

# The Brave New World of News Backhaul and the Introduction of Robustivity

## The Brave . . .

- 3G Newsgathering can be a new “Rat’s Nest” !
- But It Works - Is it Road-Ready ?
  - Easy to set up?
  - Reliable?
- A laptop with USB modem,
- Editing software,
- And a video & audio capture dongle.
- Add your combination to the above.



**“The good old days weren’t always  
good and tomorrow ain’t as bad as  
it seems...” Billy Joel**

-from “Keeping the Faith”

## There are Complete Solutions !

- Describe Terminology we will be using.
- Discuss basic 3G theory & technology.
- Discuss basic Wi-Fi theory & technology.
- Considerations in choosing a portable news backhaul system.
- Talk about the video & audio encoding methods.
  - Bit rate reduction techniques.
  - Parameters that need to be set.
- What settings are the best?
  - There are too many settings to remember!
  - Robustivity makes it Easy.

## There are Complete Solutions !

- How a 3G Newsgathering system can help you.
  - Single modem implementation = Practical & Economical.
- Other uses besides News.
- Features that will improve Productivity.
- Diagnostic tools = Basic ones are not expensive!
- Interesting Devices to Consider.
- Summary & Conclusions.
- Time for Your Questions.

## Terminology

- Broadband modem = A modem using cellular technology that provides high data rates.
- 3G modem = A Broadband modem that operates on 3G networks with peak data rates in the HIGH Kbps to LOW Mbps range. The 3rd Generation of cellular standards.
  - Same as an EV-DO modem.
- 1x / 1xRTT = Cellular modem voice channel
- 1x EV-DO / EV-DO = Cellular modem data channel
- CDMA = Code Division Multiple Access: Users share spectrum with signals that are digitally watermarked to keep transmissions separate.
- CDMA2000 = Base standard that set it all in motion.

## More Terminology

- 4G modem = A Broadband modem operating on a 4G network with a peak data rates in the HIGH to VERY HIGH Mbps range. The 4th Generation of standards.
- Wi-Fi = (trademark of the Wi-Fi alliance) These are Wireless LAN devices that work on the IEEE 802.11 standards. Short distance, high data rate device.
- H.264 video encoding = MPEG-4 Part 10, also known as AVC. Codec standard widely used for streaming and broadcast.
- AAC audio encoding = Lossy codec used in video game consoles and smart phones. Generally better sound quality than MP3. Within MPEG-4 Part 14.

