

# The New INTERNET OF THINGS

## Telemetry / Telematics / M2M

The screenshot displays the XactTrax web application interface. At the top, the XACT logo is on the left, followed by the XactTrax logo and the text "PORTABLE GPS TRACKING DEVICE". To the right, a "Usage Meter: 647" is shown, along with "Log-in" and "Search" buttons. Below the header, a navigation bar includes links for HOME, TRACKING, MY DEVICES, MY CONTACTS, MY EVENTS, and MY ACCOUNT. A secondary bar features buttons for MANUAL TRACK, REALTIME TRACK, SCHEDULED TRACK, TRACK HISTORY, and BOUNDARIES. The main content area is divided into three sections. On the left, "DEVICES TO TRACK" lists three items: a person, a car, and a dog, each with a checkbox and a "Switch to list view" link. Below this is a "TRACK NOW" button. The central section is a map of North Arlington, NJ, showing a tracked vehicle (a car) and various street names. The map includes a scale bar (200 m) and a "map24 © 2009 NAVTEQ" logo. On the right, the "Ashley GPS" section displays the last tracked location: "113 Jason Way, North Arlington, NJ 07031", with a "GET DIRECTIONS" link. Below this, "DEVICE INFORMATION" shows "SATS: 10", "GSM: POOR", "MPH: 0", and "BATTERY: 75%". At the bottom, a "SHOW ON MAP" section lists checkboxes for BOUNDARIES, CONTACTS, BUSINESSES, EMERGENCY SERVICES, and SEX OFFENDER LOCATIONS.



**TCF 2011**  
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*CTO, XACT Technology*

# The New INTERNET OF THINGS

## Telemetry / Telematics / M2M

**Abstract:** As the cellphone industry is becoming saturated with just personal calls, an entirely new business of assets communicating is heating-up.... billions of assets communicating wirelessly. This is known as Machine-to-Machine communication and expectations of billions of assets communicating wirelessly.

Today, we are seeing ocean-going ships communicating wirelessly to each other (AIS), Airplanes (ACARS), Trains (RFID), Trailers, Autos, and soon containers and every type of assets. . The first open, flexible wireless & GPS M2M Xact Technology platform will also be demonstrated. This highly-integrated platform is limited only by your imagination and will save you a year in getting your new product to market!

# GSM/GPRS/GPS OPEN M2M Development KIT



- **Complete M2M Solutions Architecture**
  - **Cocoon Kit Includes**
    - **Tested Trax Board**
      - Quad-Mode GSM/GPRS (Sierra)
      - GPS (u-Blox AMY)
      - Accelerometer (Freescale 3D)
      - Magnetic Switch (Murata)
      - Temperature Sensor
      - Battery & Integrated Charger
      - USB Slave Port



## **Development Software**

- Ellipse Integrated Development Environment
- Source Code
- Portal Access

## **Software Utilities**

- Firmware Loader
- Configuration Editor
- GPS Analyzer (u-Center)
- GSM Analyzer



# GSM/GPRS/GPS M2M Development KIT - Portal

## • Software Tools

### – Kit Includes

#### • Development & Production Portal

##### – Defined Packet Types

- » Status, Log, Config Packets
- » GPS Location (x3)
- » GPS Quality
- » Speed
- » Battery State
- » Onboard Geofencing

#### • GIS Portal Access

- XML Gateway
- API's Documented
- Multiple Portal Options
- Customization Available

SeaMonkey

File Edit View Go Bookmarks Tools Window Help

Back Forward Reload Stop <http://www.xacttrax.com/tools/sms-receive.php>

Home Bookmarks mozilla.org mozillaZine mozdev.org sms-receive.php

Top Up First Previous Next Last Document More

Last 10 communications Start at 0

Between and

Device ID / Phone # or Last six of IMEI # Apply Export Rese

id	direction	date_sent	date_received	from	to
186877	incoming	0000-00-00 00:00:00	2010-12-01 17:50:05	9739149835	xactbeta ..LCNN000W3354
186875	incoming	0000-00-00 00:00:00	2010-12-01 17:49:50	9739149835	xactbeta ..LCNN000W3354
186873	incoming	0000-00-00 00:00:00	2010-12-01 17:49:35	9739149835	xactbeta ..LCNN000W3354
186871	incoming	0000-00-00 00:00:00	2010-12-01 17:49:20	9739149835	xactbeta ..LCNN000W3354
186869	incoming	0000-00-00 00:00:00	2010-12-01 17:49:04	9739149835	xactbeta ..LCNN000W3354
186867	incoming	0000-00-00 00:00:00	2010-12-01 17:48:49	9739149835	xactbeta ..LCNN000W3354
186865	incoming	0000-00-00 00:00:00	2010-12-01 17:48:34	9739149835	xactbeta ..LCNN000W3354
186863	incoming	0000-00-00 00:00:00	2010-12-01 17:43:08	9738072653	xactbeta ..S2NW336W4782 <a href="#">More...Map</a>
186861	incoming	0000-00-00 00:00:00	2010-12-01 17:36:31	9738072653	xactbeta ..S2NW337W4782 <a href="#">More...Map</a>

start 2 SeaMo... D:\AA Xac... News Rover 2 Intern... 5:50 PM



# GSM/GPRS/GPS M2M Development KIT - Portal

GeollS Map Viewer - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Forward Stop Home Search Favorites RSS Print Mail News Groups

Address <http://irris.geodecisions.com/GeoTrak/AVLViewer.aspx#/MainPage.xml> Go

Links Customize Links Free Hotmail Windows Windows Marketplace Windows Media Open

TOOL BOX

Map navigation controls: Hand, Zoom In, Zoom Out, Full Screen, Map Type (Satellite, Street View, etc.), Scale bar.

Map labels: Satellite Acad HS, Madison Square Garden, Manhattan Mall, W 40th St, W 36th St, W 34th St, W 33rd St, W 31st St, W 29th St, W 28th St, W 27th St, W 26th St, Fashion Ave, W 32nd St, E 37th St, E 36th St, E 35th St, E 34th St, Park Ave, E 33rd St, E 32nd St, Grand Central Terminal, Vanderbilt Ave.

Vehicle icon: A blue car icon with a red and white circular arrow around it, indicating a moving vehicle.

QUERY RESULTS

XACT_DEMO2	
ESN:	357320030003603
Date/Time:	11/29/2010 5:57:04 PM
Latitude:	40.747681
Longitude:	-73.989077
Speed:	2
Ignition:	ON
Message Type:	
Temperature:	

