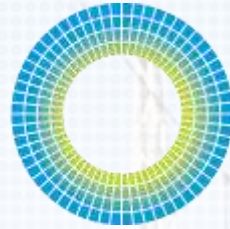


ONRAMP
WIRELESS



Introduction to On-Ramp Wireless

Presented ISA - Passive Wireless Sensor
Technology Workshop

June 6, 2012

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Company Overview

- Ultra-Link Processing™ enabled Wireless Systems & Services
- Four years old with 90 Employees
- 13 Patents Awarded – 25 Pending
- IEEE 802.15.4K Standards Support Initiative – Low Energy Critical Infrastructure Monitoring (LECIM)



Partners and Customers



Awards



The Vision

○ The Buzz

- “The Internet of Things”
- “M2M”
- “A Smarter Planet”

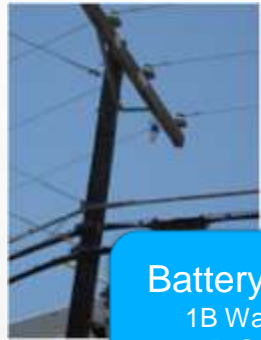
○ The Reality

- Billions of potential endpoints
- Billions of \$\$\$ in savings from operational efficiencies
- Multi-Billion \$\$\$ market opportunity

| Utilities Smart Grid | Process Industries | Personnel and Asset Tracking | Critical Infrastructure |
|---|--|--|--|
| <ul style="list-style-type: none">• AMI Electric Meters• Smart Transformers• Fault Circuit Indic.• Distribution Automation• Building HVAC Automation• Gas & Water Meters | <ul style="list-style-type: none">• Leak Detection• Pressure Sensors• Temp. Sensors• Vibration Sensors• Chemical Sensors• Radiation Sensors | <ul style="list-style-type: none">• First Responders• Military Personnel• Vehicle Fleets• Railroad Freight• Shipping Containers• Other Vehicles | <ul style="list-style-type: none">• Surveillance and Security• Border Control• Bridge Monitoring• Fire Detection• Landslide Monitoring |

Industry Needs to Connect 50 Billion Devices by 2020

An unsolved problem costing billions per year in wasted resources requires radically improved wireless performance and lower cost