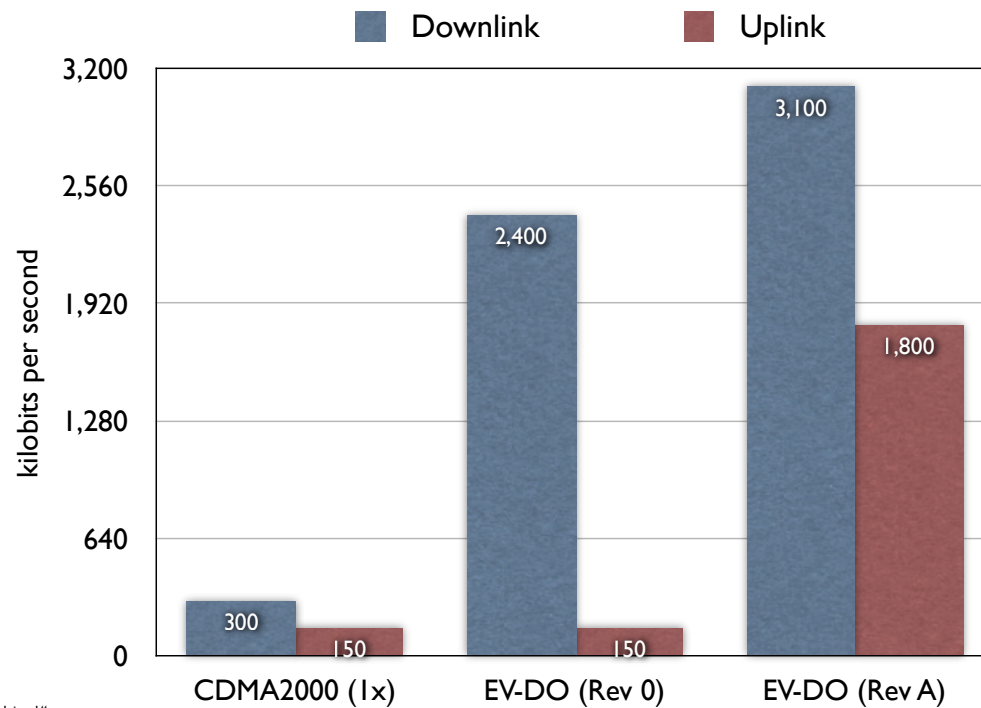
## 3G Technology

- For a 3G on CDMA (Code Division Multiple Access):
  - 3G channel bandwidth = 3 x 1.25 MHz bandwidth channels.
  - Users on same RF Spectrum, each separated by unique codes.
  - Users look like noise to each other.
- As a benchmark, Transmission Bandwidth divided by Bit Rate gives SNR:
  - $SNR = 10 \log [BW / BR]$
  - SNR is increased as the signal spreads.
  - Or, for a fixed BW, higher Bit Rate may not be possible.

## 3G Technology

- Increasing the Bandwidth gives SNR improvement.
  - Without the need to improve coverage!
- 1x and EV-DO do not simultaneously use the same channels.
  - EV-DO uses dedicated channels for its data operation.
- Modulation is Direct-Sequence Spread Spectrum.
  - 2G = TDMA
  - 3G = CDMA + OFDM
  - 4G = OFDM

## Progression of 3G Data Rates



Source: "Cellular Communications Explained"

## Wi-Fi Technology

- Most common Wi-Fi uses the 2.4 GHz band, per IEEE 802.11 standard.
- Spectrum is Channelized into 11 separate channels.
  - Standard Channel Width is 20 MHz.
  - Adjacent channels overlap each other.
- Each Access Point acts as a Host to a Wi-Fi device within its range.
  - SSID identifies the access point.
  - Password protected with WEP, WPA or WPA2 encryption.
- Short distance use from Access Point (AP), typically 300 - 1,000 feet.
- Multiple Wi-Fi devices can connect to an AP.
- Operation is half-duplex - the AP's need to listen for devices.

## What are Your Newsgathering Objectives?

- How can a 3G newsgathering system help your organization?
- Ask questions like:
  - What percent of your stories are Breaking News?
  - How experienced are your camera operators?
- This will help find a solution that fits the Station's Reporting Style.

## How Do You Gather News?

- Consider the News process:
  - Feature news.
  - Planned events.
  - Breaking news - Unplanned news events.
  - Portable, battery powered equipment.
  - Combination of full time staff and stringers.
- A Remote News Bureau:
  - Routine newscasts.
  - Full time or Part time staff.

## What Equipment Do You Use?

- A combination of analog & digital equipment:
  - Cameras.
  - Signal distribution.
  - Storage.
- As analog equipment is replaced, digital equivalent is purchased.
- Less maintenance & know-how required for high quality video !
  - Lighter weight equipment.
  - Smaller, easier to use.
  - Lots of set up not required for a quality news product.

## 3G Technology is Upgradable

- Basic foundation of the system is a plug in device form factor.
- The 3G modem form factor is user-friendly.
- Generally:
  - Embedded module is Mini PCI-Express.
  - Or USB plug in form factor.
- Can be removed, added, swapped-out by the end user.
- The devices have embedded software for connection algorithm.

## Audio & Video Encoding for Transmission

- Audio is AAC encoded.
  - Not the big contributor to overall data rate.
  - Typically 16 kbps sampling rate.
- Video passes through an H.264 encoder.
  - Encoder has 3 adjustable parameters that significantly affect the video performance:
    - Video Data Rate setting.
    - Frame Rate setting.
    - GOP number.

