Advanced Broadband Wireless Access System

- **Advanced** 4G Technology: Hybrid Air Interface – 8x Smart Antenna - Interference Resistance - SDMA
- **High Efficiency:** Long Range - Deep NLoS Coverage - High Capacity - Low Power Consumption
- **Multi-Service:** Voice Telephony - Broadband Internet - Messaging (SMS) - Trunk Services (PTT) - Video
- **Fixed & Mobile:** Voice and Data Portability and Mobility, Seamless Handoff
- **Complete Ecosystem:** Base Stations - Terminals (CPE) - Management - Voice Subsystems
Worldwide Adoption & Deployments

- **Technology**: ITU-R Standard
- **Certified**: US FCC (FCC 700 MHz band)
- **Certified**: Anatel (Brazil) Homologation
- **Certified**: CE & TUV (EU), CCSA (PRC)
- **Commercially Deployed** in over 20 countries: USA – Brazil – China – Panama – Russia – Cameroon – Nigeria – Iraq – Zimbabwe – Malawi – Sri Lanka – Myanmar – Chad – etc.
Primary Features & Advantages

- **Saves Money:**
  Long Range allows carriers to deploy coverage faster and with less cell sites - saving Time, CapEx, and OpEx

- **Makes Money:**
  Advanced RF and DSP technologies deliver high efficiency, and thus more subscribers and revenue

- **Serves All Customer Needs:**
  Fixed, Portable, Mobile Broadband, Telephony, SMS Messaging – all in one system

- **Easy to Deploy and Maintain:**
  All-IP standard architecture provides full compatibility with existing infrastructure and easy maintenance

- **Flexible:**
  Open to customization: frequencies, subscriber terminal models, ODM modules, etc.
Integrated Telecom Services

- **Broadband Data:**
  Broadband Internet access - corporate & residential, Intranet, VPN services

- **Digital Voice Telephony:**
  Built-in native high capacity fixed & mobile voice services

- **Push to Talk:**
  Portable, Mobile PTT trunking, dispatch, group communications

- **Customer Self-Install:**
  Superior RF performance allows indoor portable customer terminals, eliminating installation
Advanced Technology: Hybrid CDMA + OFDMA Air Interface

StreamStar uses an optimal combination of two most popular wireless technologies - CDMA and OFDMA.

The Hybrid Air Interface negates the disadvantages of CDMA and OFDMA while combining their advantages, and ensures optimal multipath (Non-Line of Sight) and fading performance and inter-cell interference protection - thanks to hybrid orthogonality and spreading gain.

**CDMA:**
- Strong on inter-cell interference
- Strong on frequency-selective signal fading
- Weak on multipath signal fading

**OFDMA:**
- Strong on multipath signal fading
- Weak on frequency-selective signal fading
- Weak on inter-cell interference

**Hybrid:**
- Strong on NLoS and multipath signal fading
- Strong on frequency-selective signal fading
- Strong on inter-cell interference rejection
Advanced Technology: Smart Antennas (Beamforming)

StreamStar is equipped with an 8-element Smart Antenna System that uses true Digital Beamforming.

Beamforming is an intelligent digital signal processing algorithm that focuses the radio beam to each terminal (CPE), increasing the signal strength by up to 64 times – vastly increasing range and capacity. By adjusting the beam path every 10 milliseconds, the Smart Antenna can accurately track all the terminals even if they move at very high speed.

Traditional Single Antenna:
Like a light bulb: radiates energy in all directions. This results in wasted RF energy and extra noise.

Smart Antenna (Beamforming):
Like a torchlight: focuses the radio beam in the needed direction. This results in stronger signal, less wasted RF energy, and less inter-cell interference.
**Smart Antenna Advantages: Increased Coverage**

With Beamforming, coverage is improved by at least 3 times – reducing the number of cell sites required to cover required areas by a factor of 3. This results in major Capital and Operational expense savings.

Beamforming achieves massive effective signal power without using power-hungry RF amplifiers. This reduces power consumption, increases reliability, and provides environmentally-friendly, “green” networks.
Smart Antenna Advantages: Increased Capacity

With Beamforming, the effective signal strength is much higher than systems with traditional single or MIMO antennas.

With a stronger signal, the system can run high-order modulations – resulting in higher capacity and efficiency.
**Smart Antenna Advantages: Increased Efficiency**

With Smart Antenna Beamforming, probability of Inter-cell interference is significantly reduced.

Since the beam is narrowly shaped instead of being broadcast like with single antenna systems, efficiency and overall noise performance is increased dramatically.

![Diagram comparing traditional and smart antenna overlap and collision](image-url)

- **Traditional Antenna:** 100% overlap, 40% collision
- **Smart Antenna Antenna:** 100% overlap, 0.1% collision
**Smart Antenna Advantages: SDMA**

SDMA – (Spatial Division Multiple Access) is an advanced technique used to increase the base station capacity and spectral efficiency, by introducing a 3rd domain into the resource allocation plane in addition to time and frequency – the space domain.