Battery Powered
1B Water Meters
1B Gas Meters



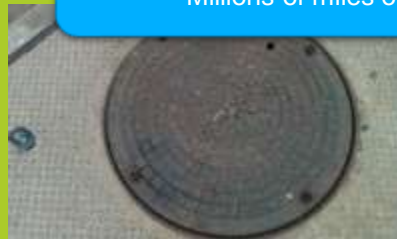
In Vaults
100M meters



Indoors
1B sensors

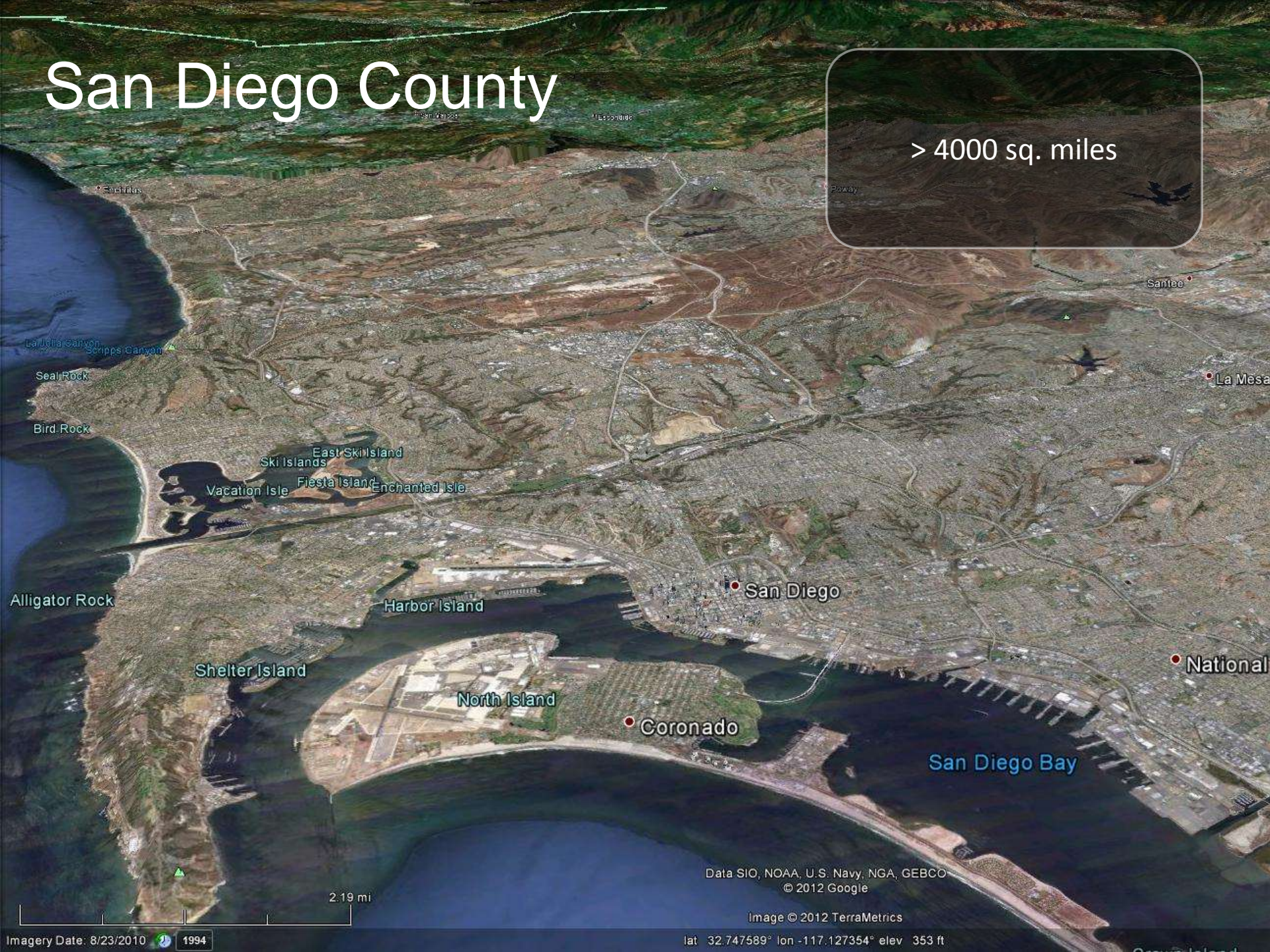


Underground
Millions of miles of Pipelines & Circuits



San Diego County

> 4000 sq. miles



Data SIO, NOAA, U.S. Navy, NGA, GEBCO
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Imagery Date: 8/23/2010 1994

THIS IS NOT WHAT YOU WANT



Designing a Purpose Built Solution...

Purpose Built
Radio for the
Smart Grid

- Lowest Total Cost of Ownership
- Best Coverage in Industry
- Connectivity in Hardest to Reach Areas
- Immense Capacity
- Seamless Support for Battery Devices
- Robust Operation in Noisy ISM Band

Radios
originally built
for other
Applications

- Limited Coverage Range
- Limited Capacity
- Limited Support of Battery Devices
- Sensitive to Interference
- Cost Prohibitive in Many Geographies

Key Performance Metrics



Coverage
Capacity
Coexistence
Power
Security
Cost

Purpose-Built Coverage

- Link Budget measures the ability of a communication system to close the link.
- Three Drivers:
 - Transmit Power
 - Antenna Gain
 - Receiver Sensitivity