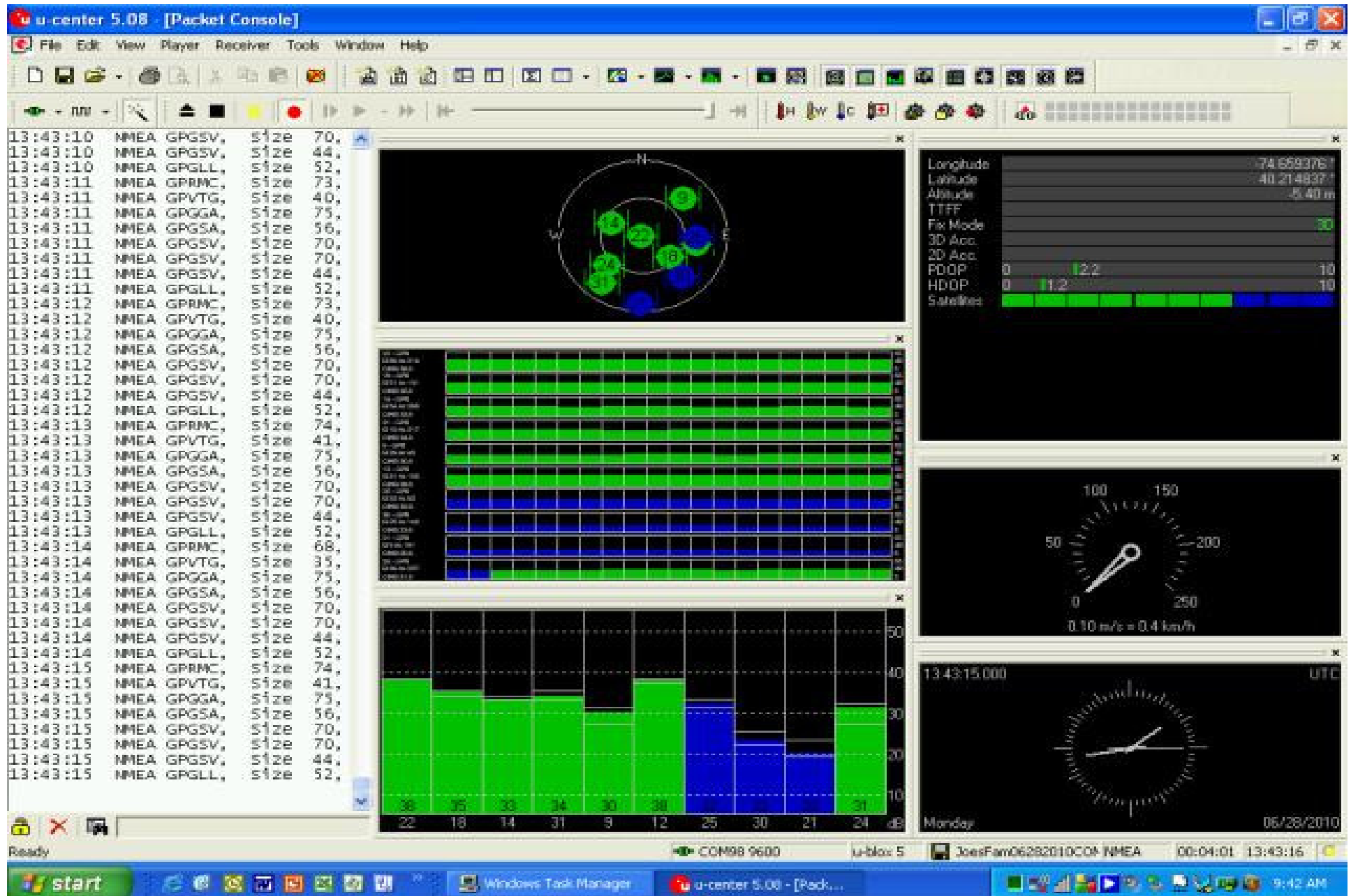
Scale bar: 360m, 1000ft

Internet

start

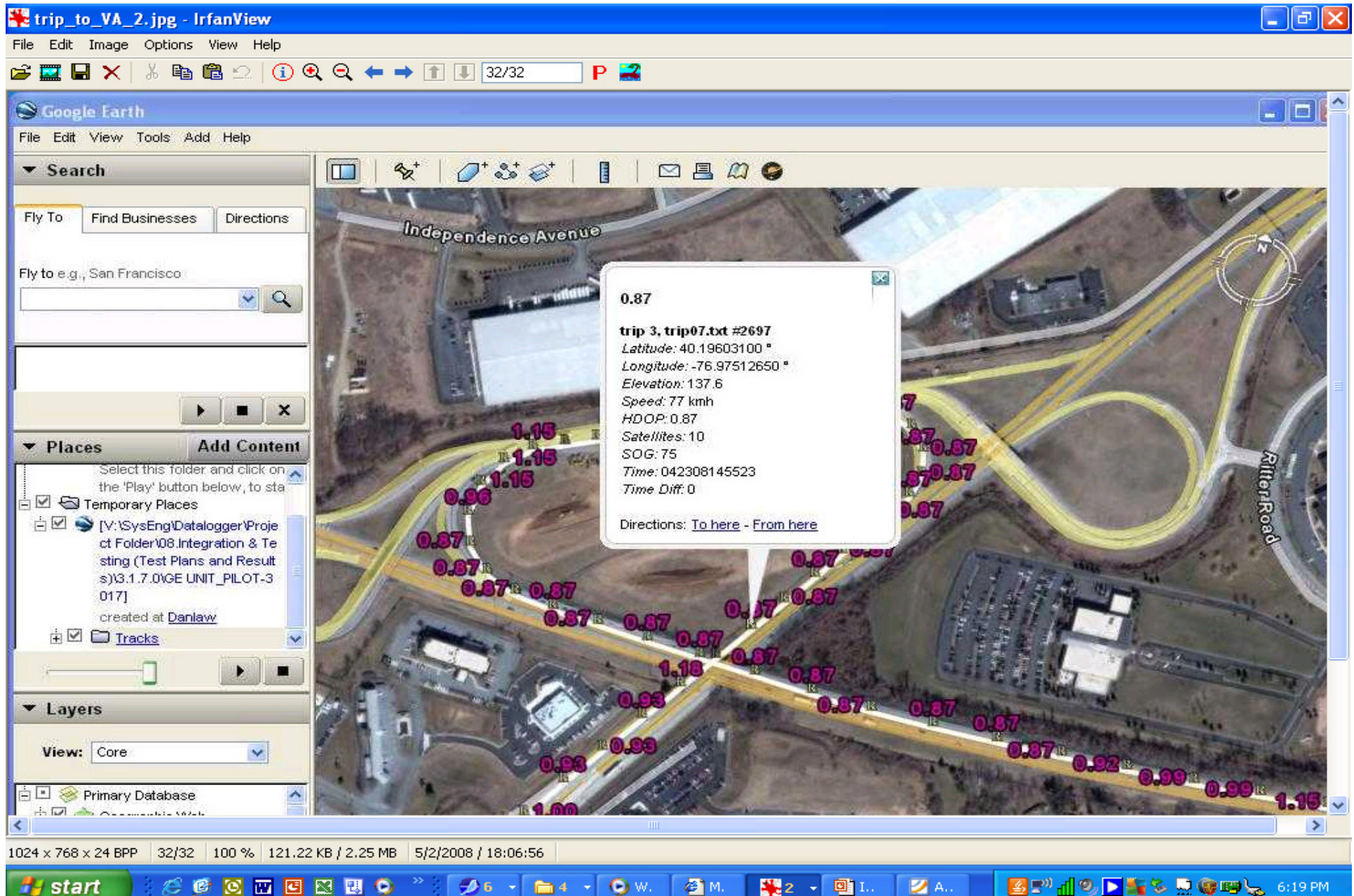
Taskbar: Ne..., 4 S..., Ge..., Dr..., Au..., Ov..., 5:58 PM

