Migrating to 4G LTE?
Choose the right carrier tester

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CEO of Berkeley Varitronics Systems
Innovator behind the Octopus Installation Tools
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The Evolving Wireless Backbone

Expansion causes problems
The development and expansion of cellular networks in the last few decades has transformed the face of industry and commerce. Wireless carriers have paved the way for non-stop data communications providing services for billions of transactions. This is very beneficial to consumers and businesses but also adds another layer of technical difficulty in maintaining network uptime and continuous operation. From energy distribution to ATMs to vending machines, 3G and 4G wireless networks provide extensive data to the central information system. However:

“when the communication system integrating all these moving parts fails, the repercussions can have a costly impact on business.”

The adage, “A chain is only as strong as its weakest link” holds true. Even though the daily dispatch of information and data is no longer performed by manual labor, these networks require human oversight and maintenance to perform at peak capacity.

New companies and devices are constantly released into the market every year to address these issues. The carriers, computing systems, electronic data collectors, and software all compete for market share, and promise the most satisfying and reliable service. However, even technology created within the last few years can be irrelevant or outdated. Ownership and functionality of cellular towers, system upgrades or new radio signal interference can cause “state of the art” equipment to fail or perform sporadically.

Since the 1980’s, Berkeley worked with carriers, installers and maintenance crews all the way back to the the initial build-outs of analog cellular networks. Over the years we have worked with industry leaders to solve in real word problems. In this video, Scott Schober, CEO and President relays the story of how BVS got its start in the cellular test equipment business back in the mid 80s.

Click on this link to watch:
https://youtu.be/-9X5_YglhgM}
Selecting a carrier by using bars on cell phones is NOT accurate

How accurate do you really think those tiny signal strength bars on your cell phone are?
You might recall when Consumer Reports removed their recommendation for Apple’s top selling iPhone 4 back in 2010 after users reported dropped calls. And while ‘Antennagate’ was overblown and addressed by Apple, it illustrated the inherent weakness in wireless consumer electronics. It was further revealed that each carrier used their own algorithms to calculate signal strength. So AT&T’s (4) signal bars might only equate to (2) signal bars on a Verizon phone. In addition, antennas on consumer phones are embedded and do not allow for an external antenna connection or proper amplification of that signal for test measurements.

In order to accurately assess various carriers’ coverage, you’d need to be like an octopus, holding a half dozen different phones (one for each carrier as well as a SIM for each) and visually comparing all the bars simultaneously for coverage. It’s why we named our product Octopus - one handheld unit that does it all. While comparing carriers, one quickly learns that they establish geographic competitive advantages by strategically placing cell towers along densely populated stretches, cities and areas that will maximize customer coverage. They also tend to focus build-outs in markets where their competition does not have coverage. All of this leaves one with the same question when determining the best wireless carrier.

Are you really going to trust the cell phone signal strength?
Suppose you’re installing a cellular booster in an office building where cellular coverage is spotty? Are you really going to trust a cell phone to determine the best spot and direction for the antenna when the cellular coverage is spotty to begin with? Modern cell phones are expensive but that’s because they contain so many bells and whistles that installers do not care about. These same phones also skimp on quality components and features that professional installers require in the field.

Watch “Cell Booster Installation Dos and Don’ts” at: https://youtu.be/kDa0N6YxTDA
Installs done right the first time to reduce expensive truck rolls

A poor installation affects the company’s bottom line
When you think of the cost of choosing the wrong carrier, one that you’ve signed a long-term contract with, the time and effort to change can get messy. Then there is the downtime of the wireless networking equipment not performing at its peak whether it is an ATM, vending machine, charging station, wireless alarm system or smartmeter. It all adds up to lost revenue.

Wireless network Installers of cellular modems often face a daunting task that requires not only the physical and electrical connection of their equipment but also many RF (Radio Frequency) factors in determining which carrier at a given spot has the best signal strength coverage. With Octopus and Octopus-Pro, installers do not need to guess which carrier has the best coverage. They measure actual signal strength at each independent site to provide the answer to the question before the trucks and crews roll in.

