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July 5, 2011

Federal Communications Commission
445 12th Street SW
Washington DC 20554

In re: FCC 11-55A1 -- PS Docket No. 11-60 / PS Docket No. 10-92

To the Commission:

Regarding the FCC's Notice of Inquiry regarding the "Reliability and Continuity of Communications Networks, Including Broadband Technologies" and the "Effects on Broadband Communications Networks of Damage or Failure of Network Equipment or Severe Overload," we would like to direct your attention to new technology, developed by ISCO, that addresses both of these concerns in 3G and 4G wireless broadband networks.

This new technology enables what is called "spectrum conditioning" and works specifically on the uplink portion of the network, or the portion connecting users to the base station. Spectrum conditioning counteracts sources of co-channel interference and high-power adjacent RF in the airwaves in order to protect wireless connectivity and enable maximum spectrum utilization for network operators. It is a continuous and automatic process based on advances in digital signal processing.

Immediate benefits include improved spectrum ulitization enabling more capacity, fewer dropped calls, higher data throughputs and less handset power required to access the base station (meaning longer battery life and reduced handset radition). With more and more people using wireless broadband networks at home or at the office and on the go, spectrum conditioning therefore will have a positive impact on the reliability and continuity of broadband networks and will guard against situations that could cause massive service disruption.

Spectrum conditioning also has an important role to play in disaster situations, or anytime networks become damaged and temporary infrastructure needs to be installed. In these situations, carriers will deploy "CoWs" or "CoLTs" ("cell on wheels" / "cell on light truck") in the affected areas.

Mobile operators in the U.S. have spent billions of dollars to ensure access to their networks in virtually every scenario. As you know, these capital expenditures have been committed to ensure a "five 9s" type level of service. This objective becomes even more important when portable cell sites known as CoWs and CoLTs are deployed

in the case of special events, disaster recovery or when temporary additional capacity is required for whatever purpose. These units are typically deployed in unpredictable and basically unknown environments. Factors such as high-power adjacent RF energy, co-channel interference from unknown sources and other carriers operating in near proximity all limit the performance of these temporary cell sites.

Uplink interference is a real problem that can severely impact the performance and the capacity of the network and, when it comes to CoW and CoLT deployments, there is often simply not enough time to engage in the traditional uplink RF interference hunting activity to determine the sources of interference and then enact counter measures.

Network operators can now include spectrum conditioning with RF digital signal processing to ensure optimal CoW and CoLT performance. We have taken the liberty of enclosing a recent white paper that gives examples of how interference affects spectrum utilization, capacity and performance in ad hoc situations and, more importantly, it provides data on actual improvements in various scenarios after implementing spectrum conditioning.

Furthermore, in a "big picture" sense, spectrum conditioning has an important role in the roll out of 4G networks vis-à-vis the installed base of 3G infrastructure. All major operators are beginning to turn up 4G networks. At the same time, 3G networks will continue to carry voice and provide services in the many areas not served by 4G networks. This will be the case for at least a few more years.

The capital investment needed to implement 4G is significant and wireless operators must balance new 4G investment with the support and maintenance of existing 3G networks. Investment in 3G is purposely limited since 4G is imminent, so maximizing use of finite 3G spectrum becomes paramount. Maximizing 3G networks with spectrum conditioning means more capacity becomes available from existing equipment and spectrum, making more capital available for 4G infrastructure. In addition, spectrum conditioning technology works in the 4G domain as well, with new products coming out towards the end of this year.

We look forward to your comments to this letter and the information about spectrum conditioning enclosed with it. Should you need additional information, we will provide it as soon as possible and would welcome the opportunity to give a presentation about spectrum conditioning at any public hearing you may decide to hold on these important topics.

Sincerely,

Gordon Reichard
CEO
ISCO International

# Adding Digital Signal Processing to CoWs and CoLTs Provides Ultimate Flexibility and Adaptability and Improves Reliability Needed for Disaster Recovery

**ISCO International**
**March 2011**

## Abstract

Continual change and growth in the wireless industry along with the need to deliver rapid recovery of reliable wireless communications in the event of a disaster are requiring service providers to expand the capabilities and capacity of their mobile cell sites; CoWs and CoLTs (Cell on Wheels and Cell on Light Trucks). As traffic continues to grow and data intensive smart phones represent a growing proportion of connected devices, mobile cell sites at a minimum need to support 3G, have the ability to easily add additional carriers if that is an option, and accommodate the upgrade to 4G LTE as required.