# GPS Analytic Tool, u-Center





# GIS Telematics Portal

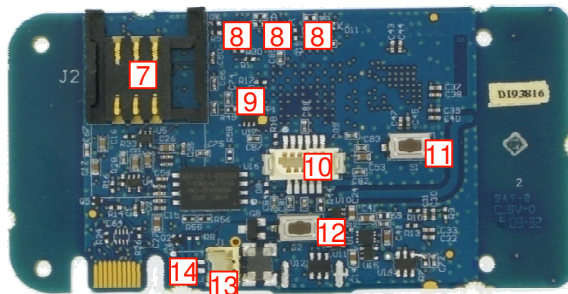


# Open Architecture of an M2M Building Block

**1 u-blox GPS with AGPS**  
 12-channel engine with over 1 million correlators.  
 Sensitivity; -160dBm, TTFF of <1 Second  
 Speed threshold notification

**2 WMP100 Quad band GSM Module (WMP150 is a direct replacement)**  
 ARM9 Processor  
 Real-Time Clock/Timer  
 Over the Air software updating & diagnostics  
 Enhanced Power management features

**3 Magnetic Contact switch**  
**CONTAINER DOOR SENSOR**  
 Detects device removal  
 Provides quick trigger methodology  
 Protect items not directly monitored by device



**4 On Board 2Mb x 16 Flash Memory**  
 Multiple geo-fences stored on device  
 Automatic logging of location data

**5 3D Multi Axis Accelerometer**  
**CONTAINER SHOCK SENSOR**  
**CONTAINER PATTERN SENSOR**  
 Can be used to trigger device alerts  
 Used for Enhanced Power management  
 Used for logging of waypoints

**6 High Performance**  
**Quad-Band GSM Antenna**

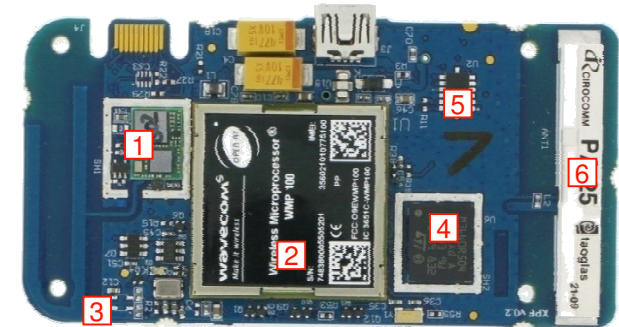
**7 SIM Card holder or**  
**CONTAINER SIM CHIP**  
 Supports Chip SIM placement

**8 Status LED's**  
 Power, GPS signal, GSM signal

**9 Temp Sensor**  
**CONTAINER TEMP SENSOR**  
 Inputs directly to WMP100 GPIO input

**10 Auxiliary interface port**  
 Multiple voltages to drive sensors  
 Multiple General Purpose Input/Outputs  
 Analog/Digital input  
 High Speed Serial  
 Audio output

**\*NOTE: PCB ACTUAL SIZE**



**11 Instant Alert button**  
 Confirmation of Alert via device feedback

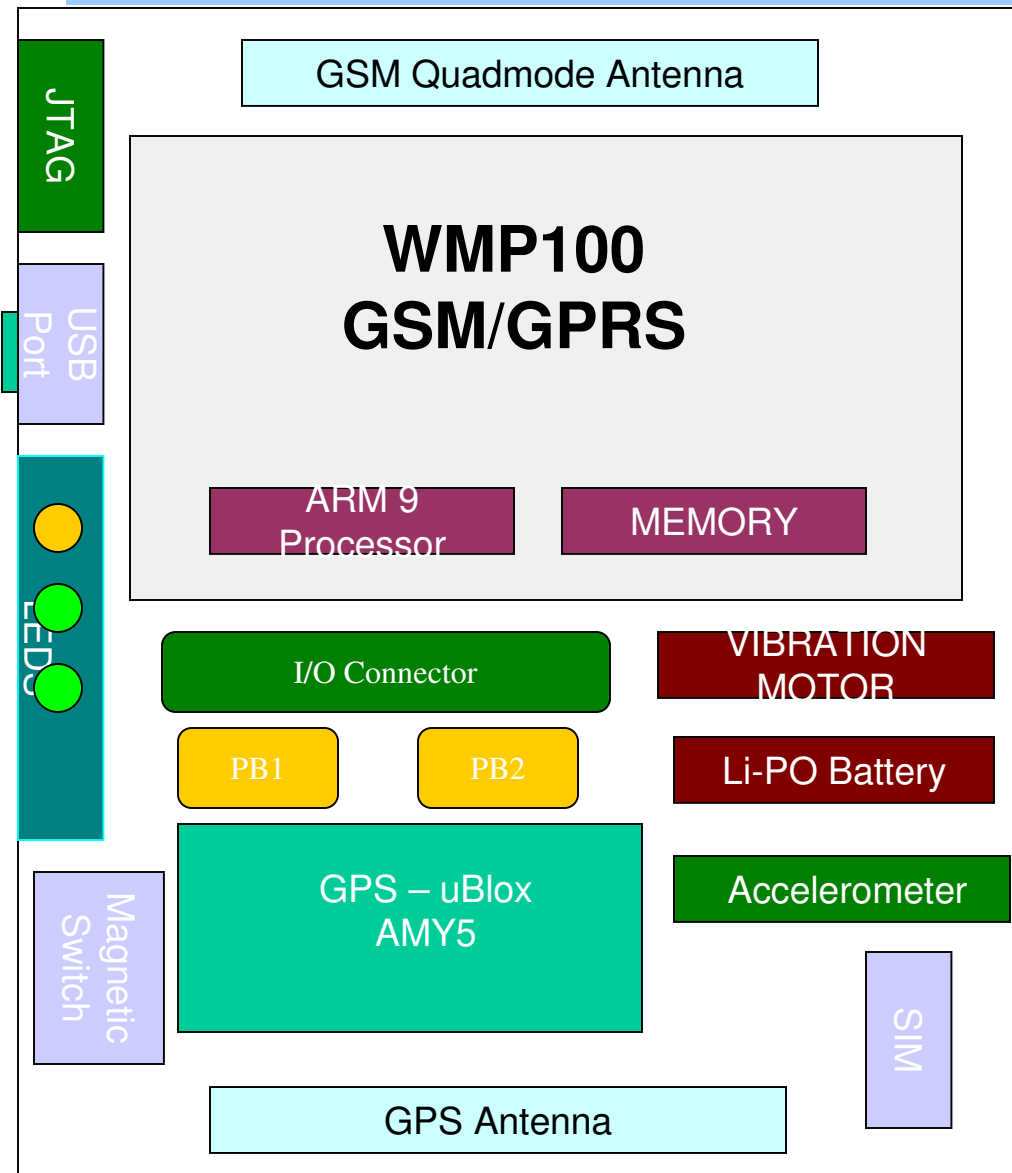
**12 Mode Set button**  
 Can act as defeatable Power Switch

**13 Internal power connection**  
**CONTAINER PRIMARY POWER SUPPLY**  
 Extended use Li-On Batteries Available  
 Automotive spec Power Supply Available

**14 Piezo or Vibration motor**  
 Audible or Vibrating notice of tracking request  
 Audible or Vibrating alert of geo-fence violation