Low cost receivers only offer RSSI measurements but this only tells half of the story. Octopus offers RSRP and RSRQ in addition to RSSI for 4G network measurement. Octopus also includes true RSCP and Ec/Io measurements for 3G UMTS wireless networks. This means that one device will not only allow installers to choose the best carrier but also easily migrate from older 3G to newer 4G networks without additional measurement hardware.

Antenna placement and directionality is also critical.
The position of the antenna ensures that the radio communication link is optimal to neighboring cell towers. In some instances, there may be other considerations such as physical constraints where the installation requires antenna placement at the highest point but away from physical and wireless interference. Some installers only have limited options for antenna placement, but for those with multiple choices, a dedicated measurement tool can save huge amounts of time and money.

Once you decide on your carrier network and base station, simply disconnect the supplied multi-band omni antenna that comes with the Octopus and connect your site’s permanent antenna directly to the unit. Now you can precisely align that antenna so that it is pointing directly at the cellular tower even if you cannot visibly see the tower. If you’re performing multiple installations across multiple sites, Octopus-Pro features GPS and time stamping of every single measurement so you can export all logged data for more coverage analysis.

CONSTANT CHANGE
Radio signal parameters and RF propagation conditions frequently change. New towers are erected, carriers change the power and geometry of the antennas, new buildings are built that can cause shadowing of a signal at the particular location and network capacity changes daily due to user needs. Even changing foliage on the trees can greatly attenuate the signals from season to season. Periodic signal strength measurement and/or the ability to troubleshoot a problem due to the changing conditions is a necessity and a simple task with our Octopus and Octopus-Pro.
Unseen Consequences of Lost Data

Think about a mobile phone signal breaking up and how a conversation gets miscommunicated...

Now, think about 3,000 ATM machines “talking” to the terminal or a network of EV charging POS terminals trying to simultaneously “handshake” with a distant cell tower. The challenge is to place these modems and antennae where they experience the best signal coverage so the data stream is not interrupted or lost. Add to this, the challenge of placing ATMs in ‘prime real estate’ spots let alone in line-of-sight to the closest cell tower. Often the ATM is placed in a 2’ x 2’ corner down the hall where there is an empty space.

A modem without signal is sometimes more easily recognized and fixed whereas delayed delivery of data, or lost and irrecoverable data, just disappears.

A poor connection can result in “corrupted” data; much like a bad or dropped phone call and poor user experience. Some of the information may make it through, but it may be unusable, inaccurate and incomplete. Even if it eventually goes through, it takes longer than expected. Consumers waiting around for their ATM transaction to go through are impatient, unhappy and a possible target for nearby thieves.

The cost of bad connections are high because...

- “Truck rolls” require travel, gear and humans at every site
- New wireless site studies must be performed
- New modems, antennas and network gear must be purchased
- Downtime directly results in lost revenue

If all the stages of the data collection system are set up properly, data is sent wirelessly to a cellular network, transmitted through the Internet and to a server in your monitoring station or headquarters.

And all is well.

But we’re talking about real life here.

# A Comparison of Carrier Testers

<table>
<thead>
<tr>
<th>Features</th>
<th>Consumer Smart Phones</th>
<th>SureCall (low cost signal meter)</th>
<th>Octopus</th>
<th>Octopus-PRO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supports all U.S. carriers (including rural)</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>All day (8+ hours) battery operation</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>True RSRP measurements</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Removable SMA antenna</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Color touch screen operation</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Antenna alignment support</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Additional measurements (EC/IO, RSRQ, RSCP)</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Support for both 3G UMTS and 4G LTE</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Fits in any pocket</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>No SIMs or subscriptions required</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Directional antenna support</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>Data logging and export for further analysis</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>GPS time stamping of all measurements</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>Optional CDMA/EVDO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>HSPA+ and GSM/EGPRS world-wide coverage</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
</tr>
</tbody>
</table>

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## Do it right the first time!

