Next-Generation Wireless Infrastructure: A Heavy Reading Competitive Analysis

EXECUTIVE SUMMARY

After a long gestation and difficult birth, third-generation (3G) wireless is finally here. More than two dozen vendors now offer network infrastructure for CDMA2000 and GPRS/EDGE/UMTS networks. And service providers are putting the technology to use: Nearly two dozen UMTS and more than 80 CDMA2000 networks are now in commercial service.

Those launches represent only a tiny fraction of the total number of wireless networks in service, so the market for 3G equipment will have significant upside for years to come. Despite persisting questions about the high costs of 3G deployment (particularly regarding spectrum licenses), wireless service providers have little choice but to upgrade to 3G for at least four reasons:

1. Although voice continues to drive the lion's share of revenue at virtually all operators, it's a commodity. Current-generation networks support low-speed data, but like voice, it's not much of a market differentiator. The high-speed services enabled by 3G are operators' best long-term shot at differentiating themselves and tapping new revenue streams.

2. Even as data usage grows, voice service will remain a priority; in some cases, upgrades can increase voice capacity. For example, although EDGE is a data technology, it can free up capacity for voice by shoehorning more data into the same amount of spectrum as GPRS.

3. Competition is entrenching itself: One immediate threat is 802.11 public "hotspot" services. Their geographic coverage is a drop in the bucket compared to mobile networks, but they're in enough places and offer enough bandwidth to be able to siphon off at least the cream of the crop: business users. That demographic is coveted because historically it's been an early adopter of new telecom services, paying a premium in the process. Any further delay in the rollout of 3G risks ceding at least part of the high-speed data market to 802.11.

4. Some operators use dead-end technologies that can't be upgraded to 3G. For example, most analog and TDMA operators are in the midst of switching to CDMA or GSM as their first step in a migration to 3G.
Next-Generation Wireless Infrastructure: A Heavy Reading Competitive Analysis delivers a comprehensive overview of available equipment, including detailed technical information on dozens of products and vendors. The products covered in this report include:

- CDMA2000 base stations
- GSM/GPRS/EDGE base stations
- UMTS Node Bs
- CDMA2000 microcells and picocells
- GSM/GPRS/EDGE microcells and picocells
- UMTS microcells and picocells
- CDMA2000 base station controllers (BSCs)
- GSM/GPRS/EDGE BSCs
- UMTS radio network controllers (RNCs)
- Gateway GPRS serving nodes (GGSNs)
- Serving GPRS support nodes (SGSNs)
- Packet data serving nodes (PDSNs)
- Home agents
- Accounting, authentication, and authorization (AAA) servers

The report analyzes 145 different products from 34 manufacturers (21 public companies and 13 private companies), comparing vendor offerings using more than a dozen different operating, performance, and physical specifications. Comprehensive product matrices yield more than 2,300 different data fields allowing for direct comparisons of product specs. Dozens of interviews with equipment makers and service providers supply critical context for information in the product matrices, pinpointing the most crucial areas of comparison.

Key Findings

Key findings of the report include the following:

Wireless service providers are spending again on 3G equipment and technologies. In its May quarterly report to the U.S. Securities and Exchange Commission, Cingular Wireless said that it plans to spend about $3 billion in 2004 to upgrade its network. Verizon Wireless spent $1 billion in the first quarter of 2004 alone. Even operators that were among the first to deploy 3G still have a long way to go. One example is Vodafone: In May 2004, the company said that only 25 percent of the potential customers in its major markets are covered by 3G.

Despite its drawbacks, 3G represents the most efficient upgrade track for wireless service providers. There are alternative ways to deliver high-speed data, including 802.11 and WiMAX. But while WiMAX potentially will deliver much more bandwidth than 3G, it lags 3G by years – a lifetime in technology – in terms of equipment availability and real-world deployments. Operators can't wait for the technology to mature. Although some operators already offer 802.11 services in limited areas, such as airports, the cost of deploying enough access points to offer coverage comparable to 2G and 3G undercuts the business model. The bottom line: For all but a few operators, alternative data technologies like 802.11 are complements to 3G service, not substitutes.