# TRAX ARCHITECTURE

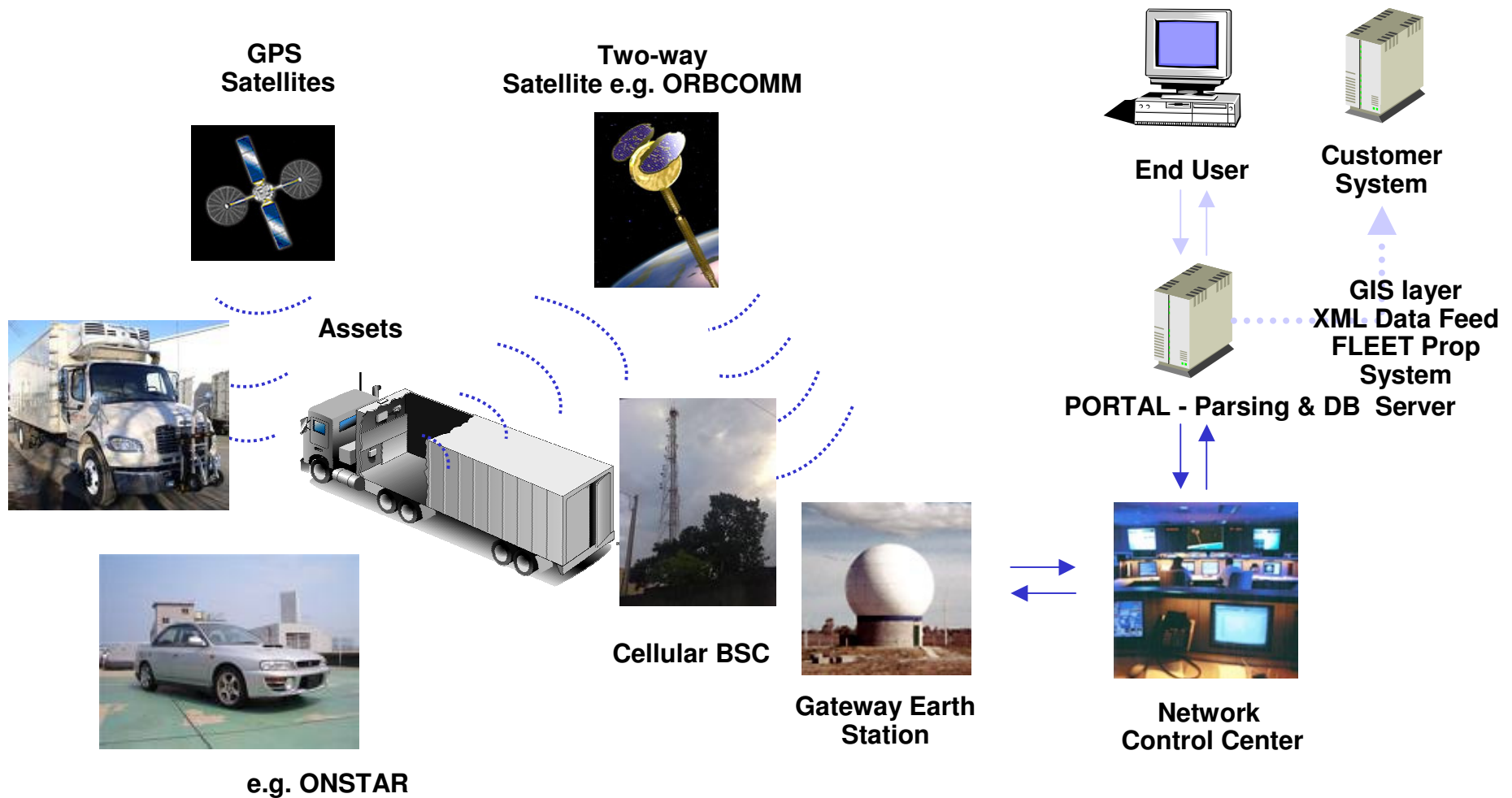


## Existing Architecture

### Architecture Elements

- ✓ GSM/GPRS Module
- ✓ GPS Module
- ✓ GSM/GPS Antennas
- ✓ Battery Power Supply
- ✓ Accelerometer
- ✓ Vibration Motor
- ✓ Magnetic Switch
- ✓ Two Push Buttons
- ✓ SIM Card and SIMLESS Option
- ✓ Expandable through I/O Port
- ✓ Optimized for Always “On”
- ✓ Integrated Antennas
- ✓ BGA Minimal Connections

# TELEMATICS/M2M SYSTEM



**Standard Telematics Architecture  
installed on Powered and Unpowered Assets**

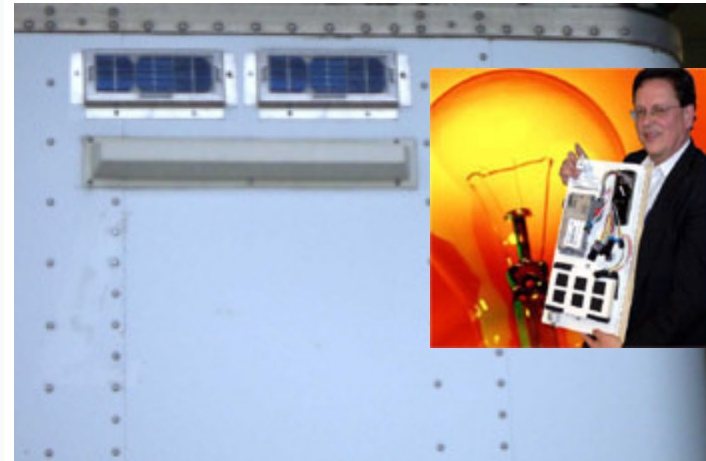


# LARGE-ASSET TELEMATICS SYSTEM



- **RAIL**

4 x PVs, 100% Solar



- **TRAILERS, >60,000 in Production**

1 x PVs, Solar Augmented

2 x PVs, 100% Solar w/o Sensors

## Solar PV Specifications

Weight (typical)	9 oz.
Size	8.2" x 3.4" x 47"
Rated Current	120 ma (9V OC)
Service Life	>10 years
Panel Impact	1" hailstones @ b50 mph
Rated Power	1.25 Watts
Rated Temperature	-40C to +85C

\* SLA Battery Pack Life Extended with Solar Trickle Charging



# ISO MARINE CONTAINER SATELLITE LINK



**SECURITY LOCATION AND DOOR STATUS**  
**ORBCOMM & GLOBALSTAR & IRIDIUM SATELLITES**



# ISO MARINE CONTAINER SATELLITE LINK

<b>Opportunity</b>	<b>Smart Container Sensor Platform</b>
<b>Solution</b>	<b>Massive Number of Containers</b> to carry Satellite-based location and selective Nuclear-Biological-Chemical (NBC) Sensors
<b>Customer Benefit</b>	<ul style="list-style-type: none"><li>• Leverage Commercial-Off-the-Shelf Trax solution</li><li>• Potential of 5MM mobile sensor platforms throughout the United States</li><li>• Lowest-Cost Sensor Communications Platform</li><li>• Seamless and Complete U.S. Wireless Coverage, No Gaps</li><li>• Leverage Low-Cost Sensors</li><li>• Embedded GPS location sensor</li></ul>