Adding to the challenges, these portable mobile cells operate in higher traffic environments and possibly life impacting disaster situations with more uncontrollable, unknown factors. Enhancing these mobile cells to include the ability to mitigate co-channel interferers and flexibility to tune band-pass and band-rejection filters to condition the RF physical layer can now become a standard practice with the availability of RF digital signal processing.

This paper will discuss the value of protecting the physical RF layer (aka, "layer 1"), especially in light of the harsh environments in which CoWs and CoLTs are deployed, and the ability to retune filters as needed, depending on the particular situation.

## What's Known about the Unknown

Mobile cell sites are typically deployed in a number of scenarios but the common goal regardless of the situation is first to provide reliable incremental capacity for a defined period of time. Second, the environment is inherently unknown since it is temporary and other service providers are also likely deploying some sort of temporary wireless communications as well. A

third known factor revolves around the possibility of an operator adding more carriers, adding LTE or changing the spectrum mapping. Knowing the environment is unpredictable, knowing configuration will change, and knowing maximum utilization of the mobile site is required means spectrum conditioning that is tunable and adaptable needs to be an integral part of the system.

With these unknowns a wireless operator could experience these problems: the existence of high-power adjacent RF energy, co-channel inference from harmonics resulting from near-in signals mixing, co-channel interference emitting from BDAs operated by subscribers or other operators, and adjacent carriers operating with reduced guard bands. With little to no time to react to counter these issues, operators must implement undesirable options such as higher channel power, reduced adjacent channel selectivity and a desensitized radio front end. To aggravate matters, using a conventional fixed filter means adding carriers is more complicated, retuning or re-banding is limited and mitigating co-channel in-band inference is likely not possible.

Figure 1 represents co-channel interference power experienced during a popular sporting event. As typical of any special event, the ultimate sources of the interferers remained unidentified, but the interference was real and would have reduced wireless connectivity.

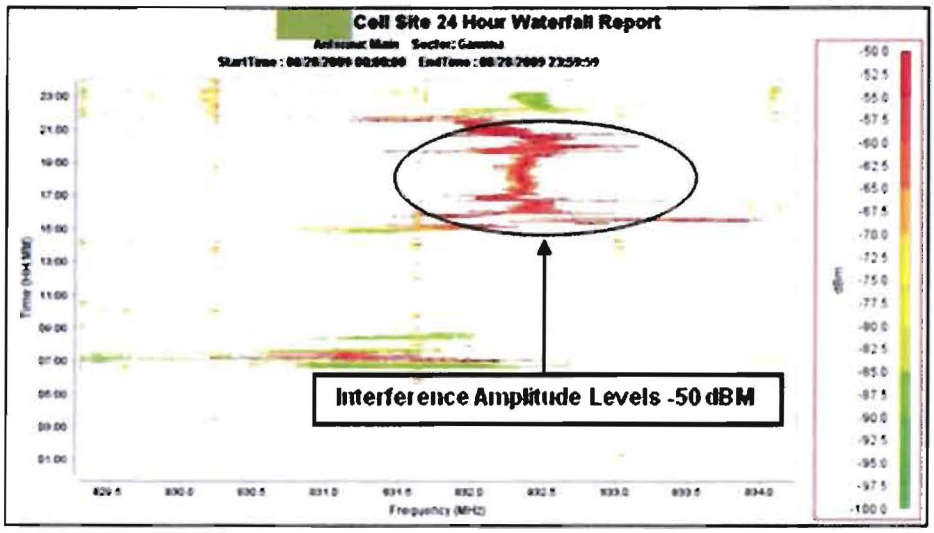


**Figure 1. Interference Power Measured at Sporting Event**

At some points during the event the measured interference power was -50dBm and in this case the frequency varied over time. The resulting channel power was dramatically increased when the interference was not eliminated from the band, as shown in Figure 2.