Pricing pressure is enormous in the base station sector and is unlikely to decrease. Prices of Node B equipment have fallen by more than 60 percent in the past 12 to 24 months. If anything, vendors will be under more pressure to slash equipment prices. One reason is that mergers such as Cingular Wireless’s pending acquisition of AT&T Wireless are creating more “super-operators,” whose scale gives them enormous bargaining power.

CDMA450 is a promising emerging market that has attracted some of the biggest players in the industry. CDMA450 is 1X or 1xEV-DO technology deployed in the 450MHz band, which is...
an attractive frequency because each cell site can cover more geography than at higher frequencies, reducing overhead costs. There are already several commercial deployments, and the selection of base stations for this band is growing. Major vendors such as Ericsson, Huawei, Lucent, Nortel, and ZTE have announced or begun shipping CDMA equipment for this band.

Many wireless infrastructure suppliers are loath to disclose meaningful technical information about their products – a strategy that can put them at a competitive disadvantage. The wireless industry is built on standards, and in a standardized market, technical information is the best way to differentiate between products. Yet the amount of publicly available technical information varies significantly from vendor to vendor. Given the quality of technical data being delivered openly by many vendors, companies that continue to hold their cards close to the vest run a real risk of losing new customers, especially as operators streamline their purchasing processes.

Microcells and picocells represent a significant growth area for wireless infrastructure vendors, but few vendors offer these products today. Microcells and picocells are essentially mini base stations in terms of features such as physical size, so they can be deployed faster and in more places than their larger cousins. These products solve real problems, especially for filling coverage gaps and adding capacity in high-traffic areas. Although the selection of microcells and picocells is smaller than that of full-size base stations, we feel that this sector has significant upside. Vendors that don't get into this market may be making a mistake.

Partnerships among next-gen equipment makers abound, and many have borne fruit. For example, Starent Networks’ nearly three-year-old partnership with Samsung has helped open doors in key regions such as Asia, where wireless data usage is at levels that justify major investments in packet infrastructure. Other examples include the joint venture Ericsson Juniper Mobile IP, Airvana's deals with Ericsson and Nortel, Eastern Communications' relationship with InterWave and Motorola, and MobiSphere, a joint venture between NEC and Siemens.

UTStarcom is bulking up as it aims to become a dominant player in the CDMA space. In March and April of 2004, the company announced plans to acquire the assets of Hyundai Syscomm and Telos Technology. Individually, these acquisitions don't represent significant leaps over the competition, but together they improve the company's overall position by deepening its know-how and relationships and by eliminating some of the competition.

ZTE is moving aggressively to establish itself beyond its home market in China. In March, ZTE announced plans to build a CDMA base station factory in Brazil. The China-based company also has plants in India, Pakistan, and Russia. These four plants are attempts to establish beachheads in countries with low wireless penetration and significant operator interest in CDMA.

Report Structure

Next-Generation Wireless Infrastructure: A Heavy Reading Competitive Analysis divides next-generation wireless infrastructure into five categories, each of which is covered in an individual section of the report:

- CDMA2000 and GSM/GPRS/EDGE base stations, and UMTS Node Bs
- Microcells and picocells
- BSCs and RNCs
- GGSNs and SGSNs
- PDSNs, HAs, and AAA servers

Each section begins with a detailed overview of the product sector, followed by an analysis of the key points of comparison for products in that sector, broken out into performance, operating, and physical specifications.
Excerpt 1: “Key Points of Comparison” from Section 2.1 of the report
The product matrices in this section compare base stations by 17 different operating, performance, and physical criteria. Regardless of whether they use CDMA or GSM, operators typically look at several key features when comparing base stations. The following are the most important:

**Key Operating Specs:**

- **Bands:** The base station obviously should be available in the frequency band(s) for which the operator has a license. Common choices include 800 MHz, 900 MHz, 1.8 GHz, 1.9 GHz, and 2.1 GHz. A relatively new choice is 450 MHz, discussed in Section 2.10.