## Dual Cellular / Satellite-based Transceiver

### Existing Sensors

- Magnetic
- Accelerometer
- GPS Receiver

### Optional Sensors

- Nuclear
- Biological
- Chemical
- Image / Video



# Amateur Radio Location & Telemetry - APRS

Amateur Packet Reporting System (APRS) as designed by Robert Bruninga, WB4APR





# Aircraft Telemetry - ACARS

**PlanePlotter view from the flight deck using Google Earth**



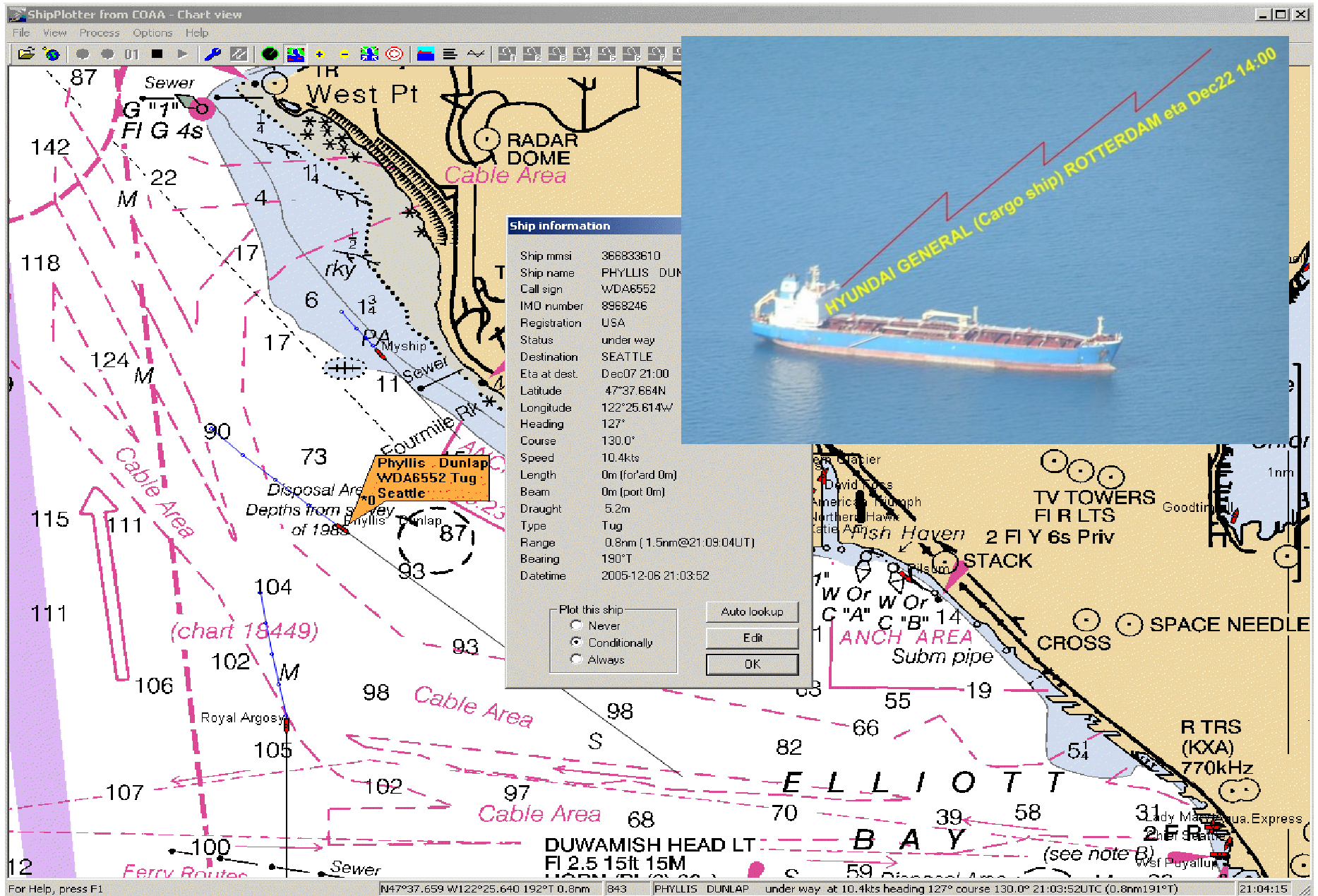
# Aircraft Telemetry - ACARS

The screenshot displays the ACARS (Aircraft Communications Addressing and Reporting System) software interface. The main window is divided into several sections:

- Top Bar:** Contains various status indicators and navigation buttons.
- Left Panel:** A list of aircraft with columns for Status, Mode, Altitude, Registration, and Aircraft. The list includes aircraft from various airlines such as Ethiopian Airlines, Kenya Airways, and others.
- Right Panel:** A map of Africa showing the location of the selected aircraft. The map is labeled with "WAD 51 220004 F270" and "WAD 51 220004 F270".
- Bottom Panel:** Contains flight details for the selected aircraft, including the aircraft type (Airbus A320), registration (ET-ANR), and flight number (ET-ANR).

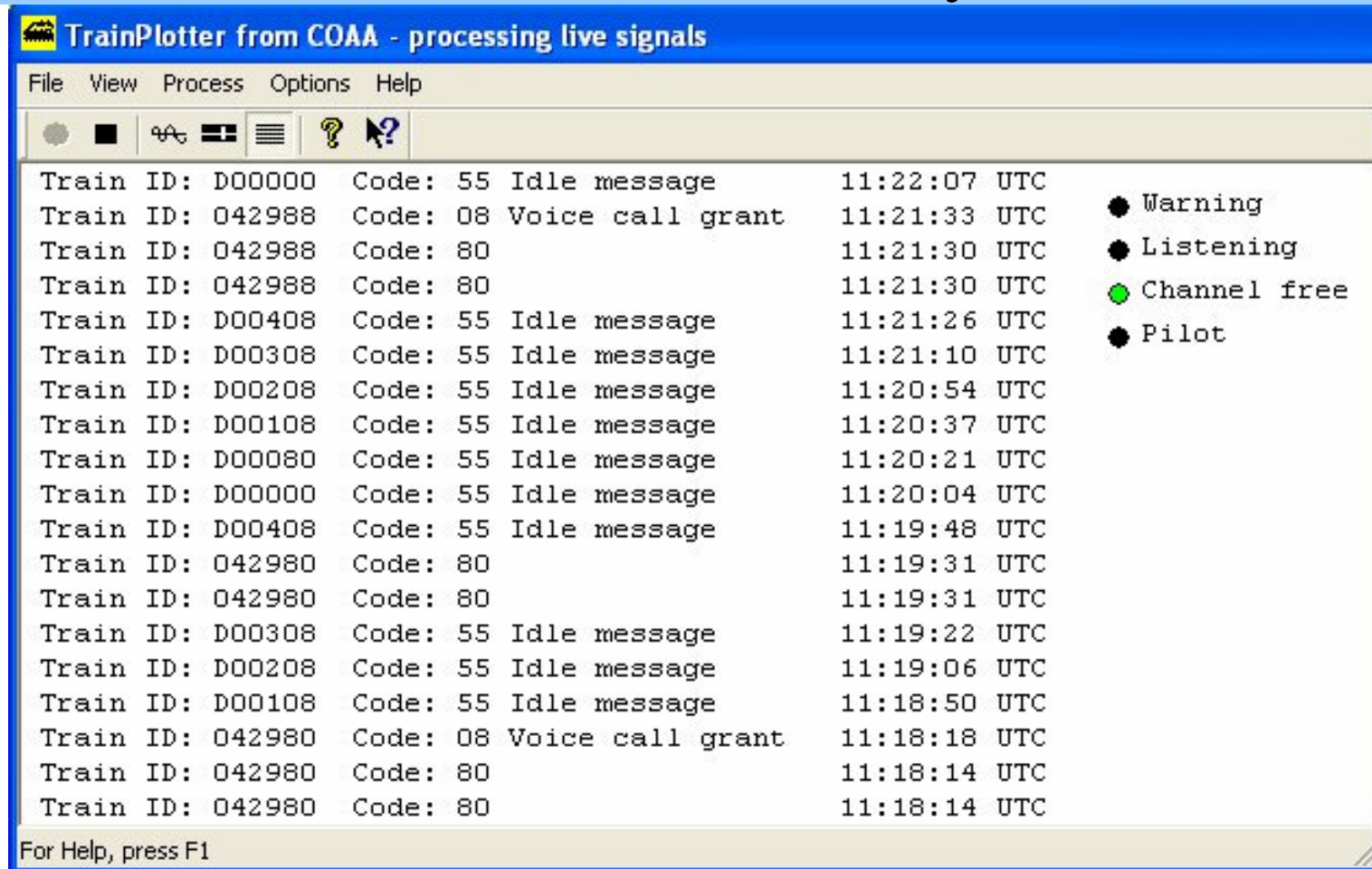
The interface also includes a search bar at the top left and a status bar at the bottom.

