Enterprise Femtocell Deployment Notes
Small Cells In The Network

New devices and applications are creating problems which cannot be easily fixed with new macro sites

Outdoor Coverage Holes
• Still a major customer dissatisfier
• Exacerbated by greater data loads

Capacity Hot Spots
• Exponentially increasing data loads
• Nomadic customer behaviour

Limited Spectrum Options
• Expensive and limited supply
• Takes years to clear incumbents

Indoor Coverage & Capacity Issues
• Premium business customers are heavy users
• Customer retention: Business and consumers

Small Cells provide an economically attractive solution to many problems
A Femtocell For Enterprise Applications

Together Sprint & AirWalk have brought the first ever enterprise-grade CDMA Femtocell to market:

Sprint® AIRAVE™ pro connect

The Sprint AIRAVE Pro Connect brings the mobile network inside the building directly to the mobile users by deploying an attractively styled wall mounted Enterprise Femtocell.

Key Product Specifications:
• CDMA2000
• Dual Mode: 1X and EV-DO
• 60 simultaneous users
• SIP/IMS core
• 200mW power

Key Benefits:
• Exceptional in-building service
• Enhanced coverage
• Dedicated offload capacity
• Fast field deployment
• Eco-friendly solution
Exceptional In-Building Service

Provides dedicated capacity & coverage for enterprises to ensure high revenue customer base satisfaction

- Professionals are relying on mobile devices for data as part of their daily business activities
- Exponentially increasing data traffic must be served
- Business users have particularly high data consumption
- Voice being used on mobile handsets rather than land lines
- Benefits also extend to public institutions and venues

Installations
- Enterprises
- Offices
- Universities
- Gyms
- Government Buildings
- Manufacturing Facilities
- Emergency Response Teams
- Public Venues
- Shopping Centers
- Coffee Shops
- Hotels
- Airports
- Many others

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Office Building Example

A typical installation consists of an Enterprise Femtocell mounted on a wall in a suburban ground floor office building

- Wall mounted for installation simplicity and appearance
- Attractive styling to blend in with the office surroundings
- Flexibility to support a variety of antenna configurations
  - Integral antenna or remotely mounted antenna

20,000 sqft facility, single floor
Ease Of Installation

Essential to simplify physical and electrical installation

- **Fulfillment Kit**
  - All parts and components to complete self installation
  - On-site technician support is not normally required
- **Wall mount bracket kit simplifies physical mounting**
  - Single stud attachment with surface offset
  - Recesses for power supply and excess cable storage
- **Unrestricted access to electrical connection points**
Ethernet, GPS & RF Connections

**Easy access and connection of Ethernet/GPS/Antenna**

- Housing design shields connections from view
- Ethernet connection to the existing local LAN
  - Local access to LAN settings is critical for enterprise applications
  - Allows IT managers to maintain control over their network
- GPS antenna connections
  - Required to support CDMA system timing
  - Also supports location verification features
- Integral or external antenna options
Automatic Self Configuration

Comprehensive self configuration capability supports “Plug’N’Play set up and operational readiness

- First Run capability to support initial configuration
  - Factory default ID and URLs
  - Find the security gateway and establish a link
  - Find the O&M system and establish a link
- Open management interface: TR-069/196
  - Proprietary management systems support
- Automatic software version control
  - Download new versions, if required
- Pre and Post provisioning modes can be supported
  - Pre provisioning provides less set up traffic impact
- Indicators provide a view of self configuration progress
  - Provide useful feedback if self configuration process fails
- White list delivery & maintenance
- RF configuration & optimization

* Some features are O&M system dependent

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Warehouse Example

Larger venues such as warehouses require different coverage profiles and power settings compared to offices

- Venues will have different coverage area requirements
- Automatic RF configuration tools must accommodate different cases
- Management of potentially greater macrocell interference

90,000 sqft facility; Single floor plus mezzanine
Interference Management

Automatic RF configuration and interference mitigation features enable touchless installation and protection against interference

- Operator RF database provides key information
- Local measurement of RF environment
- Parameter selection and power setting
- Venue/Dwelling type indicator – Large/Medium/Small
- Dedication and Shared channel support
- Interference Mitigation mechanisms

Equipped With

UltraSON™

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Controlling Beacon Interference

Provides reliable mobile acquisition and registration, but also must be managed to prevent interference

- Idle mode hand-in via hopping Pilot Beacon
  - Layered beacon sequences help control acquisition
- Macro mobile interference protection (MMIP/GUMP)
- Second receiver essential for MMIP/MMIP operation

Equipped With UltraSON™

FemtoCell Near
Macro Connected Mobile

Macro (FA 3)

Carrier Hopping Sequence 2nd Rx Detected Noise

<table>
<thead>
<tr>
<th>Carrier</th>
<th>Noise</th>
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<tbody>
<tr>
<td>FA 2</td>
<td>Avg</td>
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<tr>
<td>FA 3</td>
<td>High</td>
</tr>
<tr>
<td>FA 4</td>
<td>Avg</td>
</tr>
<tr>
<td>FA 5</td>
<td>Avg</td>
</tr>
</tbody>
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Reduce FA 3 PB Power
A Key Benefit For CDMA Operators

The opportunity to support a dedicated channel deployment provides a significant advantage for CDMA compared to UMTS Femtocell operators

- UMTS operators have Femtocell frequency planning problems
  - Wide channel spacing usually precludes dedicated femto channel operation
- More narrow band CDMA channels available to CDMA operators
  - More opportunities to dedicate a channel for femtocell operation
  - Less potential interference and greater Femtocell coverage