SDMA Spatial Multiplexing is only viable with a multi-element Smart Antenna and benefits from the fact that multiple users can be assigned the same frequency resources as long as they are sufficiently separated in space – and the 8x Smart Antenna is perfectly suited for that.

SDMA can as much as triple the base station throughput while using the same single frequency channel.

* SDMA is scheduled for release in Q3 2012 as a BTS software upgrade. SDMA will only be available for the 8-element Macro BTS models.
Smart Antenna Advantages: Interference Resilience

With Smart Antenna, external interference can also be defeated. Originating from a military communications system, the Smart Antenna employs Spatial Nulling technology which protects the system from intentional (jamming) and unintentional interference.

Spatial Nulling can detect the source and direction of interference and create a “null” towards the interferer, effectively attenuating it to harmless levels.
System Features: Security & QoS

System security features are suitable for any deployment type – from public to military. Smart Antennas are originally a military antenna technology designed to be resistant to interception and intentional jamming.

- **Air Interface Security**
  - Phased Array Antenna makes eavesdropping extremely difficult
  - Code-Spreading makes decoding the signal even harder
  - Terminal to BTS authentication prevents cloning and unauthorized terminals

- **Multi-Layer Security**
  - VLAN tagging with QinQ - PPPoE
  - ARP source address validation, ACL, Broadcast Filtering

- **QoS and GoS**
  - Per-terminal profile-based rate control (bandwidth management)
  - Type Of Service (ToS) traffic classification at air interface level
StreamStar is a fully mobile system. Base stations coordinate handoff with no packet loss and no call disconnection.

All terminal types support mobility and no special software or hardware is required on both network and the client computers: handoff is completely transparent to the users.
StreamStar supports a wide range of frequency bands for worldwide operation, and can operate even with limited spectrum allocations – as small as just 5 MHz.

- 336-344 MHz : UHF
- 400-430 MHz : UHF
- 698-746 MHz : 700 MHz US FCC
- 1785-1805 MHz : 1.8 GHz GSM Guardband
- 2150-2180 MHz : BWA/FWA band
- 2525-2560 MHz : BWA/FWA, WiMAX
- 3300-3400 MHz : BWA/FWA, WiMAX
- Custom frequency bands can be made
System Network Elements: Macro Base Stations

Macro Base Stations (BTS) are optimized for macro-cell coverage with a choice of Smart Antenna arrays.

- Base Station: Baseband Indoor Unit (BBU)
- Outdoor Unit: 8-channel RF Transceiver (RRU)
- Baseband to RF Unit connection: Single-mode Fiber
- Antennas: Smart 8-element Omni or Sector
- Backhaul Interface: Ethernet
- Synchronization: GPS
Micro Base Stations (BTS) are optimized for micro-cells and quick addition of network capacity wherever it is needed.

Micro BTS are fully outdoor and do not require any indoor infrastructure, reducing expense and deployment time.

- Base Station: All-Outdoor Unit
- Antennas: Smart 2-element Omni or Sector
- Backhaul Interface: Ethernet
- Synchronization: GPS
Element Management System software is a cross-platform client-server system that provides full configuration, management, performance monitoring, and diagnostics for all network elements.
Telephony services in a StreamStar⁴ network are handled by a dedicated device – the SAC (Service Aggregation Controller). SAC supports standard Customized Local Area Signalling Service (CLASS) features, such as caller ID, call waiting, three-way calling, call holding, etc.

The SAC device functions as the gateway between StreamStar⁴ and PSTN or NGN networks by providing TDM (SS7/R2 E1, STM-1) and SIP interfaces.

Each SAC device supports up to 1000 simultaneous voice calls; SAC devices can be stacked for additional capacity and redundancy.

System Network Elements: SAC Voice Switch
StreamStar uses an all-IP distributed core architecture. Core services are all software-based and run on standard x86 servers. Voice telephony services are processed by the dedicated SAC voice switch (not required for data-only deployments).

The all-IP architecture is compatible with all standard routers and switches.
A wide variety of CPE is available supporting integrated telephony, broadband Internet and messaging. All terminals can be used in fixed, portable and mobile scenarios.
**Subscriber Terminals (CPE): Desktop Broadband Modem**

Desktop Broadband Modem: Portable and Mobile Wireless Telephony + Broadband Data

- **Desktop CPE**
  - DC/USB Power
  - USB / Ethernet Interfaces
  - Optional Built-in 802.11bg WiFi
  - FXS POTS Telephone Port
  - 2 Internal Patch Antennas
  - Detachable Antenna
**Subscriber Terminals (CPE): Desktop Broadband Telephone**

Desktop Broadband Telephone: Portable and Mobile Wireless Voice + Broadband + SMS

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Desktop Telephone
- Ethernet Data Interface
- Speakerphone, Call Memory
- LCD screen, SMS Support
- Detachable Antenna
- Internal Battery
**Subscriber Terminals (CPE):** Mini-USB Portable CPE