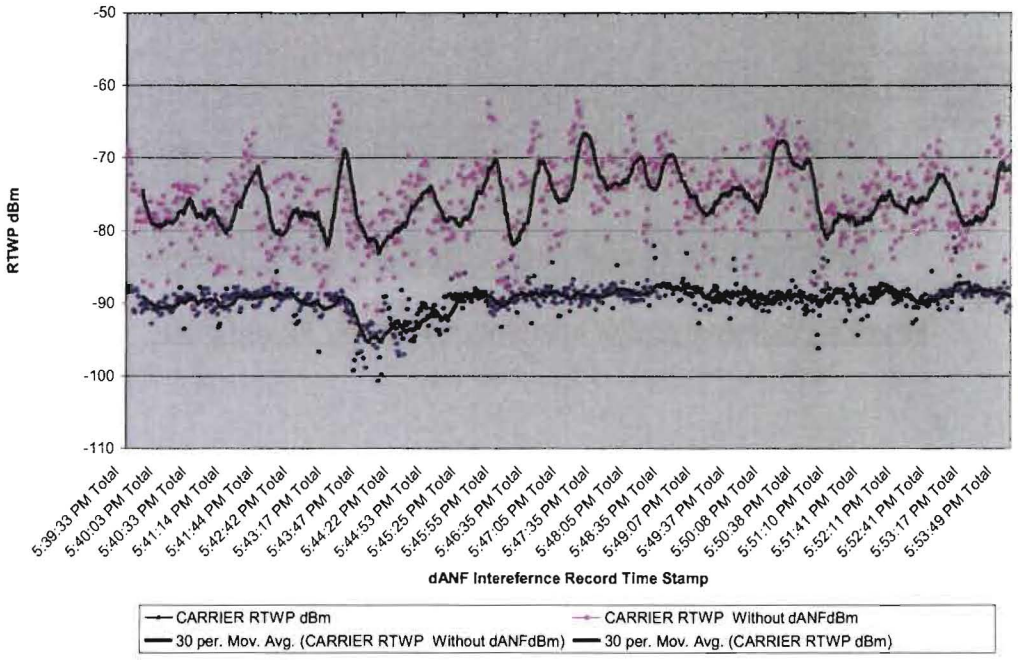


**Figure 2. The impact on RTWP when the interferer was allow to exist in-band**

Figures 1 and 2 pertain to co-channel interference. Figure 3, on the next page, shows a typical situation where high-power RF carriers exist immediately adjacent to the band in use, as well as other carriers adjacent and beyond that further out in the band.

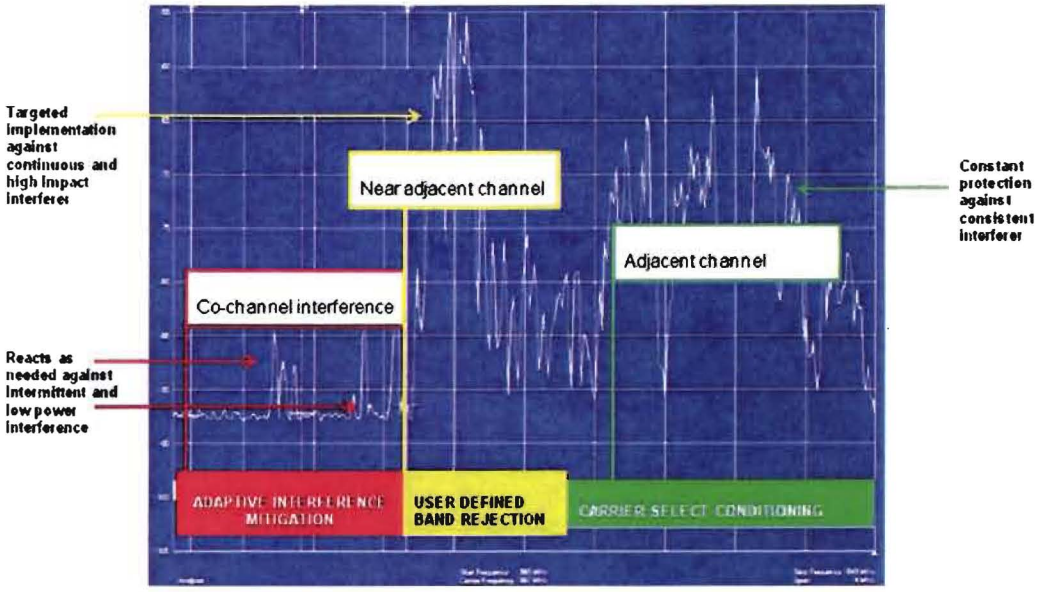


**Figure 3. Spectrum plot of adjacent high-power RF and other carriers**

The existence of these adjacent carriers directly affects Carrier to Interference ratio (C to I), Adjacent Channel Selectivity (ACS) and Adjacent Channel Interference Ratio (ACIR). Degrading these parameters will reduce spectrum utilization, capacity and performance. Applying band rejection filters to suppress the immediately adjacent RF and a band pass filter to suppress the RF from the farther out carriers maximizes the sensitivity and performance of the portable site's radio front end. The results are lower channel power and greater coverage which mean more offered traffic, more capacity and better handset battery life.