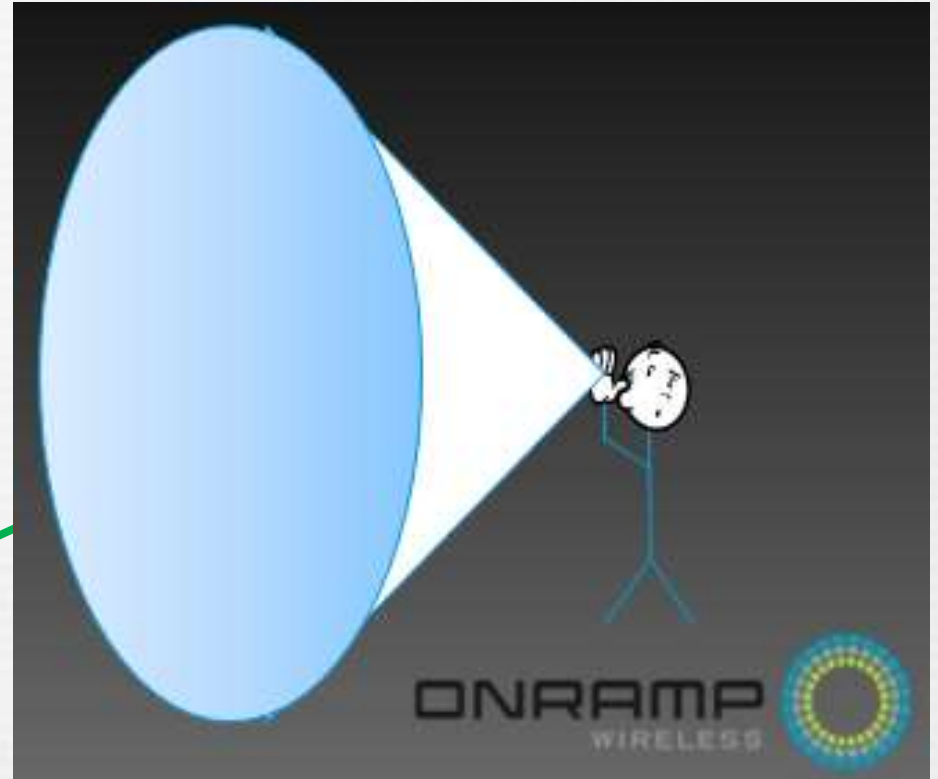
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