Mini-USB CPE: Portable and Mobile Broadband Wireless Internet Access

- USB Power and Interface
- Retractable Antenna
- Weighs 50 grams
Subscriber Terminals (CPE): Mobile Handsets

Mobile Wireless Handsets: Mobile Voice + Data + SMS + GSM dual-mode

Mobile Handsets
- Fully Mobile Data/Voice/SMS
- USB Data Interface
- USB Charging Capable
- Dual-mode with GSM SIM
- Internal Battery
Subscriber Terminals (CPE): Push-to-Talk Trunk Handset

Trunk Handset: Mobile Voice + Data + SMS + Push to Talk functions

PTT Handsets
- Data via USB
- Mobile Data/Voice/SMS/PTT
- Internal Battery
## Technology Comparison: StreamStar⁴ vs. WiMAX

<table>
<thead>
<tr>
<th>Feature</th>
<th>WiMAX 802.16e</th>
<th>StreamStar⁴</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced Antenna Systems (AAS)</td>
<td>MIMO</td>
<td>8x Beamforming w/SDMA</td>
</tr>
<tr>
<td>Multi-Antenna Gain</td>
<td>Up to 5 dB MIMO A (DL Only)</td>
<td>18 dB DL, 9 dB UL</td>
</tr>
<tr>
<td>Typical Link Budget</td>
<td>150 dB</td>
<td>165 dB</td>
</tr>
<tr>
<td>Air Interface</td>
<td>OFDMA</td>
<td>SCDMA + OFDMA Hybrid</td>
</tr>
<tr>
<td>Native Voice Telephony</td>
<td>None (3rd party VoIP)</td>
<td>Built-in Digital Telephony</td>
</tr>
<tr>
<td>Single Frequency Capability (N=1)</td>
<td>None, impossible with OFDMA</td>
<td>Yes, N=1 capable</td>
</tr>
<tr>
<td>Net Spectral Efficiency</td>
<td>1 b/s/Hz</td>
<td>2.8 b/s/Hz</td>
</tr>
<tr>
<td>Custom Frequency Bands</td>
<td>Only standard bands</td>
<td>Yes, custom bands available</td>
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## Technology Comparison: StreamStar⁴ vs. CDMA / EVDO

<table>
<thead>
<tr>
<th>Feature</th>
<th>CDMA / EVDO</th>
<th>StreamStar⁴</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smart Antennas</td>
<td>None</td>
<td>8x Beamforming w/SDMA</td>
</tr>
<tr>
<td>Beamforming Gain</td>
<td>None</td>
<td>18 dB DL, 9 dB UL</td>
</tr>
<tr>
<td>Air Interface</td>
<td>CDMA</td>
<td>SCDMA + OFDMA Hybrid</td>
</tr>
<tr>
<td>Maximum Modulation Mode</td>
<td>16 QAM</td>
<td>64 QAM</td>
</tr>
<tr>
<td>Dynamic Telephony / Data</td>
<td>No, needs separate carriers</td>
<td>Yes, dynamic partitioning</td>
</tr>
<tr>
<td>Duplexing</td>
<td>FDD - separate UL/DL carriers</td>
<td>Flexible 7-Level TDD</td>
</tr>
<tr>
<td>Cell Breathing Problem</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Net Spectral Efficiency</td>
<td>0.8 b/s/Hz</td>
<td>2.8 b/s/Hz</td>
</tr>
<tr>
<td>Terminal Throughput</td>
<td>153 kbps</td>
<td>3 Mbps</td>
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<tr>
<td>Custom Frequency Bands</td>
<td>Only standard bands</td>
<td>Yes, custom bands available</td>
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## Technology Comparison: StreamStar⁴ vs. TETRA (PMR)

<table>
<thead>
<tr>
<th>Feature</th>
<th>TETRA</th>
<th>StreamStar⁴</th>
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<tbody>
<tr>
<td>Smart Antennas</td>
<td>None</td>
<td>8x Beamforming w/SDMA</td>
</tr>
<tr>
<td>Beamforming Gain</td>
<td>None</td>
<td>+ 18 dB (64x power)</td>
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<tr>
<td>Air Interface</td>
<td>TDMA</td>
<td>SCDMA + OFDMA Hybrid</td>
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<tr>
<td>Interception</td>
<td>Easy (All communication is broadcast)</td>
<td>Hard (Communications are directional)</td>
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<tr>
<td>Group Calling</td>
<td>YES</td>
<td>YES</td>
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<tr>
<td>BTS Data Throughput</td>
<td>152 kbps</td>
<td>15 Mbps</td>
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<tr>
<td>Terminal Data Throughput</td>
<td>7.2 kbps</td>
<td>1.5 Mbps</td>
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<tr>
<td>Custom Frequency Bands</td>
<td>Only standard bands</td>
<td>Yes, custom bands available</td>
</tr>
</tbody>
</table>
Thank You!