## Reliable Wireless in the Event of a Disaster

In disaster situations a typical Network Emergency Management (NEM) plan will include Network Disaster Recovery equipment (NDR)[1]. NDR equipment includes a wide array of

[1] Oberg, J.C.; Whitt, A.G.; Mills, R.M.; "Disasters will happen - are you ready?," *Communications Magazine, IEEE* , vol.49, no.1, pp.36-42, January 2011.

Morrison, K.T.; "Rapidly recovering from the catastrophic loss of a major telecommunications office," *Communications Magazine, IEEE* , vol.49, no.1, pp.28-35, January 2011

components ranging from generators to PBX, to DACS to CoW/CoLT portable cell sites. This equipment represents a significant capital investment and optimum results are expected regardless of the situation.

Whether for a natural disaster or a man-made disaster the need for rapid recovery, sometimes as quickly as 15 to 20 minutes, is essential. With such pressing needs for rapid recovery, time wasted trying to clear spectrum to provide a solid RF physical layer cannot be tolerated.

Therefore, preparedness requires not overlooking the foundation (i.e., the physical layer) upon which practically the entire NEM plan rests. Applying RF digital signal processing will:

- mitigate co-channel interference that could emit from an infinite number of sources given the unpredictable environment,
- create band-rejection filters to suppress high-energy adjacent RF from public safety, GSM or numerous other sources, and
- build pass-band filters to limit the RF channel power exposed to the radio, improving sensitivity, coverage and performance.

Given the uncontrollable nature and proximity of interference sources, having the flexibility and adaptability of spectrum conditioning through RF digital signal processing will protect the capital investment in NDR equipment. More importantly, it will better assure the successful execution of the NEM plan. It is not an exaggeration to conclude in these situations that any Physical Layer Impairment (PLI) can severely impact the performance of the entire portable cell and associated NDR equipment and could create financial and life impacting consequences.

## Having Visibility is Valuable

During a deployment having visibility into the spectrum can be the difference between delivering the expected capacity or not. A view of the condition of the spectrum can help with trouble resolution and isolation, enabling timely delivery of needed communications.

KPI data typically is collected from the CoW or CoLT after a deployment to assess success or failure. In the event of poor performance the service provider traditionally has had to guess or hypothesize what occurred. With intelligent spectrum conditioning, the operator will have a record of the spectrum to better understand what occurred during the deployment. Figure 4 shows a sample of reports that are available.