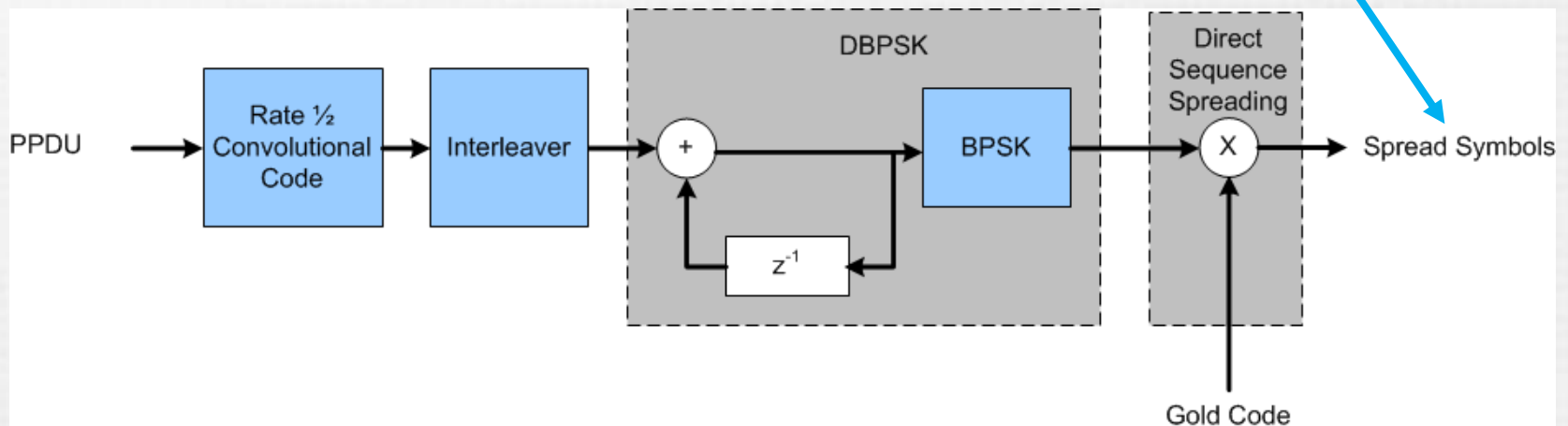
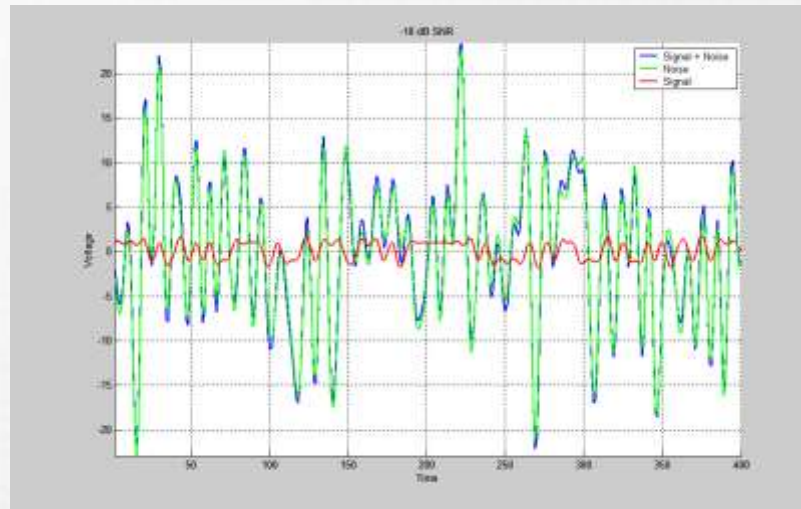
Purpose-Built Coverage