## Concept of Robustivity

- H.264 video encoder has adjustable parameters.
- Which parameter changes can be helpful ?
  - Video Data Rate
  - Frame Rate
  - GOP Number
- Extensive research & testing over several months has resulted in creation of the Robustivity Matrix.
- Robustivity can be set by choosing a number from the device front panel menu.

## Robustness Demonstration Video Clips

- Clip #1:
- Lexington Ave and East 60th in Manhattan.
  - Robustness 11 = (30 F / 600 kbps video)
  - Sprint network
- Clip #2:
- Philadelphia next to the stadium.
  - Robustness 3 = (3 F / 75 kbps video), 5 = (6 F / 125 kbps video),
  - Robustness 7 = (10 F / 175 kbps video), 9 = (30 F / 400 kbps video), 11
  - Sprint network

## Solutions for 3G newsgathering should:

- Have a technical support system,
- Have replaceable parts,
- Be user-friendly to operate,
- Have a short learning curve,
- So the product can be used by all the staff.

## How 3G systems can help

- **Complement a Newsgathering vehicle:**
  - Use Wi-Fi to get the story back to the truck, live, without wires.
- **Go Live from a location that is inaccessible to vehicles:**
  - Able to get that unpredictable Breaking News story.
  - Or for routine News reports, Wi-Fi infrastructure can be set up at known location on a permanent basis.

## 3G & Wi-Fi Can Have Multiple Uses

- Question: What can't you do now that you COULD do ?
- Note: The answer will cover more departments than News.
- That's OK !
  - Other departments will "buy in" ,
  - This helps get purchasing approval,
  - And makes good business sense.

## Features To Improve Productivity

- Ability to select between modems on different carriers. For example:
  - Verizon
  - Sprint
  - AT&T
  - T-Mobile
- Ability to use Wi-Fi for high quality video requirements.
- An IFB system: Interruptible Fold-Back.
  - Allows communication To and From Technical Operator in the Field.
  - Allows for privately cueing the on-location Reporter.

## Ability to Select a Different Carrier

- Not all service areas are equal.
- Network traffic may bottle-neck higher video bit-rates.
- Data throughput can be unpredictable.
- Be prepared !

## Ability to Use Wi-Fi Transmission

- More channel bandwidth = higher quality video possible.
- Can use both SSID and password encryption to keep the network private.
- Wi-Fi is well suited for routine newsgathering locations like:
  - Stadiums
  - Court House
  - Town Square
- Wi-Fi access points in multiple locations on a private network can be quite flexible.
- Multiple access points Enable Creativity.