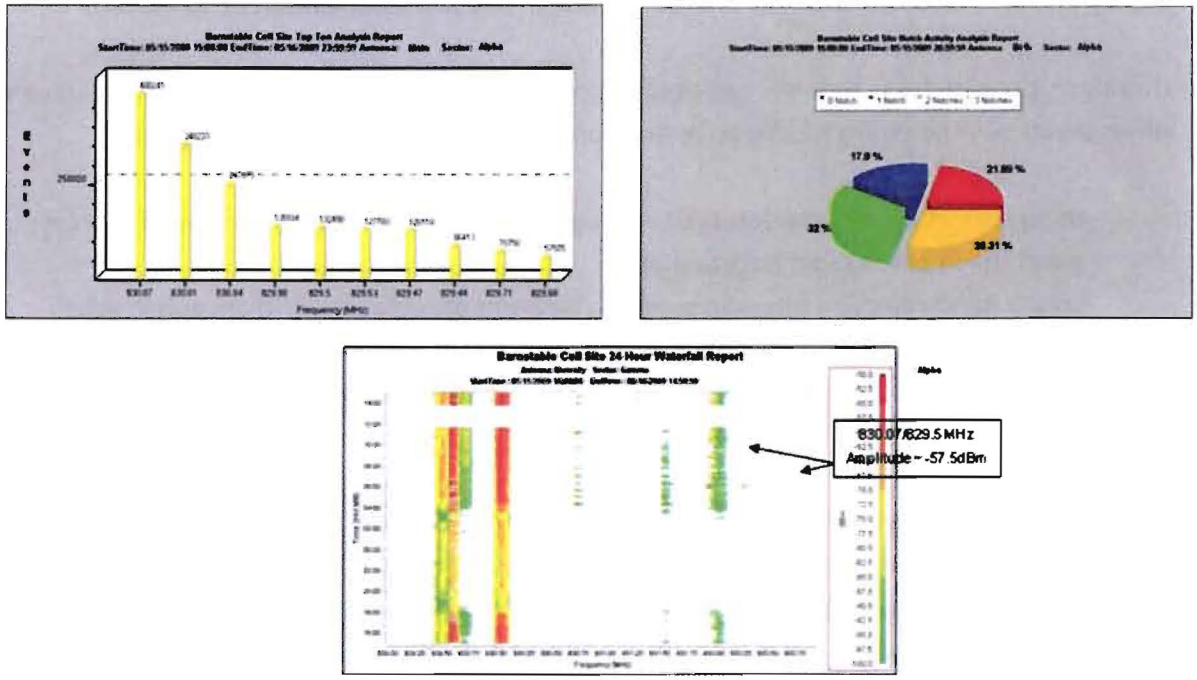


**Figure 4. Sample Spectrum Analysis Reports**

The upper left chart shows the number of interferers that occurred at each frequency. The upper right chart shows the percent of time multiple interferers occurred and the bottom chart shows the time, frequency and amplitude of the interferer. With this information the operator can better determine whether configuration, equipment or spectral events impacted performance.

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## Being Prepared Requires Managing Performance when Multiple Adjacent High-Power RF Exists

When deploying mobile cell sites multiple bands and multiple operators will most likely exist. Today it will not be uncommon to see the 700 MHz LTE band, the various Cellular bands, PCS bands and AWS all co-existing in very close proximity. In some cases all will exist within a single operator. In other situations multiple competing operators will have established wireless communications in the same area. For sure, planning needs to assume all will exist -- and exist beyond the control of the service provider.

To better assure maximum performance, both adjacent channel leakage and co-channel interference need to be addressed. With RF digital signal processing, a service provider can now create band-reject filters to remove unwanted signals adjacent to or in their band. In the Cellular band, A /A' or B/B' licenses coexist. In both cases, one operator's radio frequencies will pass through conventional filters and impact the radio front end receiver of the other operator. This is particularly important in special events where it is expected that there will be a significant amount of high-power RF generated by other operators covering the same area, which can degrade performance significantly if not rejected.

For example, a typical B-band carrier would have a full band B-band filter allowing A' to pass through the receive filter. Also a typical A-band carrier would have a full band A-band filter allowing B to pass through the receive filter. This negatively impacts performance since all the energy of "the other carrier" slams the base station receiver, desensitizing the front end. This extra energy reduces the maximum capacity of the base station and results in sub-optimal capital efficiency. By passing only the band or bands being used and absent of any co-channel interference, Adjacent Channel Selectivity (ACS) is improved and capacity is maximized.