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Receiver Sensitivity using DSSS

- Spreading factors up to 8192 chips/symbol to get up to 39 dB of **processing gain**
- Receiver sensitivity is -133 dBm on downlink and -142 dBm on uplink



Link Budget Comparison

FHSS Radio



132 dBm

ULP



172 dBm

Purpose-Built Capacity

All at the same time!
For uplink and downlink

○ Uplink (Node → AP)

- AP can receive **100 MBytes/day** in steady-state using RPMA
- Can service >2000 nodes simultaneously, e.g. outage flood

| Application | Data/Day | # per AP* |
|---------------------|-----------|-----------|
| Electric AMI Meter | 2.4 KB | 20,000+ |
| Hazardous Alarms | 100bytes | 100,000+ |
| Pressure Sensor | 100 bytes | 100,000+ |
| Cathodic Protection | 100 bytes | 100,000+ |

○ Downlink (AP → Node)

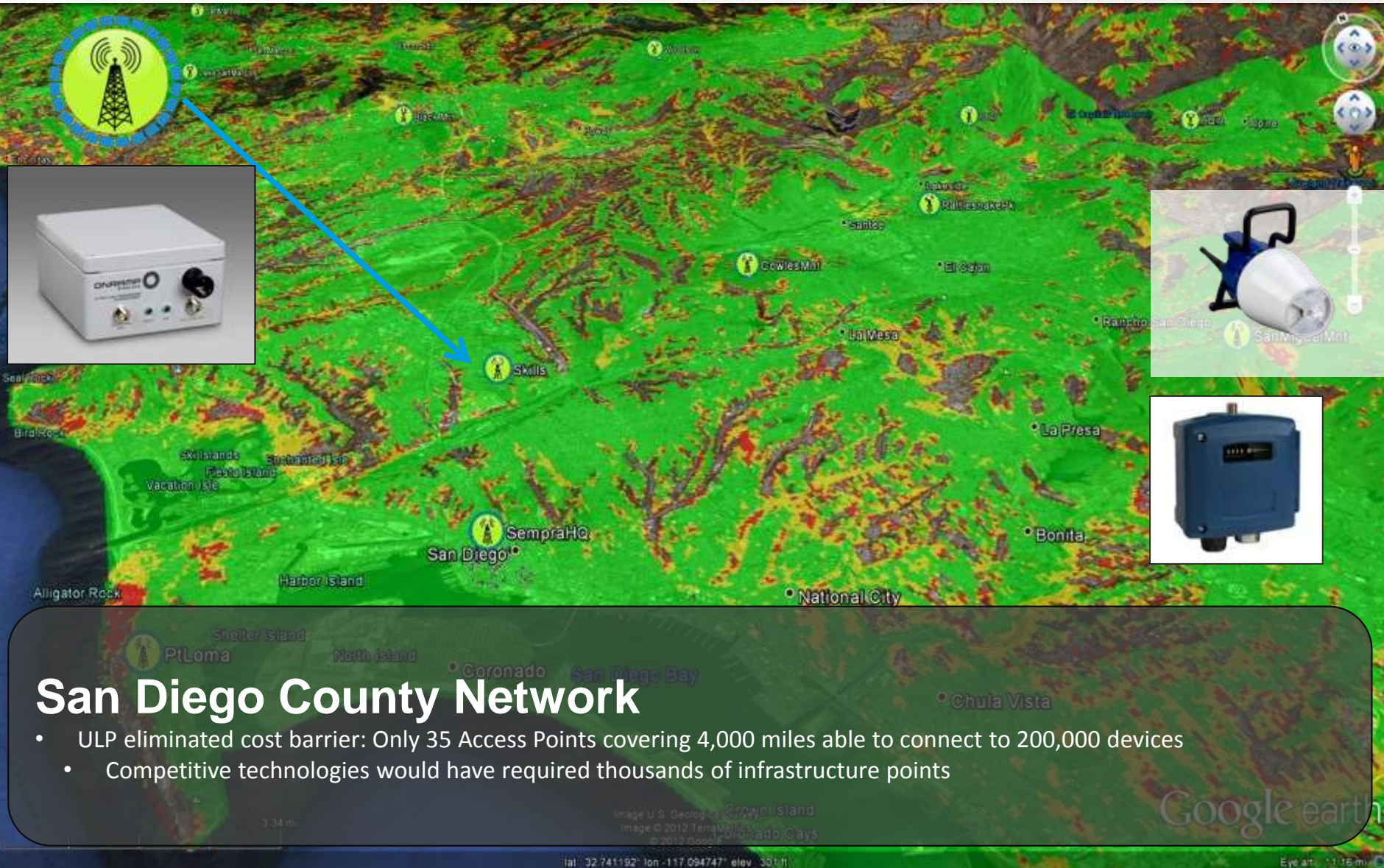
- Up to **72 MBytes/day** of unicast user data
- Up to **144 kBytes/day** of multicast user data
- Up to **72 kBytes/day** of broadcast user data

The Fundamental Tradeoff

- ULP optimizes the balance of data-rate and link budget
 - DSSS spreads information over long period of time
 - Each node can uplink **90 kBytes/day**
- Many Smart Grid applications are not “chatty”
 - ULP is well within sweet spot for AMI, DA, etc.

| Electric Meter | Data Per Day (kBytes) | Percentage Throughput |
|--------------------|-----------------------|-----------------------|
| Current Data Model | 0.8 | 0.9 % |
| 3x Data Model | 2.4 | 2.7% |
| 10x Data Model | 8.0 | 8.9 % |

On-Ramp Cost Effectively Covers Vast Geographies



ULP Access Point

- Provides wide area wireless coverage to sensors with ULP Nodes
- Supports various indoor and outdoor mounting options
- Supports powered or un-powered installations
- Environmentally certified for utility and industrial applications
- Transports data on secure IP backhaul



