Wireless Technologies Provide Effective Data Communications to the Solar Power Industry

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Agenda

Wireless In Solar
Wireless Options For Solar
Case Study

INTRODUCTION: WIRELESS IN SOLAR

- Utility scale and commercial scale solar power generation has become an increasingly compelling solution
- Operators are looking for new ways to maximize their investment by using communication networks
- Require reliable and secure data transmission
- Many communication options - data radios, wired network, fiber-optic cable, cell phones & satellite modems.

This talk and case study focus on the use of proprietary protocol data radios.

INTRODUCTION: WIRELESS OPTIONS FOR SOLAR

- Data Radios:
  - Frequency Hopping Spread Spectrum
  - Direct Sequence Spread Spectrum
  - Licensed Spectrum Fixed Frequency
- Cell modems
- Satellite modems

The case study in this talk implemented frequency hopping spread spectrum data radios.

WIRELESS: TECHNOLOGY SYSTEM EXAMPLES

Tracking Systems:

- **Concentrated Solar Power (CSP)**
- **PV**
- **Solar Dishes (Stirling Engines, etc)**

Heliostats

Rooftop Campus

Business Park PV Systems

Utility Scale PV

WIRELESS: APPLICATIONS IN SOLAR

- Orientation and Positioning
- Tracking Controls
- Status Updates
- Telemetry
- SCADA
- Temperature Monitoring
- Pressure Monitoring
- Vibration Monitoring
- Performance reporting
- Operations & Maintenance
- Condition Monitoring
- Weather Station Communications
- Emergency Msg (weather, etc)
- Alarms from the remote points
- Emergency Stop (E-Stop)
- Perimeter Security
- and more

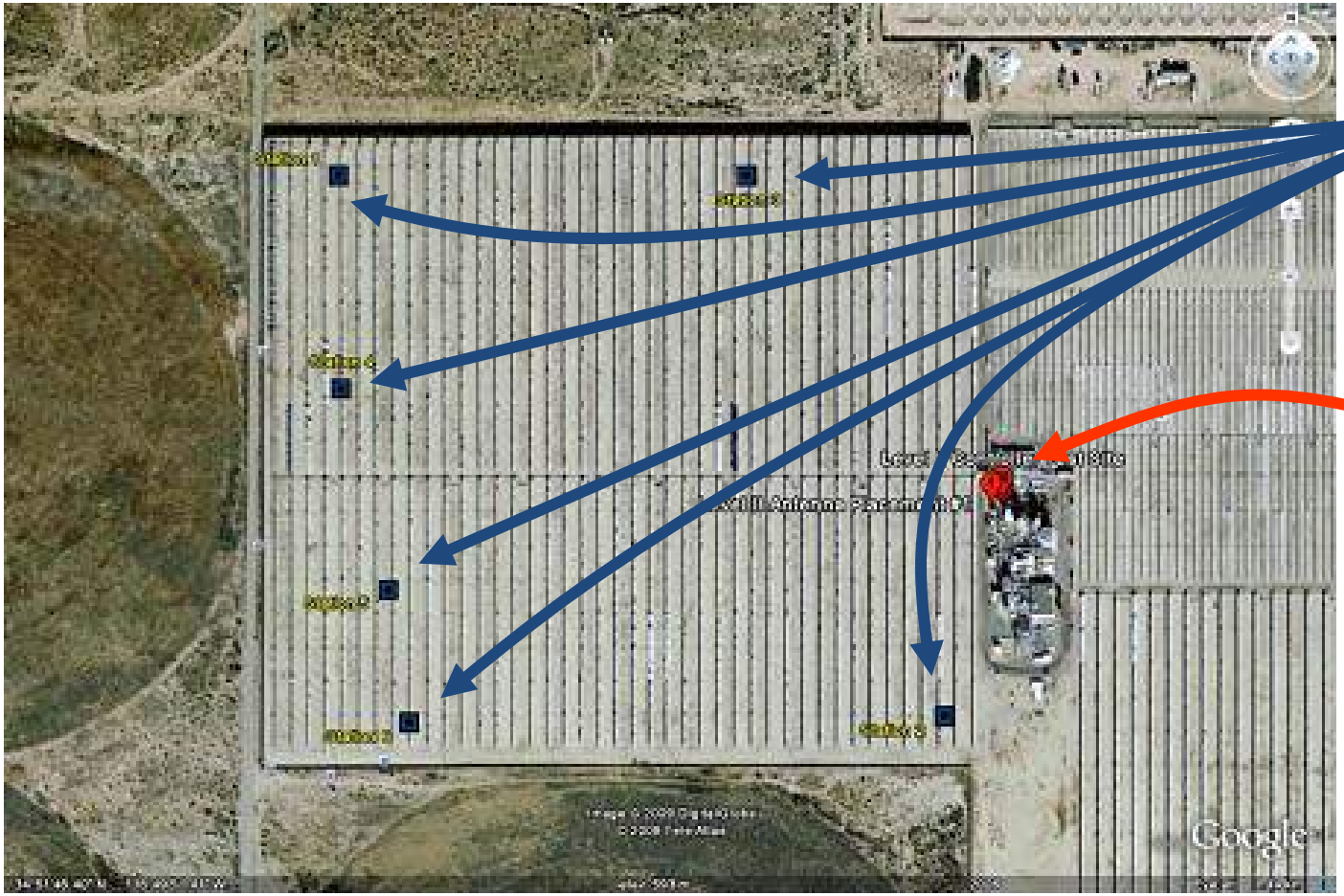
Case Study

Solar Pilot Project

2008-2009

- Concentrated solar power trough field in California
- Used 900 MHz frequency hopping spread spectrum
- Throughput = 188 kbps : 115.2 kbps user data
- Results monitored and communicated via www
- Remote antennas “below line of sight plane”
- Master antenna on top of plant building
- Communicated effectively even with Faraday Cage effect possible

Pilot Project Typology



Equipment Samples

- Pelican case housing radios, batteries, cabling and etc.
- Antenna cable

- Pelican case housing radios, batteries and cabling.