# Ship Telemetry - AIS



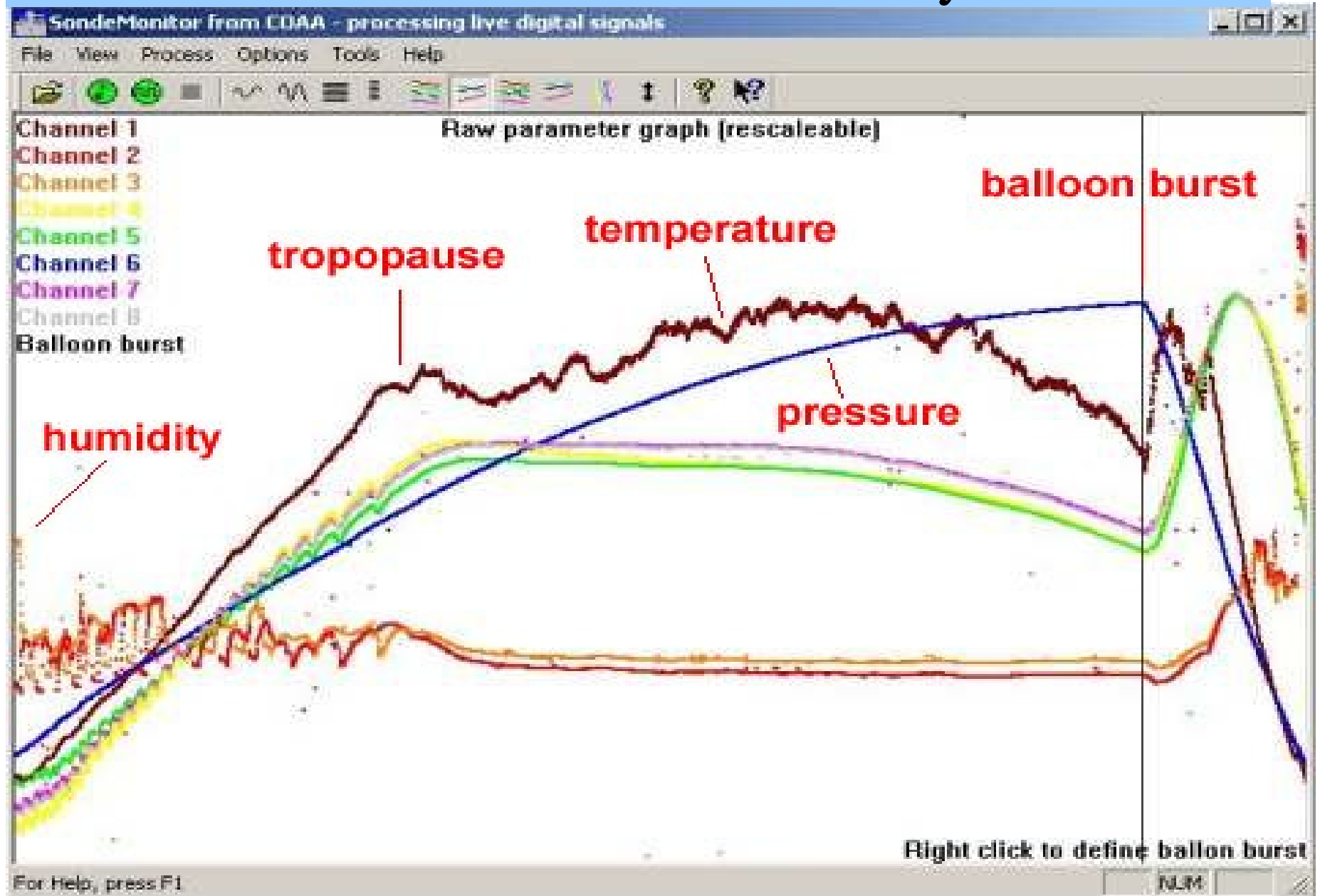


# TRAIN Telemetry

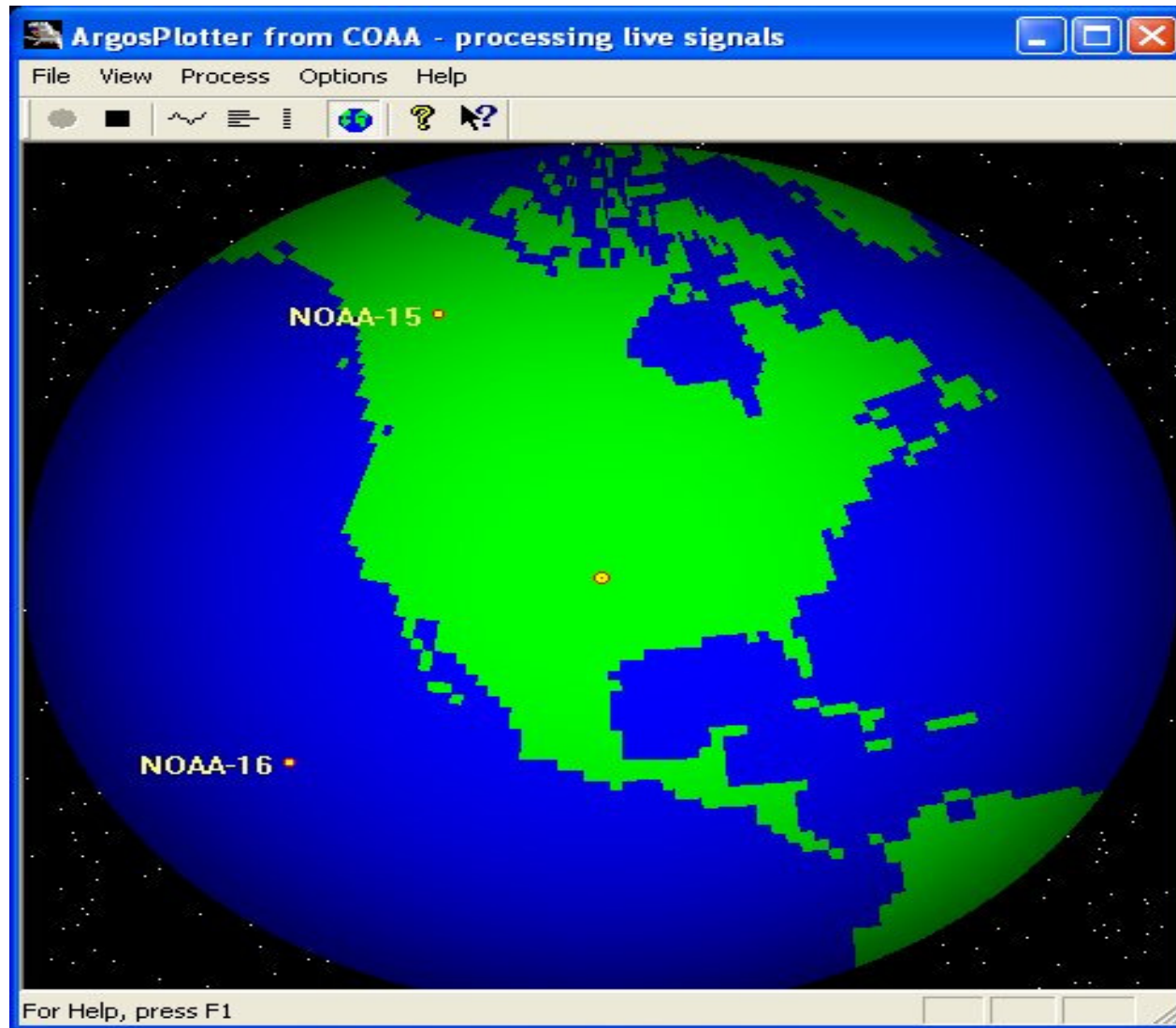


The messages are sent on channels around 460 MHz with 25kHz channel spacing, in FM mode, using FSK signaling at 600 bps. TrainPlotter decodes and displays these messages using the PC soundcard. You can use a simple UHF radio receiver (scanner) tuned to the appropriate band to pick up these messages. With TrainPlotter you can see the message data and find out the train's identity as well as such things as commands to