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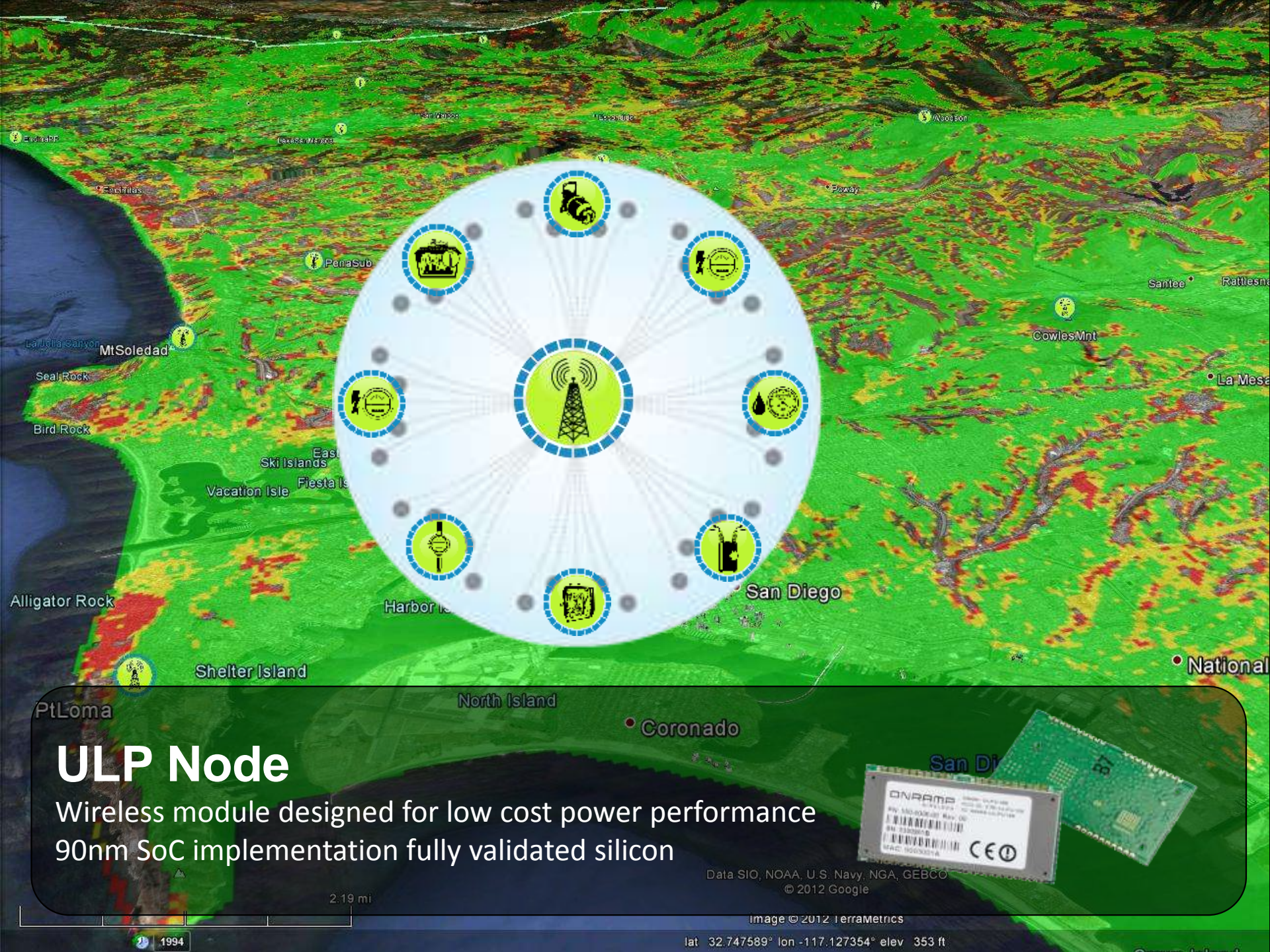
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ULP Node