- **Standards and Upgradeability:** The base station should support the latest 3rd Generation Partnership Project (3GPP) or 3rd Generation Partnership Project 2 (3GPP2) standards for GSM/GPRS/EDGE/UMTS or CDMA, respectively, and it should be upgradable to the next revision of those standards. Those upgrades should be accomplished primarily via software rather than through swaps of major pieces of hardware. (Some caveats regarding upgradeability are discussed below.)

- **Backhaul interfaces:** "Backhaul" is catchall term that describes the link connecting two pieces of network infrastructure, such as a base station and a BSC. These generally run over wired networks (e.g., copper, fiber) but can include wireless, particularly microwave.

**Key Performance Specs:**

- **Output Power:** Power is a major factor in determining a cell site's coverage area, which is important because the greater the area covered by each site, the lower the operator's capital expenses (capex) and operating expenses (opex). However, power is less of a concern in densely populated areas, where cell sizes are limited more by the number of simultaneous users that a base station can support.

- **Receive Sensitivity:** A second major factor that determines a cell site's coverage area is receive sensitivity, or the ability "hear" and maintain a usable connection with callers who are anywhere from hundreds of feet to a couple of miles away. Again, the greater the area covered by each site, the lower the operator's capex and opex. A highly sensitive receiver can also be useful in dense urban areas, where users may be nearby but generating weaker signals because they're inside a building or otherwise obstructed.

- **Capacity:** Blocked and dropped calls are the bane of wireless operators, because they represent lost revenue. If the problem is chronic, it can translate into high customer turnover. A base station should be able to support the operator's current traffic loads, and it should scale easily and cost-effectively to accommodate growth. Capacity is typically measured by the number of carriers or transceivers supported. The term "carrier" in this context refers to the radio frequency (RF) signal that carries voice and data traffic. The number of voice or data channels that can be carried by a carrier depends on the technology. The role of capacity in differentiating base stations is discussed in detail below.

**Key Physical Specs:**

- **Size and Weight:** A base station's physical attributes are particularly important in urban and suburban locations, where space is often limited, expensive, or both. For example, a rooftop might be the best place for a cell site, but it might not be an option if the rooftop can't support a half-ton cabinet. In many cities, opposition to new towers is fierce, so if two vendors' base stations offer comparable performance, the one that's smaller and thus better able to fit into an existing cell site will have an edge.