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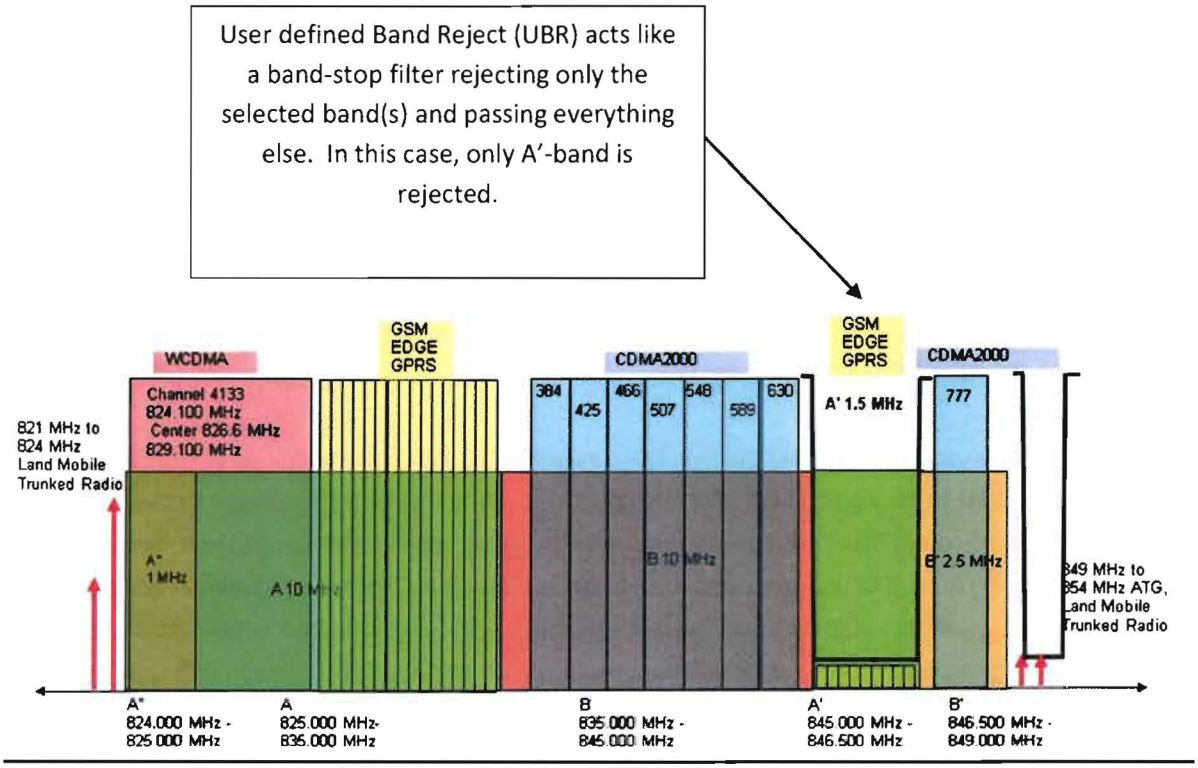


**Figure 5 –UBR applied to the cellular Band**

*This example illustrates passing only the 12.5 MHz B-band while rejecting A' Band*

For the PCS, six bands (A to F) coexist. With RF digital signal processing, a service provider can create a band-pass filter to pass only the desired band or bands to the base station. This limits the amount of RF energy passed to the radio receiver.

U.S. carriers deployed band specific filters in PCS early on but came to realize that they do not own a particular license nationwide. The result was the need for multiple filter models. This made life very difficult for supply chain price negotiation and field operations since numerous filter types needed to be maintained nationwide.

To achieve some level of commonality, a typical PCS site would have a full band PCS filter allowing all six bands to pass through the receive filter. This negatively impacts performance during a typical special event, since all the energy of the entire PCS band from other carriers slams the base station receiver, desensitizing the front end. This extra energy reduces the maximum capacity of the base station and is especially critical during a special event. By passing only the band or bands being used, clear of any co-channel interference, Adjacent Channel Selectivity (ACS) is improved and capacity is maximized.

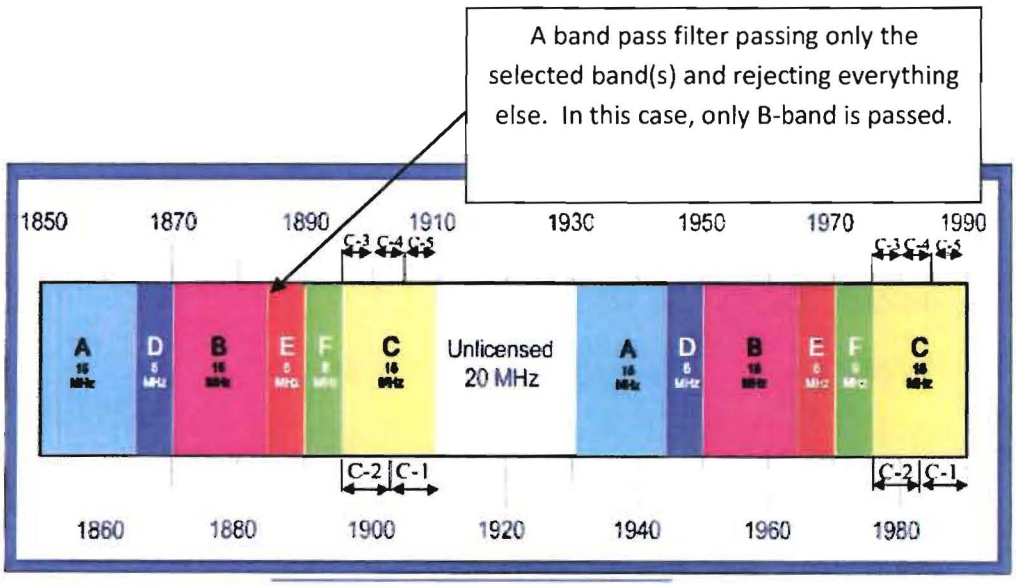


**Figure 6 – Band Pass can be applied to a specific carrier in the PCS band**

*This example illustrates passing only the 15MHz B-band while rejecting the remaining portion of the PCS band.*