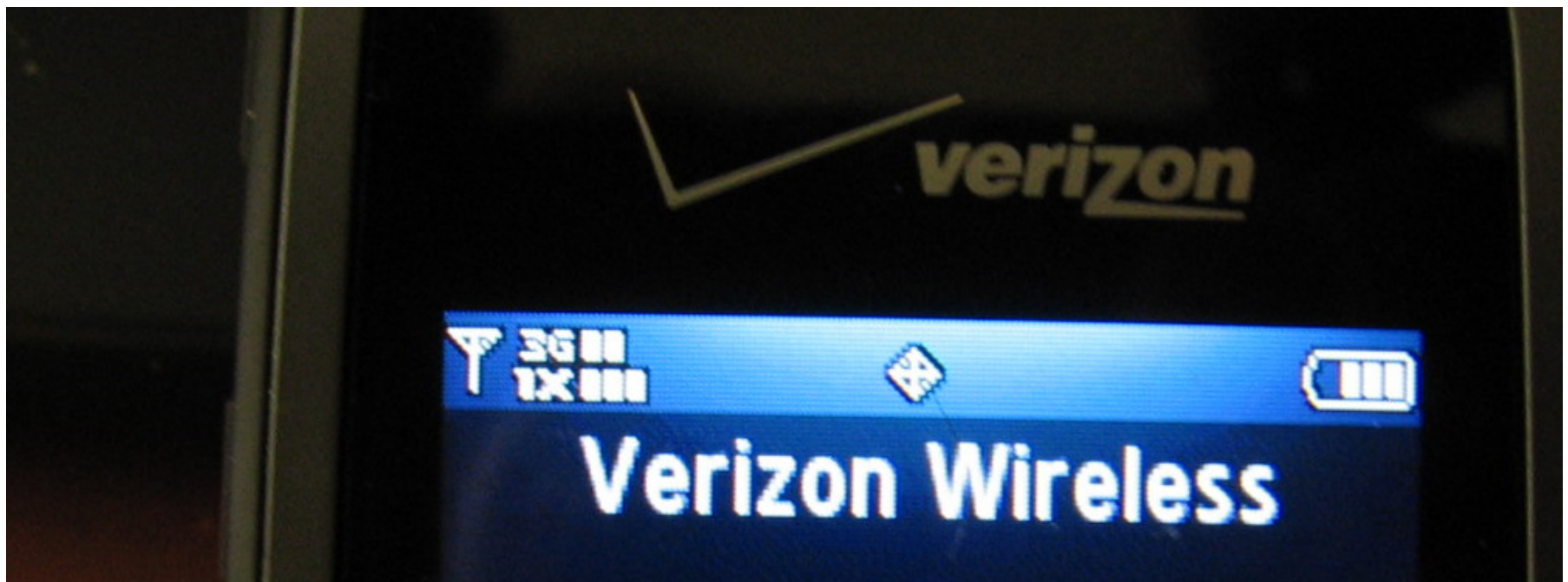
## An IFB System

- Private communication To and From the field location.
- Lets the field crew concentrate on the task at hand - the news story.
  - Cell phones not necessary.
  - No two-way radios required.
  - IFB system should be built in, so no added costs necessary.
  - No extra equipment to carry along.

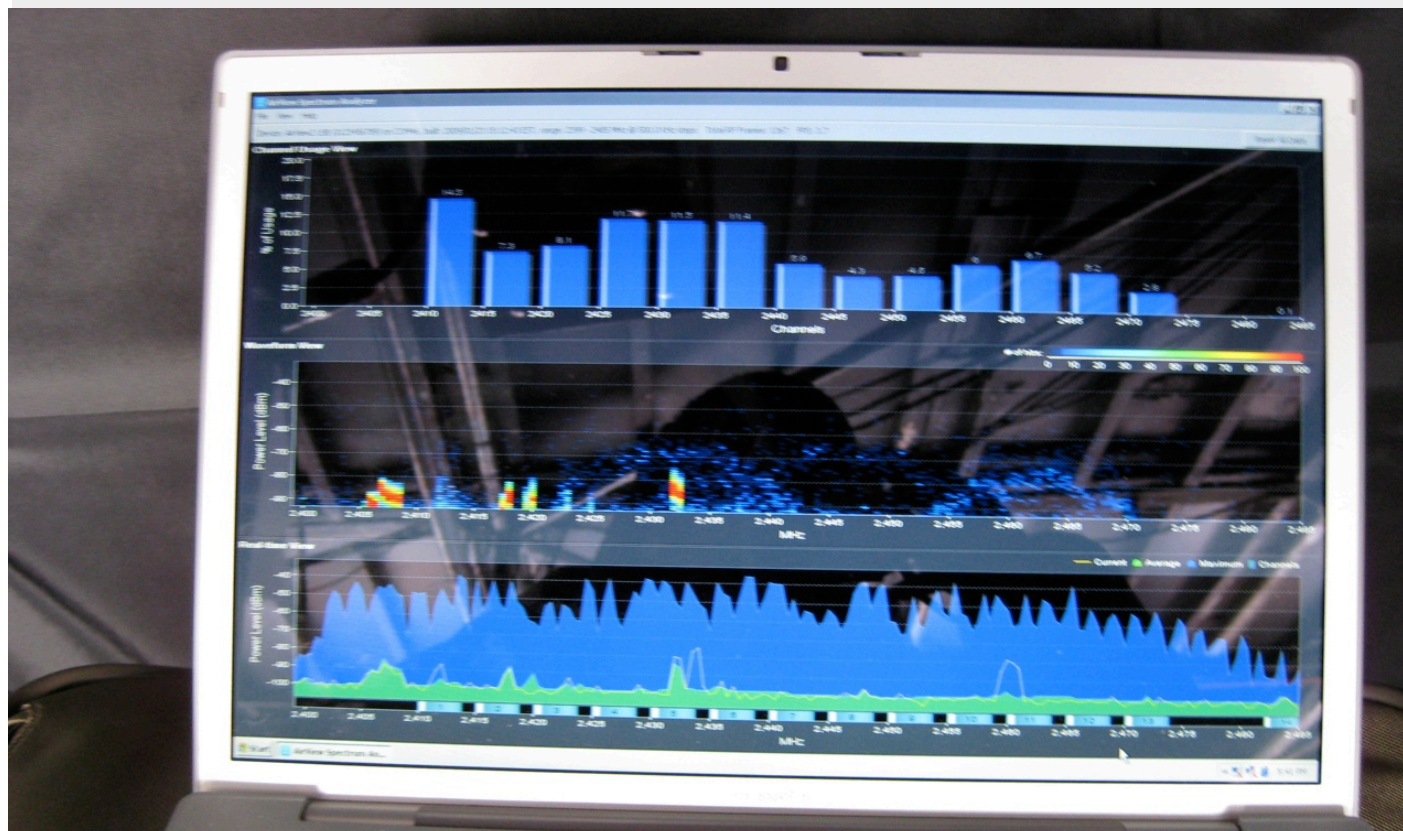
## Diagnostic Tools for 3G & Wi-Fi Operation