End Excerpt
Excerpt 2: CDMA Base Stations – Operating Specs

<table>
<thead>
<tr>
<th>Vendor</th>
<th>Product Name</th>
<th>Bands (in MHz)</th>
<th>Standards Supported</th>
<th>Upgrade-ability</th>
<th>Standard Backhaul Interfaces</th>
<th>Optional Backhaul Interfaces</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airvana Inc.</td>
<td>IP-RN 8000</td>
<td>800, 1800, 1900</td>
<td>IS-856 (CDMA2000 1xEV-DO)</td>
<td>IP</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>AirWalk Communications Inc.</td>
<td>AW-96</td>
<td>450, 800, 1800, 1900, 2100</td>
<td>1X, DO</td>
<td>DV</td>
<td>IP</td>
<td>ATM, T1/E1</td>
</tr>
<tr>
<td></td>
<td>Airbridge BTS3606A</td>
<td>–</td>
<td>1X, DO</td>
<td>DV</td>
<td>E1/T1/STM-1</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>Airbridge BTS3612</td>
<td>450, 800, 1900, 2100</td>
<td>TIA/EIA IS-2000, IS-97D, IS-856, TIA/EIA IS-866</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>LM Ericsson</td>
<td>RBS 1130</td>
<td>450, 800, 1900, 2100</td>
<td>TIA/EIA IS-2000, IS-97D, IS-856, TIA/EIA IS-864</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>RBS 1131</td>
<td>800, 1900, 2100</td>
<td>TIA/EIA IS-2000, IS-97D, IS-856, TIA/EIA IS-865</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>RBS 1140</td>
<td>800, 1900, 2100</td>
<td>TIA/EIA IS-2000, IS-97D, IS-856, TIA/EIA IS-866</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>RBS 1143</td>
<td>800, 1900, 2100</td>
<td>TIA/EIA IS-2000, IS-97D, IS-856, TIA/EIA IS-867</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Lucent Technologies Inc.</td>
<td>Flexent CDBS</td>
<td>800, 1900</td>
<td>CDMA2000 1X (IS-2000) 850MHz; TIA/EIA ANSI-95 1.9GHZ; ANSI-J-STD-008</td>
<td>–</td>
<td>2 x T1/E1 per baseband unit</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>Flexent Modcell 4.0 - Indoor</td>
<td>850, 1900 ready; 300 to 2100 capable</td>
<td>ANS J-STD-008 for 1900; T1A/E1A 95-A plus TSB-74; T1A/E1A 95-B for 850MHz; CDMA2000</td>
<td>–</td>
<td>12 x T1/E1 per frame</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>Flexent Modcell 4.0 - Outdoor</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>8 T1/E1</td>
<td>–</td>
</tr>
<tr>
<td>Nortel Networks Corp.</td>
<td>Univity Metro Cell - Indoor</td>
<td>450, 800, 1900</td>
<td>CDMA2000 1X, 1xEV, IS-95</td>
<td>DO</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>Univity Metro Cell - Outdoor</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Samsung Corp.</td>
<td>SCBS-500 - Indoor</td>
<td>800, 1900</td>
<td>IS-95, CDMA2000 1X, 1xEV-DO, 1xEV-DV</td>
<td>W-CDMA via software &amp; channel card</td>
<td>E1/T1</td>
<td>E3/T3, STM-1</td>
</tr>
<tr>
<td></td>
<td>SCBS-500 - Outdoor</td>
<td>800, 1900</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Telos Technology</td>
<td>iCell (macro version)</td>
<td>–</td>
<td>IS-95, 1X</td>
<td>–</td>
<td>IP 10/100 BaseT</td>
<td>–</td>
</tr>
<tr>
<td>UTStarcom Inc.</td>
<td>MovingMedia 2000 BTF-2300</td>
<td>800, 1900</td>
<td>1X, IOS</td>
<td>1xEV-DO</td>
<td>ATM</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>MovingMedia 2000 BTF-2404</td>
<td>450</td>
<td>1X, 1xEV-DO, IOS</td>
<td>Upgrade from omni to 3 sector, 1FA to 3FA</td>
<td>ATM</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>MovingMedia 2000 IP-BTS-181A</td>
<td>1800 ready; 450, 800, 1900 optional</td>
<td>1X</td>
<td>DO</td>
<td>IP / Ethernet</td>
<td>–</td>
</tr>
</tbody>
</table>
The report is essential reading for a wide range of industry participants, including the following:

- **Next-gen wireless systems vendors**: How do your products compare with those of your competitors? Are you able to present your customers with an accurate portrayal of the value of your products compared with those of the competition? What are the key advantages that you hold over each of your rivals? What are the areas you need to address to maintain a competitive edge in the marketplace?

- **Wireless service providers**: Are your suppliers delivering the best systems on the market, or do other vendors have equipment that better meets your needs? What products are available now to meet your most critical needs, such as filling nagging gaps in coverage areas? Can comparative product data help you to negotiate more aggressive pricing deals with your current suppliers?

- **Suppliers of wireless components and subsystems**: Are you reaching the entire potential market for your products? Which systems vendors are making the most aggressive moves into new product lines? How does your product portfolio match up with likely market demand from systems manufacturers?

*Next-Generation Wireless Infrastructure: A Heavy Reading Competitive Analysis* is published in PDF format.