Why Smart Antennas & Subscriber Device Based Enhancements Are Important to Wireless Service Providers
Factors Driving More Spectrally Efficient Technologies beyond Standards Work

- Three primary areas that are drivers for higher spectral efficiency
  - Continued growth in wireless subscribers and in the voice and data demand forecasts
  - Financial pressure to lower the cost of providing service to the end customer at the same time, improving the wireless customers overall wireless experience
  - Government (local and Federal) regulations that place a premium on Spectrum, restrict land use and cell site locations, plus a push by regulators on licensees to adopt more spectrally efficient technology
Two Approaches

- Smart Antenna Technology
- Terminal Based Performance Enhancement
How Sprint is Addressing the Challenge outside of Standards

- For the last 3 ½ years, Sprint has been partnering with the industry in the development of network and subscriber based advanced antenna technology that will benefit the CDMA community at large.

- For example:
  - Sprint participated in the CDG effort to develop the Service Operators requirements for Smart Antenna technology.
  - Sprint has and continues to work with each of our infrastructure suppliers on the development and testing of cost effective smart antenna solutions.
  - Sprint has and continues to work with ‘Third Party’ solution providers to evaluate both network and subscriber based advanced antenna solutions.

- Our goal
  - Increasing the spectral efficiency of the CDMA air interface by two or more times with a single solution and providing higher gains with a combination of both network based and subscriber based solutions.
Smart Antenna Technology
Motivations for Sprint’s Actions

- In the Sprint PCS network
  - For all of the sites in which traffic exceeds capacity thresholds,
    - 51% of the sites only have one sector that exceed the capacity limits
    - 38% of the sites have two sectors that exceed the capacity limits
    - And only 11% of the sites have all three sectors exceeding the capacity limits
  - Thus for 100% of the capacity deployed, only 53% of the capacity is utilized
    - If capacity utilization is broken down on a per carrier basis, the utilization drops to lower than 33% for large number of carriers

- Bottom Line:
  - Wireless service providers are paying for capacity upgrades to multiple sites in order to address capacity demands on some of the sites
  - **Smart antenna technology can improve this situation**
    - When deployed per sector, SA allows the operator to address capacity where additional resources are needed, increasing the utilization of every deployed carrier
How do Smart Antennas Provide the Operator Better Capacity Utilization (1)

- Today, hot sectors trigger the need for capacity growth, however, as in this example 7 sites, only 3 of the 21 sectors need capacity growth.
- This means that only 14% of the sectors are demanding capacity relief.
How do Smart Antennas Provide the Operator Better Capacity Utilization (2)

- Today, either three cell splits or a carrier overlay would be required to address this capacity situation – assume a carrier overlay is used.
- If a carrier addition costs $100K per site, then this carrier overlay would cost the service operator $700K.
How do Smart Antennas Provide the Operator Better Capacity Utilization (3)

- With Smart Antenna solutions, the actual 3 sectors needing additional capacity are given a capacity upgrade.
- Assuming that SA cost $100k per sector carrier, the total cost of this capacity upgrade would be $300K or 57% less than the cost of the carrier overlay.

Cost For Carrier Add versus SA Add

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Sprint
Terminal Based Performance Enhancement
Increasing Network Capacity via the Mobile Terminal

- Not all capacity gains have to be based as infrastructure solutions
- For the last 18 months, Sprint has been working with the subscriber device manufacturers to pursue advancements to improve subscriber device performance with the goal to:
  - Increase the link performance to any mobile by at least two times
  - Working to drive down cost of these enhancements by leveraging technology such as zero-IF
  - Test and prove that these enhancements provide both the capacity gains and the cost benefit that make the solutions attractive to the service operator
What are the Subscriber Based Solutions

- Multiple solutions are in development today, however, in order to simplify the discussion, when terminal based performance enhancement (TBPE) solutions are described in this presentation, it refers to any solution that provides up to or more than two times gain in spectral efficiency and can include such technologies as:
  - Mobile Receive Diversity
  - Smart Receive Antenna solutions that dynamically select the best path to receive
  - Multi user interference reduction
TBPE Provide Gains with Every New Terminal provisioned in the Network

- Efficiency gains are only realized if the penetration of the handset base is large enough, thus these solutions must be implemented into every device.
- Benefits from enhancements in the subscriber device not only benefit the service operator, but also the end customer.
  - Sprint’s testing with enhanced subscriber devices on a CDMA2000 1X network yielded average data rates of up to two times better for the enhanced device versus non-enhanced mobile terminals.
  - Improved handset technology like mobile receive diversity or other subscriber based smart antenna solution will provide more reliable coverage, especially in areas of poor RF coverage.
  - Lower incidence of dropped calls will be an additional side benefit from enhanced RF processing in mobile terminals.
Network Capacity Gains from TBPE

Realized Capacity Gain for Terminal Based Performance Enhancement
As a function of the amount of penetration (new sales plus handset churn)
and the amount of gain provided by the solution
Network Impacts due to TBPE Solutions

Demand vs Capacity for MRD Gain of 100%, 75%, and 50%

Period when Capacity exceeds Demand

% Growth Year over Year

2005 2006 2007 2008

Sprint®
The Strength of Combined Technology

For the service operator, the combination of network based smart antenna solutions plus subscriber based advanced antenna solutions represents a large opportunity to:

- Decrease the amount of CAPEX spent each year to address capacity in the network
- Address capacity at the source of the capacity issue rather than throwing blanket solutions at the capacity challenges
- Reduce our dependency on relying on the FCC to allocate more spectrum to continue our business and reduce the amount of dollars spent to acquire new spectrum in markets where spectrum limits pose a challenge
- Improve customer satisfaction with better performance through few dropped calls, better data performance and better coverage overall
What are the Benefits to the Supplier Community

- In today’s economic environment, the service provider has to become more economically efficient, Wall Street and our shareholders demand that we lower the cost to provide more reliable service to our customer base. This means finding better ways to serve the customer and we are motivated to derive these gains in the most efficient manner possible.

- Smart Antenna technology and subscriber based smart antenna solutions represent a new opportunity for infrastructure suppliers to address a new line of revenue in an environment where service operator spending continues to decline.

- Smart Antenna technology and subscriber based smart antenna solutions offer a solution to the service providers to spend money on technology rather than on spectrum, which is and will continue to be a challenge for the service operator.

- The combined strengths of all advanced antenna solutions, both network based and subscriber based, allow the supplier community to begin to address solutions that reliably achieve broadband experiences for the mobile user, allowing the service operators to address new market segments that cannot be addressed with current technology.

- Advancements like smart antenna technology and TBPE will help move wireless service to the primary means of communication, which will mean continued business for the service operator and the supplier community.
Conclusion

- Service operators need to get ‘smarter’ with how we address capacity in our networks
  - Voice demands continue to increase as do the number of subscribers, placing stress on our networks
  - The cost of and limited amount of spectrum restricts the service operator from pursuing this as an alternative to growing our capacity in the top markets
  - Traffic imbalances in our network make utilization of the deployed capacity very low, decreasing our economic efficiency
- Smart antenna solutions in the infrastructure and in the subscriber device help the service operator intelligently address these current challenges and at the same time,
- Smart antenna solutions provide the supplier community a new opportunity to revenue in an ever shrinking capital spending environment