Test Plan/Results

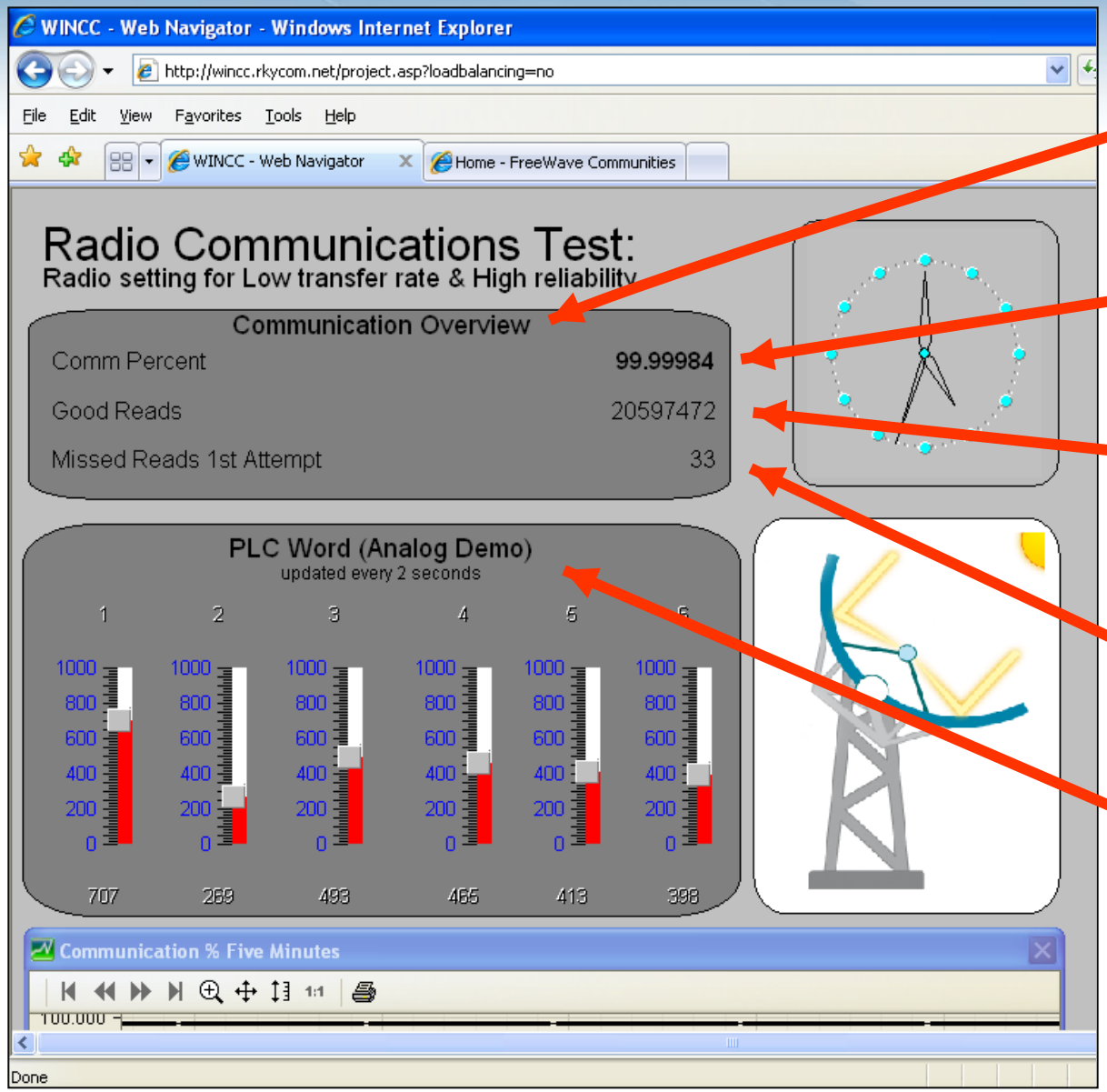
Stage testing was originally planned as follows:

Stage 1: 20 days - Medium Transfer Rate and Reliability
Stage 2: 5 days - Low Transfer Rate and High Reliability
Stage 3: 5 days - High Transfer Rate and Low Reliability

Cumulative response data for the first two stages combined includes:

Period Ending	Packet Quantity Successfully Passed on First Attempt	Packet Quantity not Successfully Passed on the First Attempt	Percent of Packets Successfully Passed on First Attempt
January 28, 2009	19,150,000	33	99.99997
February 2, 2009	34,000,000	1,200	99.99999
February 12, 2009	43,000,000	2,250	99.99994

Pilot Monitoring Screen Example



Communications settings for this test.

The successful % received rates first time a packet has been sent.

The number of packets sent successfully.

The number of packets missed on the first attempt.

Simulated analog inputs such as temperature or pressure.

Solar Pilot Project Conclusions

2008-2009

- These radios proved high reliability over several months of environmental conditions – no less than 99.99994% first packet received rate
- High reliability was achieved in three different radio system configurations
- This type of radio was successfully deployed with antennas without shadowing the troughs
- There was no impact of a Faraday Cage reflectance
- The entire installation was relatively inexpensive and was installed very quickly

FreeWave®

The Difference is Clear

Thank You!

Thank You!