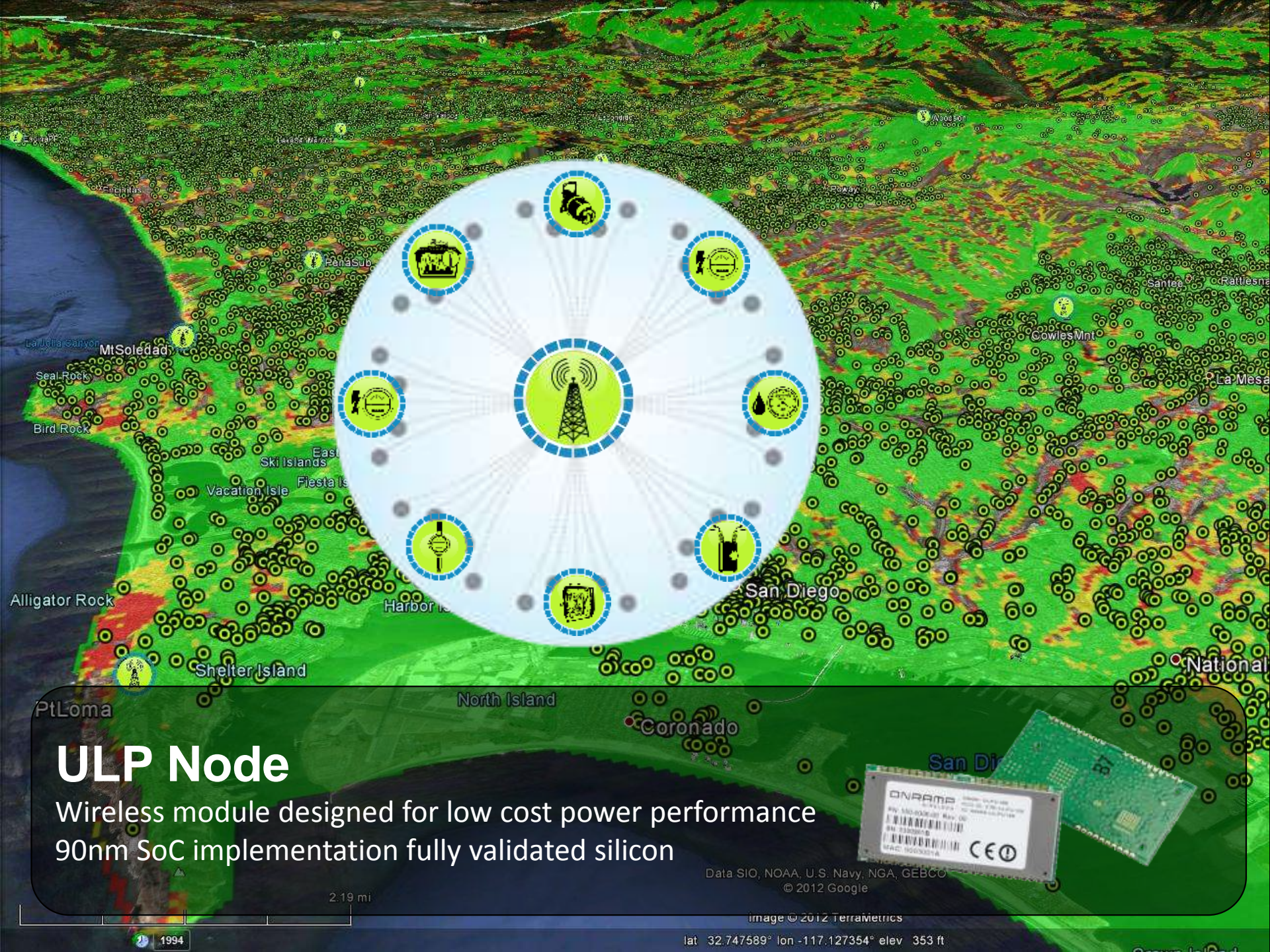
Wireless module designed for low cost power performance
90nm SoC implementation fully validated silicon



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ULP Node

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METER DATA
MANAGEMENT
SYSTEM

OUTAGE AND
DISTRIBUTION
MANAGEMENT
SYSTEM

CRITICAL
INFRASTRUCTURE
MONITORING
(CIMA)

Process Control
System

OTHER

Enterprise Services Bus

Head End System

Data
Services

EMS

KMS

Network Controller

ULP Back Office



San Clemente Island



Harbor Island



San Diego



National City

North Island

Coronado

San Diego Bay

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ULP-Enabled Smart Grid Devices