increase or decrease speed, to set up a voice call or even to address the passengers.

# RADIOSONDE Telemetry



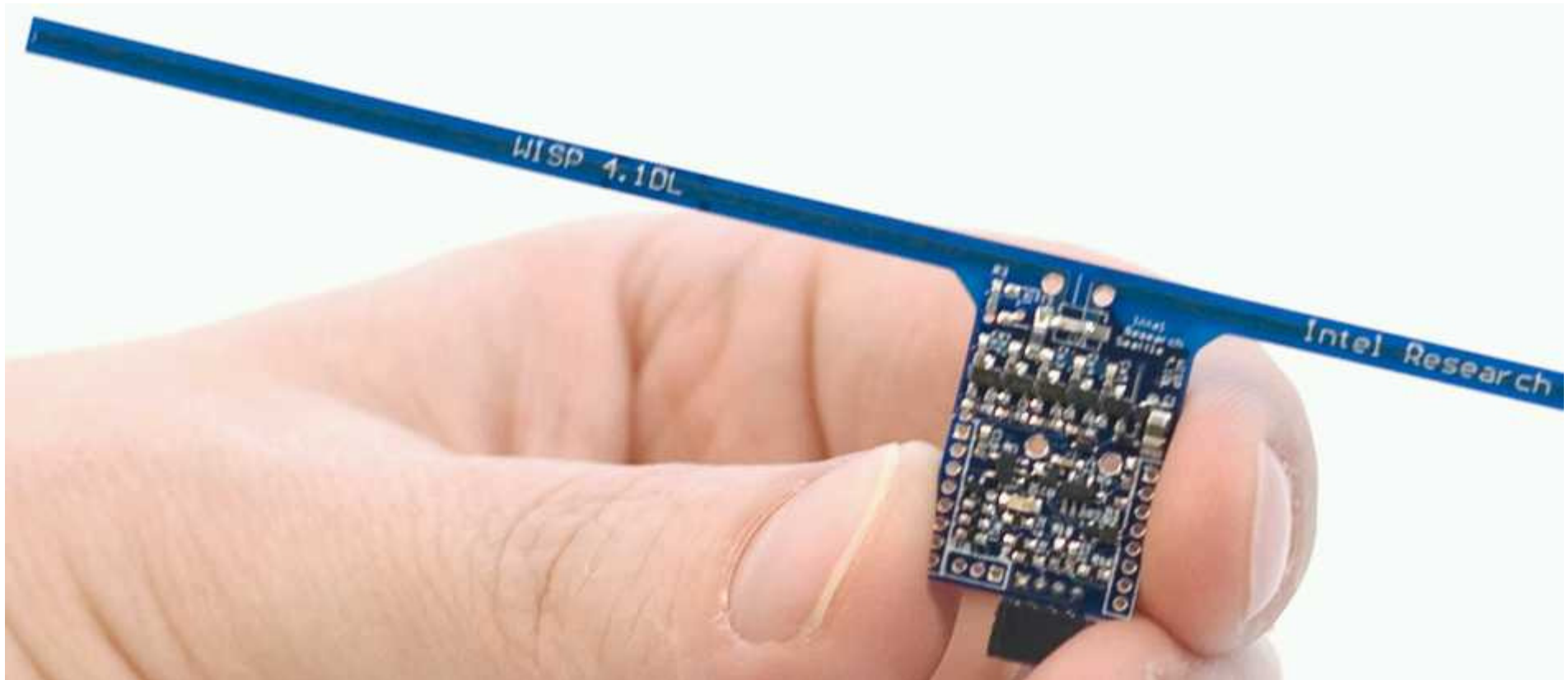
# Oceanographic Buoys and Wildlife Tracking – Argos-3



You can use a simple UHF radio receiver (scanner) tuned to the 465.9875MHz downlink frequency to pick up the strong signals from these satellites. With Argos3Plotter you can decode the telemetry and find out the positions of the satellites, their operational status and monitor the command messages sent to the remote data collection platforms.

