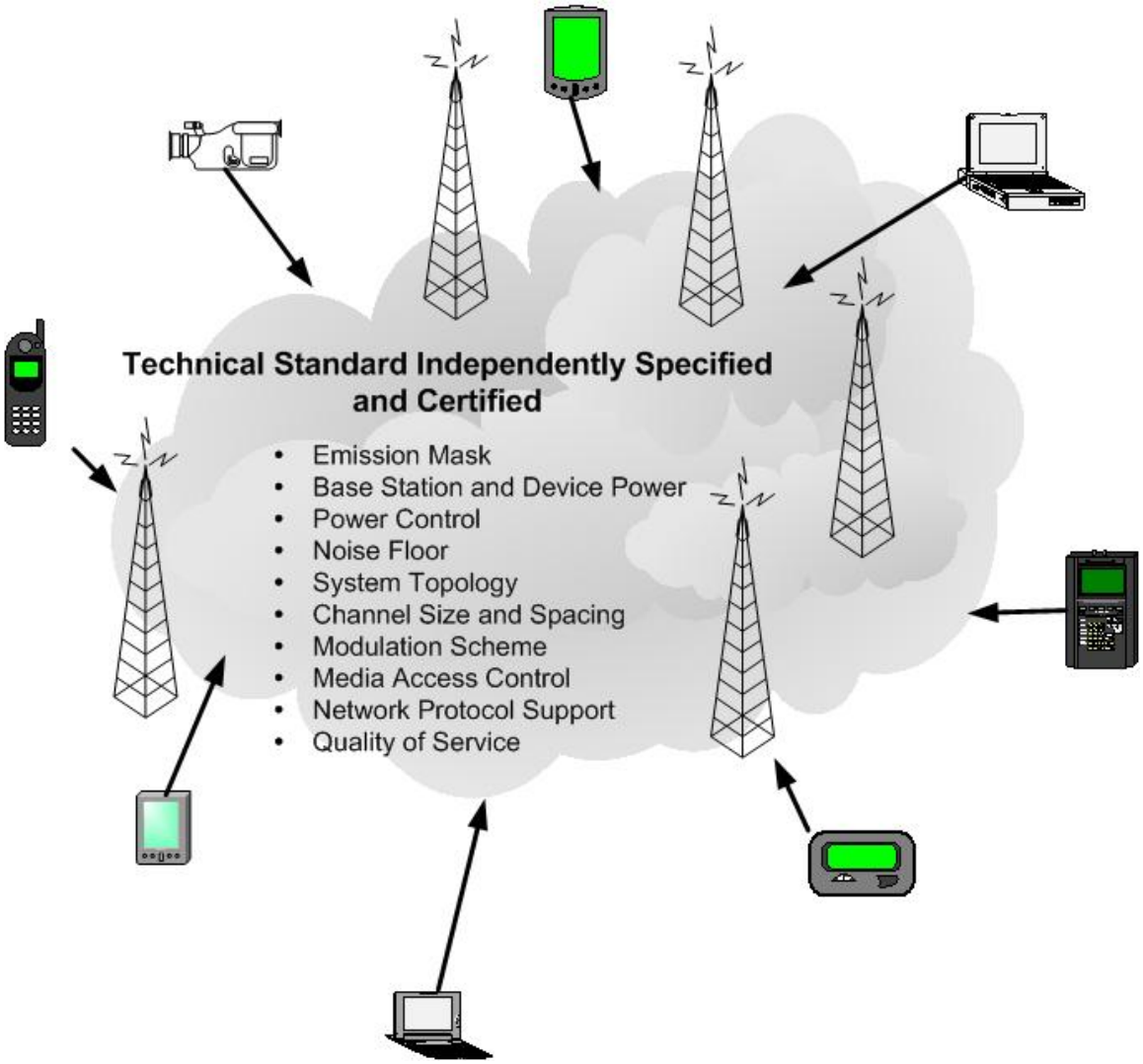
The open access plan does not preclude compliance with industry standards. Rather, the open access plan is intended to facilitate competitive access by all providers who agree to reasonable technical standards and requirements. It is important to note that open access does not suggest chaos—on the contrary, it enables multiple providers to operate cooperatively (but competitively) over the same network in a way that is smooth and not evident to the user.

To facilitate this goal, the Licensee would select an industry standard according to procedures and criteria agreed to by the Commission. Only devices certified under this standard should be allowed so as to make efficient use of the spectrum and effectively use technologies such as adaptive power. Devices should be tested and certified by an independent standards body to conform to the requirements of the standard, including the use of a particular emissions mask, receive sensitivity and transmission power, quality of service, and media access control (Figure 3). In addition, the Licensee should have the latitude to designate a meet point between the Licensee and service provider network and to use the features within the standard to optimize aggregate performance of the network

[1] Several suitable technical standards could be designated by the FCC and/or Licensee, including but not limited to variations of WiMAX, LTE, and EVDO.

in a manner that does not technically discriminate against particular service providers or services.

Figure 3: Use of Standards-Compliant Technology



Such a requirement would not be unusual – rather, it would be grounded in the Commission's successful prior efforts. In other instances, FCC has required that detailed standards be followed to provide wireless services in licensed spectrum.

One recent example is the Commission's requirements with respect to high-definition (HD) radio. HD radio technology enables radio broadcasters to provide digital audio and data services in the AM and FM broadcast spectrum in the same band as the existing radio stations. Care was necessary to do no harm to those signals because the system must work effectively, and the technology must enable the existing licensed services to continue operating in the same band. In order to provide HD radio services, the HD radio

programmer must be compliant with standards including National Radio Systems Committee NRSC-5-A.[2] Broadcasters must implement this particular standard and may not substitute any competing standards, and it is not permitted for equipment or broadcasters to omit portions of the standard unless explicitly permitted by the standard itself. The requirements include the emission mask, channel coding, modulation, interleaving, packet encapsulation, and error correction. The standards group is sponsored by the National Association of Broadcasters (NAB) and the Consumer Electronics Association (CEA).[3]

Similarly, the Commission decided it was in the public interest to require use of a detailed industry standard in order to "efficiently and rapidly" enable broadcasters to begin digital service and selected the iBiquity in-band, on-channel (IBOC). The commission had initiated an NPRM, had studied the issue and technical alternatives, had identified the need to select a uniform technical approach, and selected the iBiquity solution as an interim approach pending a further NPRM.[4]

[2] http://www.nrscstandards.org/Standards/NRSC-5-A/NRSC-5-A.pdf, accessed July 5, 2007.
[3] Ibid.
[4] FCC 02-286, http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-02-286A1.pdf, accessed July 5, 2007.