- Choose the best sites
- Save on labor
- Choose the best carrier
- Get accurate antenna placement
- Eliminate unnecessary service calls
- Avoid downtime

*Purchasing the right gear requires less training and less troubleshooting*
Quick start-up guide for reliable Carrier Signals

On start-up Octopus will display the main screen of carrier choices.

Choose carrier directly or ALL 4G or ALL 3G UMTS base stations. Unit scans all 4G in background by default.

Sort through ALL 4G by carrier, Frequency, RSRQ or RSRP (shown)

Sort through ALL 3G UMTS by carrier, Frequency, EC/IO or RSCP (see screen on next page)
**The Solution**

**Why is RSRP better than RSSI?**

**It’s technical.**

What is RSRP? It is an LTE (4G) specific metric that averages the RF power in all of the reference signals in the passband. RSRP is the average power of resource elements that carry cell specific Reference Signals (RS) over the entire bandwidth, (i.e. RSRP is only measured in the symbols carrying RS. A resource element is one OFDM subcarrier for the duration of one OFDM symbol.

**What about RSSI?** This is an valid metric but more fittingly used to display signal strength for 3G technologies (GSM, CDMA1X. etc.) and it integrates all of the RF power within the channel passband. In other words, for LTE, RSSI measurement bandwidth is ALL active subcarriers, measured in all symbols. By definition, RSSI includes power of all interference and thermal noise.
The Octopus - a reliable carrier signal tester

- Support for AT&T, Verizon, T-Mobile and all U.S. regional carriers
- No subscriptions, SIM cards or multiple phones required
- True RSCP and Ec/Io (3G) and RSRP, RSRQ and RSSI (4G) measurements

**SMA Antenna Input**
Easily remove omni-directional antenna (included) and connect directly to your external antenna for precise alignment

**Color Touchscreen**
for instant navigation and visible measurements from a distance

**Sort Carriers by**
RSRP, RSRQ or RSSI in dBm for 4G
RSCP and Ec/Io for 3G UMTS

**Battery Powered - Rechargeable**
Runs all day (12 hours) on internal rechargeable Li-Ion battery

**USB Port**
Install powerful firmware updates directly from support on www.bvsystems.com

**Designed and manufactured in the U.S.A.**

**Handheld and Pocket-sized**
Weighs only ounces and fits in your pocket

**Includes a water resistant, high impact carrying case**

Also available at
amazon
The Octopus PRO - All the great features of the Octopus PLUS much more...

- **Directional Antenna**
  - support for pinpointing distant base stations

- **Data logging and export**
  - for comprehensive coverage
  - mapping and analysis

- **GPS Time-Stamping**
  - of all measurements

- **HSPA+ and GSM/EGPRS**
  - worldwide coverage

- **Optional:**
  - CDMA/EVDO measurements

Why Purchasing, Maintenance and Installation Departments request the Octopus

1. Why do Purchasing Offices specify the Octopus?
   To ensure customer satisfaction and long term profitability

Reduced costs up front and down the line
Up to now you are at the mercy of the cellular carriers and their coverage maps. Now, with one device any technician can drive to multiple sites in a day and record which network, carrier and cellular bandwidth is optimal for that specific location, ensuring a quality connection. Plus:
   - No monthly carrier subscription costs
   - No expensive software to purchase or lease
   - No multiple devices to calibrate and maintain

2. Why does the Maintenance Department specify the Octopus?

Infrastructure maintenance personnel are no strangers to the advantages of wireless and cellular technology. Using wireless technology is much more cost effective than traditional hardwiring methods and allows for increased functionality.

Pat Smith, from Data-Command shares, “In one instance, a properly installed wireless network cut the City’s monitoring costs for a segment of their water supply system by 50%.

The Octopus carrier testing tool allows quick signal audits of existing installations. When performing routine maintenance checks, technicians can review signal strength and note in maintenance logs whether there have been changes in carrier or signal quality.