- Look up the Coverage Map for your area from Service Provider.
  - It is probably helpful - at least for an initial “go” or “no-go”.
  - Not many details available on how the Map is generated.
- Use the cell phone you have in your pocket.
  - Rough answer to the question: Is there 3G service here ?
  - Some cell phone Signal Strength indicators give more detail than others.
- Wi-Fi spectrum analyzers (\$39 range).
  - A small USB dongle plugged into a laptop.
  - PC software is provided.

## Cellular Signal Strength Indicator



# Wi-Fi Spectrum Monitor



## Interesting Devices to Consider

- **Virgin Mobile (and others) Mi-Fi device:**
  - A Wi-Fi to 3G / 4G bridge.
  - Portable with rechargeable battery.
- **Femtocell:**
  - Creates local 3G / 4G hotspot via hardwired Internet connection.
  - May help in difficult coverage areas.
- **Alcatel-Lucent “Light Radio”:**
  - A small, self-contained cellular access point.
  - Breaks up large coverage area into multiple, tiny coverage areas.
- **AT&T “Cell Tower in a Suitcase”:**
  - Electronics in a small case - satellite antenna carried separately.
  - Enabling communications in disaster areas.

## Summary & Conclusions:

- 3G and Wi-Fi systems are stable tools for ENG.
- A 3G Single-modem system is an acceptable solution for covering breaking news.
- Video encoder parameters must be set to get the best picture.
  - Video Bit Rate
  - Frame Rate
  - GOP Number
- Robustivity takes the Trial & Error out of video encoder settings.
- Basic Diagnostic Tools are handy to have on hand.

**It IS a Brave New World !  
Constantly Filling with New Technology and New Techniques.  
Play to the Strengths of each Platform  
for Maximum Productivity !**

## Reference Books

- “Cellular Communications Explained” by Ian Poole.
- “4G LTE / LTE-Advanced for Mobile Broadband” by Erik Dahlman.
- “Greater Insight into LTE Design and Test” application notes by Agilent Technologies staff.

**Thank You !**

**Questions ?**

For later questions by email: [jstack@dsirf.com](mailto:jstack@dsirf.com)