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ANALOG OUTLOOK WHITE PAPER

QUALCOMM

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Wireless solution providers must constantly track the trends in network technology in order to optimize their offerings. In recent years the transition process from analog to digital cellular technology has created significant difficulties in technology planning. QUALCOMM Wireless Business Solutions (QWBS) has an unparalleled track record for wireless technology planning in its platforms, applications, and services, ensuring customer satisfaction and long-term service availability.

Based on an FCC ruling in 2002, cellular carriers in the United States can stop providing service using analog (AMPS) technology beginning in February 2008. The period between 2002 and 2008 was provided so that there would be sufficient time to migrate device populations from analog to digital. At this time, there are millions of analog devices still in use; therefore the transition to eliminate analog technology across the country will still be gradual when it begins in 2008. However, the analog "sundown" will start to occur quickly in some of the largest cities after the specified date. Understanding this process and how it will take place is important when considering long-term wireless network choices. In particular, providers of enterprise class mobile wireless solutions must focus on long-term assurance of service for their customers. This white paper explains key economic forces underlying the transition from analog technology to digital in the US, and will help clarify what should be expected.

Analog cellular technology remains important because it provides over 99% coverage of population, and 80% coverage of geography. Mobile wireless solutions that require ubiquity essentially must include analog cellular technology or satellite, and sometimes both. Solutions that apply analog cellular can furthermore choose between a "circuit switched" approach, which uses a voice connection with a modem to send data, or a "control channel" approach. Control channel technology makes use of small data messages that are normally used for unit cell registration and call setup. These same message formats can be used to send and receive short data messages for telematics and telemetry. The leader in analog and digital control channel messaging services is Aeris.net (www.aeris.net) with its "Microburst" technology. Most solutions that use cellular control channel messaging today apply Microburst.

QWBS and Aeris.net each have extensive business relationships with cellular carriers because both companies provide solutions that operate over the cellular networks. In fact, the two companies combined have relationships with virtually all of the carriers in North America. In certain products, QWBS applies Aeris.net network services, and QWBS has collaborated with Aeris.net in establishing this outlook regarding the future of the analog networks. To summarize, the shared view is that:

1. Analog service will be discontinued in certain major urban markets shortly after February 2008; on the scale of months not years.
2. The degradation of analog across the less populated areas of the country will happen very gradually, probably spanning another five years or more.
3. It is virtually certain that the analog control channels will be eliminated at the same time as the voice channels as carriers discontinue analog service in urban areas.
4. It is expected that GSM-based carriers will be more aggressive in removing analog as opposed to competitors using CDMA technology because the capacity advantage provided by CDMA reduces the need to recover the spectrum that is currently utilized by analog systems. (Major GSM carriers include Cingular and T-Mobile; major CDMA carriers include Verizon and Sprint.)

To understand the process for analog network transition, the underlying economic forces that drive carriers' technology decisions must be analyzed. Their decisions to maintain or deploy infrastructure are made by assessing the costs of deployment and operation versus the ability to generate revenues on that infrastructure.

There are three primary reasons that digital technology is replacing analog:

1. Digital provides a great deal more network capacity per unit of spectrum, allowing carriers to serve more subscribers.
2. Digital provides new capabilities such as Internet access, creating new revenue streams with existing subscribers.
3. Digital phones have far greater battery life, which allows subscribers to use their phone more, therefore increasing revenue per subscriber.

The primary disadvantages of digital at this time are:

1. Less network coverage than analog (until completion of the digital transition).
2. Higher phone cost versus analog (until analog phone volumes shrink further).

In many of the largest urban areas in the US, carriers are capacity constrained based on their licensed spectrum. This means that in those areas, the carriers have a high motivation to shut down their analog service and deploy additional digital systems in that spectrum. It costs far too much to continue providing analog service because of the lost revenues due to capacity constraints on their digital networks. In this situation, the cost advantage of the analog phones is far outweighed by the network economics. This causes the carriers to subsidize digital phones to a greater level, and to drive the transition to digital. It is noteworthy that most new phones sold in the past few years are already digital-only. Consistent with this, cellular chipset providers such as QUALCOMM are generally eliminating analog technology from the new chip designs they are introducing.

In rural areas in the US, the carriers' motivations are entirely different than in the urban areas. They have fewer available subscribers and therefore their systems do not reach spectrum capacity constraints. This means that they have less motivation to transition to digital technology. Even when they deploy digital, they have an ability to continue running analog side by side with digital because they have adequate spectrum. This allows them to pursue new revenues with digital services while maintaining service to analog subscribers. They have less motivation to subsidize digital phones at a different level than analog phones, therefore some cost-sensitive subscribers continue to choose analog phones that propagate the analog network service. Finally, a larger portion of rural carriers' revenues come from phones roaming onto their networks, which motivates them to maintain multiple technologies in their network so they can serve the broadest possible mix of phones on a roaming basis.

Because of the distinct differences between the carriers' motivations in large urban areas versus rural areas, analog technology will initially "sundown" in the large cities. The carriers that are most capacity constrained will cease analog service first (generally the GSM carriers), followed by their competitors in those markets. The shift in the networks will accelerate the volume shift from phones with analog technology to phones with digital-only technology. This shifts the mix of devices that are roaming onto the rural carriers' networks toward digital. It also accelerates the manufacturing volume shift to digital so that digital phones become less expensive than analog. Over time, these trends cause the analog usage on the rural carriers' networks to diminish, until it is no longer economically attractive to maintain their analog network service.

It was noted previously that analog networks support circuit-switched technology as well as control channel messaging. It is possible to have control channel messaging without voice service, but not voice calling without the control channels. Maintaining analog control channel messaging still requires allocation of a minimum block of spectrum and maintenance of the system. The amount of revenue associated with control channel messaging is very small versus the revenues in voice calling. On that basis, maintaining analog control channel messaging alone would be economically unattractive. Recognizing that analog control channel degradation will occur along with voice, Aeris.net has established its digital Microburst service in order to provide service continuity. Forward-looking providers of wireless solutions that use Microburst have transitioned as rapidly as possible to devices that support digital Microburst, so that the degradation of the analog network will not negatively impact its customers. Analog-only solutions will begin to experience network degradation in 2008.

When network analog network degradation begins, devices that are analog-only (whether circuit-switched, Microburst, or both) will begin to experience reduced network availability. When the network availability degrades to an unacceptable point, these devices will have to be replaced or have a major upgrade (to digital) to resume operation at an acceptable performance level.

QUALCOMM's business solutions are designed for unsurpassed reliability and length of service to the customer in order to maximize return on investment and customer satisfaction. To achieve this, the trends in network technology are monitored closely, and products are developed based on this insight. QUALCOMM's multi-mode solutions will maintain continuity of network service throughout the transition from analog to digital technology.

About QUALCOMM Wireless Business Solutions

QUALCOMM provides companies around the globe with industry-leading mobile platforms, applications, and services that are ideal for mission-critical applications and enhanced security. Products include the OmniTRACS® and OmniExpress® mobile communications system and the GlobalTRACS® equipment management system. QUALCOMM solutions feature location monitoring, security alerts, productivity-enhancing applications, and wireless advisory and managed network services. These products serve a variety of industries including transportation and logistics, third-party logistics, and construction.

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