<table>
<thead>
<tr>
<th>Dedicated Femto FA Operation</th>
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<tbody>
<tr>
<td>Macro FA</td>
</tr>
<tr>
<td>F1</td>
</tr>
<tr>
<td>Macro FA</td>
</tr>
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</table>

**Shared FA Allocation**
- Desired Femto In-building Coverage
- Managed Interference Zones

**Dedicated Femto FA Allocation**
- Desired Femto In-building Coverage
- Inter-Femto Interference Is Much Less Relevant
Gymnasium Example

A venue with unusual traffic patterns, including highly concentrated arrival and departure cycles

- Peak hour loading occurs during key hours
  - Mass migration to the gym during the lunch hour
  - Support for hundreds of registrations
- Significant signaling requirements
  - Emails and messaging requires many active/dormant transactions
- Streaming services are a surprisingly important component of Gym traffic
High Capacity Support

Validates the requirement for a high tier enterprise Femtocell product capable of high capacity and RF power

- High active call capacity
  - 32 simultaneous EV-DO active sessions
  - 32 1x channel elements

- Requirement to support high session capacities
  - Support for 500 1X registrations
  - Support up to 2000 EV-DO dormant sessions
  - Full RF rates provide superior streaming performance

- Essential to have the ability to de-register users
  - Network deregistration and clean-up time outs
Large Facility Examples

Larger facility example with a large coverage area that requires the use of multiple Femtocells in a “clustered” configuration

- More than one Femtocell required to provide full coverage
- Peer-to-peer soft handoffs in a common “cluster” configuration
- Local mobility activity does not burden the core network

120,000 sqft facility
Clustering

Provides the ability to automatically create clusters of Femtocells with local inter-Femtocell handoffs

- Essential feature for multiple Femtocell implementations
- Cluster operates as a single virtual coverage area
- Local soft handoff between Femtocells
  - No burden on the core network elements
  - No need for a local gateway product
- Automatic set up features – Building a cluster
- SMART Tool will provide set-up assistance
The Portal Cell Feature

Portal and Non-Portal cells provide PN code deployment flexibility and protection against false acquisition

- Portal and Non-Portal Femtocells
  - Portal cells support hand-in from macrocells
  - Non-Portal cells do not permit hand-in from macrocells
- Protection against false acquisitions & registrations
  - Particularly useful in multi-story buildings
- Allows better PN management
  - Enables larger clusters
  - Does not exhaust designated Femto PN list

<table>
<thead>
<tr>
<th>Macro PN</th>
<th>Femto PN</th>
<th>Available PN</th>
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</thead>
<tbody>
<tr>
<td>- 123</td>
<td>- 255</td>
<td>- 256-512</td>
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<tr>
<td>- 156</td>
<td>- 205</td>
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<td>- 189</td>
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<td>- 031</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>- 067</td>
<td>-</td>
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</tbody>
</table>

High Rise Building Example

Acme Building

Macro PN=156
Femto PN=354
Femto PN=427
Femto PN=507
Femto PN=238

Acquisition via Lobby

No False Acquisition

Full Cluster Mobility
Institution With Public Access Example

Providing coverage & capacity relief in a large publically accessible venue requiring open access by all users

- Public access requires open access to all users
- Connecting to an in-building DAS system
- Effectively fulfilling a Picocell role, with similar flexibility

Enterprise Femtocell
Deployed As A DAS Driver

Large multi-story, multi-building complex with public access
(one 4 story building shown)
Network Pico Applications

The EdgePoint PRO Enterprise Femtocell can fulfill many traditional network Picocell roles by virtue of its capabilities

- Sufficient power and capacity to meet Picocell requirements
- Coverage infill and capacity offload
- Public venues
- Transportation equipment
- DAS system drivers
- Portable cell sites for rapid emergency response cell service
Core Network & Connectivity

The open Femtocell core network interfaces enable Picocell deployments without impacting existing MSC systems

- Open core network interfaces shared with Femtocell deployments
  - X.59 convergence server interface for 1X services
  - A-series interfaces for EV-DO data services
  - IMS core network for scalability
- Common Picocell/Femtocell O&M via TR-069/196
  - One system to manage all small cell applications
- Optional RF configuration overrides
  - Support for conventional picocell/macrocell frequency planning

Open Core Network Interfaces

- Convergence Server: X.59 SIP/IMS
- PDSN: A10/A11
- HA/AAA: A12
- O&M: TR-069/196
- Security Gateway: IP-SEC

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Comprehensive Small Cell Product Line

Multiple products available for different applications, and all can leverage the same open interface core network system

- EdgePoint™ Consumer Femtocell 8 user stand-alone
- EdgePoint™ ACE Office Femtocell 16 user with clustering
- EdgePoint™ PRO Enterprise Femtocell 32 user with clustering
- Strand Mount outdoor Picocells 32 user, macro RF planning
- Conventional indoor/outdoor Picocells 32 user, macro RF planning

Stores / Medical Offices / Enterprise Floors / Warehouse / Public Venues / Shopping Malls / Sports Venues / Streetscapes

- 5,000 - 10,000 ft²
- 15,000 - 25,000 ft²
- 40,000 - 100,000 ft²
- >100,000 ft²
- 1-5 km² (outdoor)
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Evolution To Tri-Mode

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Summary

Enterprise Femtocells are being successfully deployed & have proven to be a compelling solution for in-building services

- Actively deployed in a variety of venues
- Excellent performance with minimal interference
- Successful automatic configuration capabilities
- Proven to be an economical and reliable solution
- Opportunity to cover a much larger number of applications

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