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## The Value is Measured Increase in Capacity

It is not enough to show that adjacent RF or co-channel interference is present; a real increase in capacity must be demonstrated or an improvement in KPI performance measured. Figure 7 below shows two recent events that realized a capacity increase as a result of layer 1 spectrum conditioning.

| KPI Metric | Date | Result | Improvement | Total Market |
|---|---|---|---|---|
| PS CALLS | 1/2/20XX | 464496 | | |
| PS CALLS | 1/16/20XX | 755148 | 63% | |

| KPI Metric | Date | Result | Improvement | Total Market |
|---|---|---|---|---|
| CS CALLS | 1/2/20XX | 22469 | | |
| CS CALLS | 1/16/20XX | 38774 | 73% | |

| KPI Metric | Date | Result | Improvement | Total Market |
|---|---|---|---|---|
| Erlang | 1/2/20XX | 335 | | |
| Erlang | 1/16/20XX | 588 | 76% | |

**Figure 7. Packet Switched Calls, Circuit Switched Calls and Erlangs before and after deployment of Spectrum Conditioning**

While this data is not specifically from a CoW / CoLT deployment, it is provided to illustrate the difference in performance between a cell site with spectrum conditioning and a cell site without. In this particular situation, a high-traffic special event location similar to where mobile cell sites would be deployed, the service provider realized on January 2 they were not operating at the maximum capacity available from their radio access network. After deploying spectrum conditioning the results measured two weeks later, on January 16, show a tangible increase in capacity. These values will vary from situation to situation, especially in CoW / CoLT scenarios, and will be impacted by a number of variables. But the point is to see the real performance

gains that were realized from spectrum conditioning at a location no different than where a CoW / CoLT would typically be deployed.

## Conclusion - A Solid, Verifiable RF Layer is Critical for Successful CoW and CoLT Deployments

For special events, disaster recovery or situations needing an immediate but temporary increase in capacity the use of mobile cell sites fits the bill. Common to all scenarios is the requirement for immediate and reliable wireless communications in an unpredictable environment. At the foundation of wireless communications is the RF physical layer, layer-1, that is prone to impairment if not protected. Assuring a solid RF physical layer regardless of the situation is essential to achieving maximum performance from the CoW / CoLT that is deployed.

Today with RF digital signal processing, CoWs / CoLTs can include spectrum conditioning to guard against high-energy adjacent RF or unpredictable damaging co-channel interference. The presence of either will degrade performance of the wireless system immediately, and with little time to react the expected value and benefit of the deployment can be lost. Customers will be negatively impacted, revenue and operating expenses will suffer and possibly worse, in the event of a disaster, human life could be at risk jeopardizing the success of the overall Network Emergency Management plan.

Simple use of RF digital signal processing can significantly improve the RF physical layer in harsh unpredictable environments, better assuring the deployed CoW / CoLT mobile cell site delivers wireless communications as planned.

**About ISCO International**

ISCO International operates on the "front lines" of 3G – and soon – 4G communications by enhancing the integrity of a mobile operator's "physical layer" assets – the cell site and acquired spectrum. ISCO understands that wireless communications depend heavily on the user's RF connection to the base station and the company's "spectrum conditioning" product line ensures that this connection performs as expected even in the most hostile and unpredictable environments. ISCO's new Proteus® product, based on the latest PurePass™ digital signal processing technology, adaptively identifies and corrects the physical layer impairments (PLI) that decrease a cell site's coverage, capacity, data throughput and KPI performance. In sum, ISCO allows wireless carriers to get the most out of their existing base stations and spectrum (possibly eliminating the need to build additional ones in certain situations), reduce operating expense and deliver a consistently high quality of service.

More information about all ISCO wireless solutions can be obtained from the ISCO website at www.iscointl.com.

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