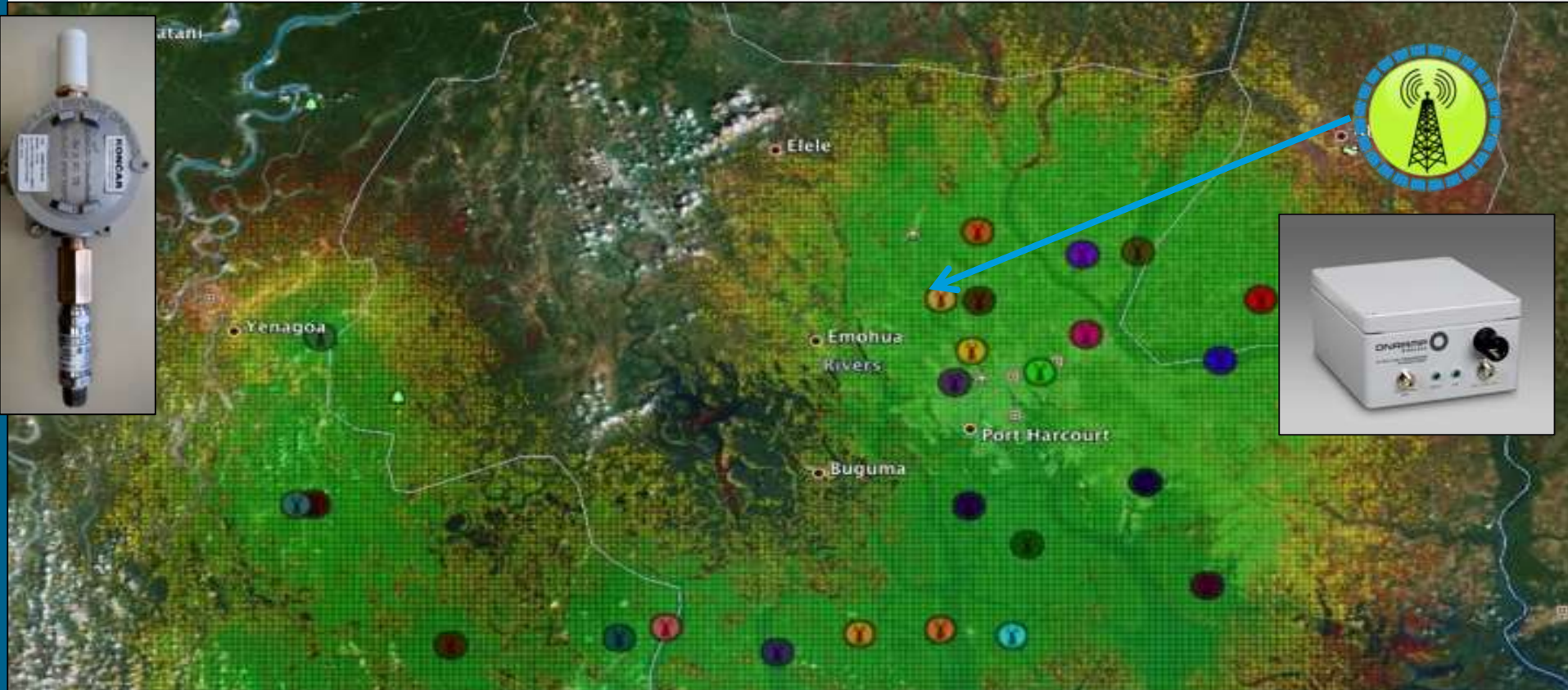
Overhead Line Monitors

>1000 Deployed In San Diego County



10 Year Battery Life

Pilot Deployment 10,000 km² area of challenging terrain in Niger Delta



Shell Nigeria Case Study

- Shell losing 100,00 barrels of production from theft and leaks needed solution for better operated sensing
- Tried RF Repeater based solution which failed after 2 years of effort and \$10M invested
- On-Ramp connecting 5-7Km in challenging RF environment for initial pilot phase with ULP enabled sensor
- Final validation phase for major roll out solving customers issues not possible with any other technology

Ultra-Link Processing

- A single network enabling oil and pipeline automation
 - Rural, suburban, dense urban
 - Powered or battery operated sensors
 - Above or below ground applications
- Production system or hosted network and software
 - Realizing operation benefits at a fraction of the cost of other systems
 - Easily expanded to support future application roadmap
- Fastest time to benefit
 - 50-300 sq miles of coverage enabled per day!
 - Solution agility – deploy network and lead applications and expand over time



Foundation for ULP enabled pipeline integrity solution