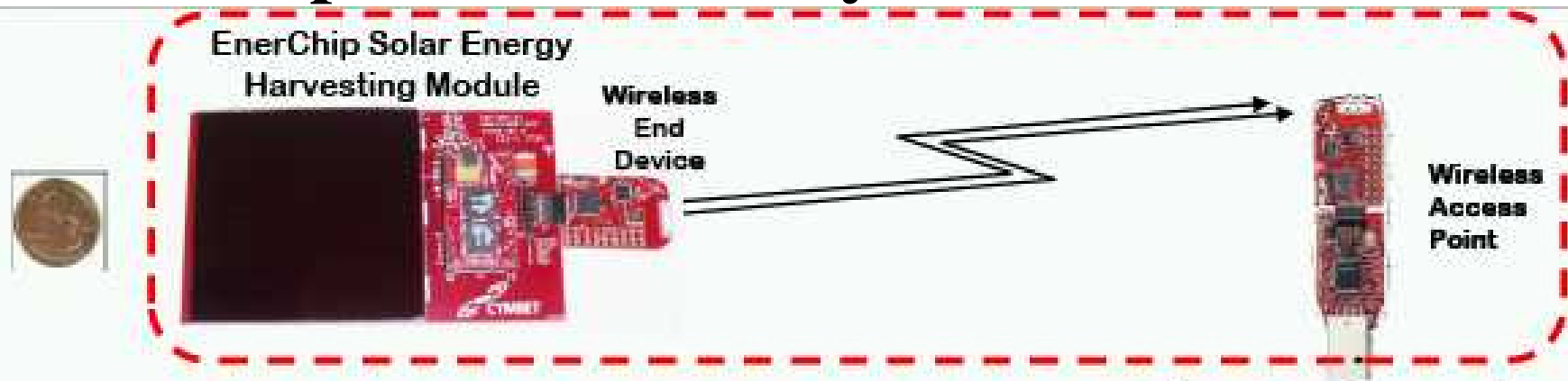


# Intel WISP, Wireless identification and Sensing Platform:

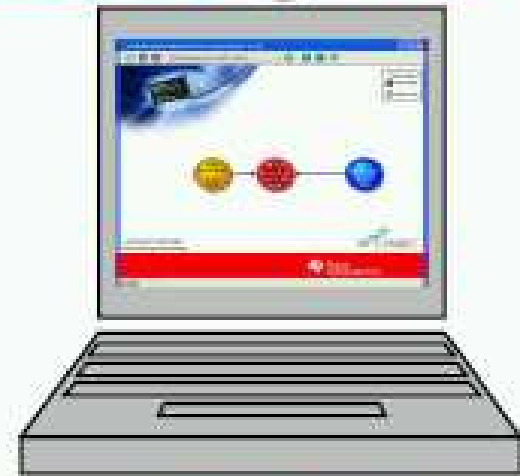


**Imagine Powering your Smart Wireless Sensors by Stealing Power from your Local TV Station? Shades of Nicolai Tesla!!**

# TI & Chipcon Radio & Cymbet Evaluation Board:



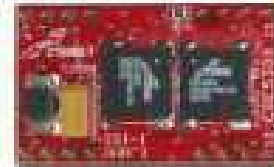
- Available as the TI eZ430-RF2500-SEH Evaluation Kit in January 2009
- Compact module with integrated solar cell
- Works in low light – down to 150Lux
- Low self-discharge enables high-efficiency
- No battery replacement or disposal; 10-year life
- Uses the EnerChip EH CBC5300 – Energy Harvesting Module
- CBC-EVAL-08 is Cymbet's version of Solar EH Board for generic Energy Harvesting designs



**TI's eZ430-RF2500-SEH  
Evaluation Kit Contents**

# TI & Chipcon Radio & Cymbet Evaluation Board:

- EnerChip EH Module – CBC5300:
  - Capacity = 100uAh, uses 2 CBC050s
  - Compatible with solar, inductive, piezo & thermoelectric transducers
  - No battery replacement or disposal; 10-year life
  - Provides control signals to enable “Energy Aware” sensor nodes
  - Low self-discharge enables high-efficiency
  - Order P/N: CBC5300-24C
- Solar Evaluation Board – EVAL-08:
  - Solar Energy Harvesting Demo Kit
  - Compact module with integrated solar cell array
  - Works in low ambient light:
    - Down to 100Lux
  - Uses the EnerChip CBC5300
  - Adaptable to many sensors and wireless networks via Interface Header
  - Order P/N: CBC-EVAL-08



CBC5300  
Module



Interface  
Header



# Relative Power Availability by Parasitic Source:

<i>Energy Source</i>	<i>Challenge</i>	<i>Estimated Power (in 1 cm<sup>3</sup> or 1 cm<sup>2</sup>)</i>
<b>Light</b>	Conform to small surface area Wide input voltage range	10μW-15mW (Outdoors: 0.15mW-15mW) (Indoors: <10μW)
<b>Vibrations</b>	Variability of vibration	1μW-200μW (Electrostatic: 50μW-100μW) (Electromagnetic: <1μW)
<b>Thermal</b>	Small thermal gradients	15μW (10°C gradient)
<b>Piezoelectric</b>	Capturing pressure or motion	~ 200μW
<b>RF &amp; Inductive</b>	Coupling & rectification	Various

Source: EE Times

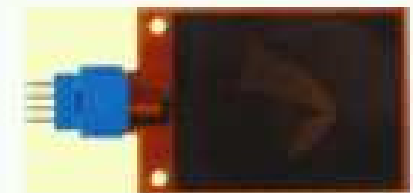


AdaptivEnergy – JouleThief™

Solar - Various



Peltier - Thermo Life



MIDE – Vulture™ Piezo

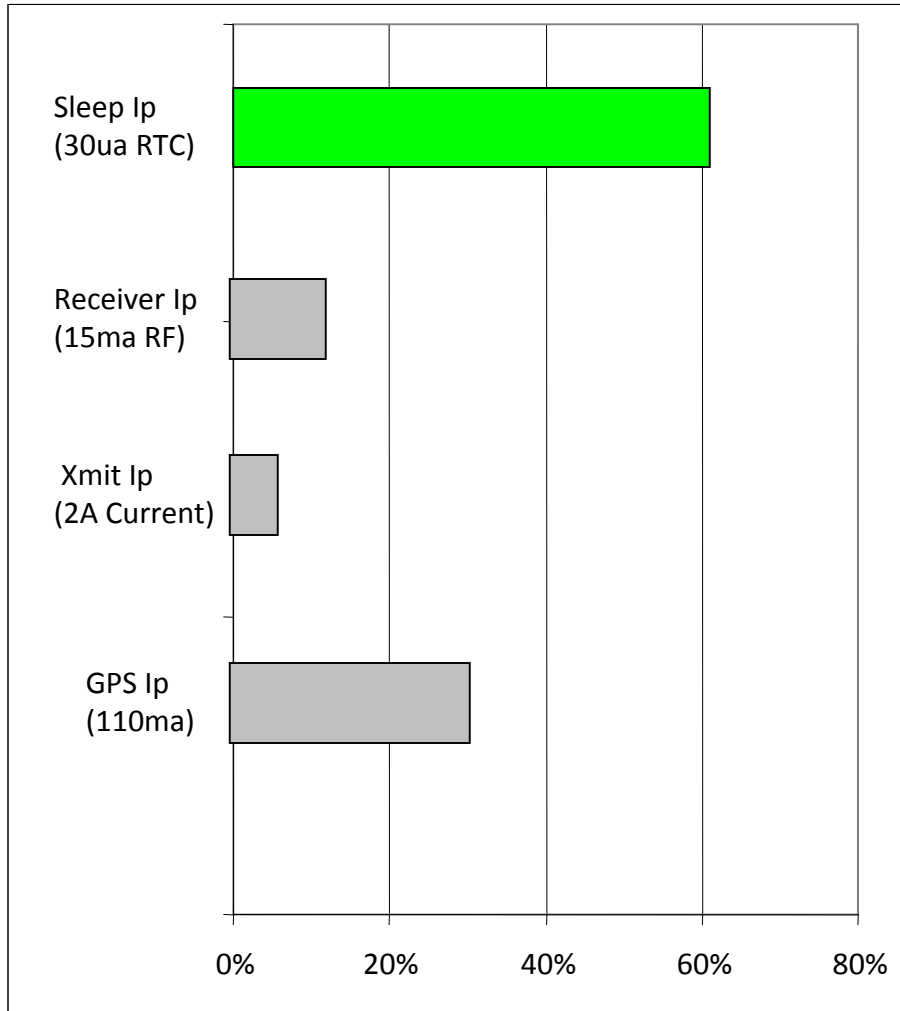
# Evaluation Board Power for 802.15.4 Protocol:

Parameter	Min	Typical	Units
Min input Lux	200		Lux
Full charge Lux	700		Lux
Load current (charging		20	uA
Load Current (not charging)		800	nA
Battery Charge Voltage		4.06	Volts
Battery Cutoff Voltage	3.0	3.3	Volts
UVLO Trip Select Voltage		0.7	Volts

**Key Take-away is the 802.15.4 short-range wireless protocol can be powered through most of the Energy Harvesting Technologies which Enable self-powered sensors TODAY!**

# Percent Power by Architecture Element

**Infrequent Location Reports (2x Day):**



**Frequent Location Reports (12x Day):**

