Interference Solutions

Improve Performance
Realize New Traffic

CDG Technology Forum
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ISCO Products & Services

We provide products & services that:

- Improve the performance of CDMA networks
  - In-band interference removal
  - Recover cell site capacity, coverage and performance

✓ Improve network performance
ISCO Products & Services

• Audit and monitor cell sites
  – Identify performance limited sites
  – Recommend solutions

• Are commercially deployed in hundreds of locations world wide

✓ Improve network performance
Interference
Are You Experiencing....?

• High dropped call rates
• High access failure rates
  – Origination, Termination, Blocked calls
• Unable to launch carriers for:
  – Voice Traffic
  – Data (CDMA2000 1X) traffic
• Reduced coverage and capacity due to interference

✓ ISCO products installed in these sites have improved network quality
You have interference from:

- Border Sites
  - Adjacent MSA/RSA
- Co-located SMR, cellular, paging sites
- Microwave transmitters
- FM transmitters
- Transmitters near airports
- CATV amplifiers
- RF from neon signs

This Interference is degrading network performance
How much interference?

**High-severe interference**
- 2 to 5% of cell sites
- Site is unable to carry traffic on a CDMA carrier
- Lost call rate regularly exceeds 5 percent or more
- High noise rise metric disproportionate to carried traffic

**Low-moderate interference**
- 10 to 20% of cell sites
- Lost call rate exceeds 3 percent
- Noise rise disproportionate to carried traffic
Problem of In-band Interference

- Due to power control, CDMA signals at the BTS are low power
- All subscriber signals are in the same 1.25-MHz bandwidth
- A single high-power interferer affects all subscribers
- Interference impacts performance, coverage and capacity
Effects of In-band Interference on CDMA Cell-site Capacity

- Two –100 dBm interferers yield approximately 12 dB increase in noise
- All mobile units will have to increase transmit power by 12 dB
**In-band Interference Mitigation**

- Notch filter will significantly reduce the power level of the interfering signal as perceived at the receiver.
- As a result, effects of interference on the individual received signals and on reverse-link cell-site capacity will be minimized.
- Notch will have some effect on CDMA signal as well, but processing gain allows significant tolerance to these effects.

<table>
<thead>
<tr>
<th>Signal Power [dBm]</th>
<th>Frequency</th>
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</thead>
<tbody>
<tr>
<td><strong>Desired CDMA Signal</strong></td>
<td></td>
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<tr>
<td><strong>Interfering Signal</strong></td>
<td></td>
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<tr>
<td><strong>Noise Floor</strong></td>
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</table>
ANF Reduction of In-band Interference in CDMA Systems

Effects of In-Band Interference on CDMA Coverage & Capacity

- ANF has no impact on system when no in-channel interference is present
- ANF recovers almost all lost coverage and capacity when interference occurs

Example with Two -100 dBm Interferers
• Increase in mobile transmit power linear with interferer power level for interferers above about –105 dBm
• ANF eliminates almost all of the increase in mobile transmit power
Communications channel integrity is determined by the signal-to-noise ratio: $S/N$

- $S =$ Total signal power in the channel

- $N =$ Total noise power in the channel (from other users, other base stations, narrow band interference, etc.)

What happens to $S/N$ when a narrow notch is applied at an interferer?

- a small fraction of signal power is removed (S decreases by $\sim 2\%$)
- a large fraction of noise power is removed (N decreases by $\sim 50-90\%$)

**Channel $S/N$ increases**
• Installs with zero downtime
• ANF unit installed after front end gain stage
  – Suitable for simplex or duplex cell sites
  – Noise figure of ANF unit has minimal impact after amplification stage
• One ANF unit covers up to 4 CDMA carriers
In-Band Interference Removal in CDMA systems

- Minimize CDMA Cell Breathing due to interference
- Removal of dynamic, intermittent interference
  - Interference is statistical in nature
  - Interference varies in time, frequency, amplitude and space
- Hundreds of Systems deployed worldwide

✓ Increased Traffic
✓ Improved Quality of Service
Recap of ISCO Interference Solution Products
ISCOS Products & Services

Products

• A-2000 – Adaptive Notch Filter
• ANF Web Monitor
• IA-2000 – ANF on Wheels

Services

• iSMART analysis (Interference from System Metric Analysis Rules Tool)
• Interference Audit
• Network Performance improvement services
Adaptive Notch Filter – A Series

- Extremely rapid and dynamic interferer identification and removal
- Web based network management tool
  - Configuration
  - Event reporting
- Carrier grade compliant for cell site installation
  - Standard 19” rack mount
  - Alarms

- Notches only applied when interferers are present
- Maximum effective utilization of CDMA Traffic potential
Web Monitor Architecture

Web based A-2000 network management

+ A-2000
+ Modem
+ PSTN
+ Modem Pool
+ Server & Database
+ Intranet
+ Dial up access from remote location

Cell site alarm panel

A-2000

Laptop

Desktop PC
A-series: Management

- Network wide, web based management tool
- Remote operator control and configuration
- Interference activity by time-of-day, channel, CDMA carrier, geography

✔ Enables “lights out” operation
IA-2000 – ANF on Wheels

• Complete ANF package for 3 sector cell site
• Optimize network performance
  – Rapid deployment unit for interference hot spots
  – Identify and measure network interference issues
  – Interference test tool
  – Cell site monitoring

✓ Simplified installation for rapid deployment
SMA Rules analysis (iSMART)

- iSMART helps identify potential interference candidates

- In-band interference manifests as higher Average Noise Rise on the reverse link for a given traffic (WC Hour) thereby limiting the potential to carry traffic and/or reducing coverage

- Average Noise Rise and Walsh Code Hour (traffic) data is collected on a sector-carrier-hourly basis for one week

- Three types of analysis are done on the data
  - Comparison of Traffic and Average noise rise for 24 hours
  - Comparison of Traffic and Average noise rise for busy hour
  - Comparison of Average-to-Peak noise rise as a function of increasing Traffic
Thank You!