3. Why do The Installers specify the Octopus?
   No more “you guys screwed up”

How do you streamline the installation? For example, your bid may include an option to use 2 different carriers. Do you have the appropriate SIM chips in your truck? How do you make the judgment call on which carrier to select so that there are minimal callbacks for service?

We have heard of installers using:
   - Expensive subscription software that create signal “maps”
   - Expensive hardware to run the “signal survey” programs
   - Multiple mobile devices subscribed to each main carrier
   - Their personal or company phones to track “signal bar” strength
   - Purchasing up to (4) cellular modem USB sticks with (4) carrier contracts

Does that sound like reliable quality control? The Octopus focuses only on cellular signal detection and strength analysis. Now they can “Do it right the first time.”
The 3G Sunset refers to manufacturers and carriers making the transition from 3G to 4G LTE (long term evolution) networks. Eventually they will stop making and supporting devices that use 3G networks. It’s like the 3G network is a major interstate and the cut-off dates are when the Dept. of Transportation will close the road. For companies that use older devices, the 3G network coverage they have relied on may not work.

While some carriers won’t drop 3G support till after 2022, there are some like Verizon, that will drop it after 2019. In the next few years, cellular service providers plan to phase out 3G service entirely. If you haven’t started migrating, you should start as soon as possible.
Some of the most common Applications

The future is expanding daily. While it is beyond the scope of this document to describe the thousands of daily applications and potentials for Cellular Networks, below are some of the most common we encounter.

**Commercial**
- Vending Machine
- ATMs
- Fleet monitoring
- Delivery Services: Propane, Concrete
- Taxi Services: Better allocation of driver
- Construction Company: Labor, material supply

**Industrial**
- Warehouse Management: Inventory
- Water Supply Systems
- Agribusiness Irrigation Systems: Moisture sensors
- Manufacturing Supply Chain Management

**Food Production**
- Livestock feed systems
- Agriculture Flood Management
- Consumer Goods
- Beverage Manufacturing
- Orchard Moisture Sensors

**Infrastructure**
- Electric Car Charging Stations
- Electric Grid Distribution Lines
- Railway Systems: maintenance and monitoring
- Smart Meters: Natural gas, Water and Electricity
- Weather Monitoring Systems
- Water Treatment Plants
- Critical Building Systems: HVAC, Water, Sewage, Electric
- Personnel Traffic Patterns

**Remote Monitoring**
- US Geological Survey
- Water Réervoir Levels
- Healthcare ICU Patients in their homes

**Security**
- Home Security Systems
- Sensors
- Business Security/Alarms
This year, we started to deploy directional cellular antennas and have started using the Octopus for the installations. The Octopus is easy to use and ensures that the directional antenna is positioned correctly. The tool has been a great help in completing installations quickly and correctly.

Frank Brown
Senior Operation Analyst, PG&E, CA

Have you ever thought about how Redbox® knows whether the DVD you want is at the corner store or the McDonalds® down the street? Cellular networks are keeping websites, software management systems and databases up-to-date with real time information.
About Scott Schober
Author, Inventor and CEO of Berkeley Varitronics Systems

“Ever since I was a child, I’ve always been fascinated with how things work. That same curiosity that drove my early exploration has made me a relentless scientist, engineer and innovator who sees challenges as opportunities.”
Scott Schober

Award Winning Inventor

Cybersecurity Expert on TV & Radio
Scott is a highly sought after Cybersecurity subject matter expert for media appearances and commentary. He is often seen on ABC News, Bloomberg TV, Al Jazeera America, CBS This Morning News, CCTV America, CNBC, CNN, Fox Business, Fox News, Good Morning America, Inside Edition, MSNBC and many more.

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Acclaimed Author of “Hacked Again” and “Cyber Security is Everybody’s Business”

Read about Scott’s personal experiences as well as his advice to global brands and the Department of Defense. If you are connected to the internet (as we all are), both of Scott’s book are “must reads.” Scott describes the reality of cyber threats and provides tips and techniques that will help protect you and your business interests from a devastating cyber security breach.

Feel free to reach out to Scott Schober directly at Scott@BVSystems.com or call 732-548-3737

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