ARTES Application Workshop
Container Tracking
ESA Contract AO/1-5153/06/NL/AD

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Agenda

➢ Introduction

➢ Commercial Concept

➢ Major Technical Issues

➢ Implementation

- Hardware description
- Software

➢ Results

- Power Consumption
- Range Measurements
- End-to-End Validation

➢ Summary/Commercial Update

Commercial Concept

➢ Market – 18M containers world-wide accounting for 90% of non-bulk commercial trade

➢ Value – Security (hazmat), logistics, fleet management (inter-modal)

➢ Technology – satellite uniquely positioned to provide real-time data with ubiquitous coverage

   ▪ GlobalWave – robust protocol with low power consumption vs. competitors
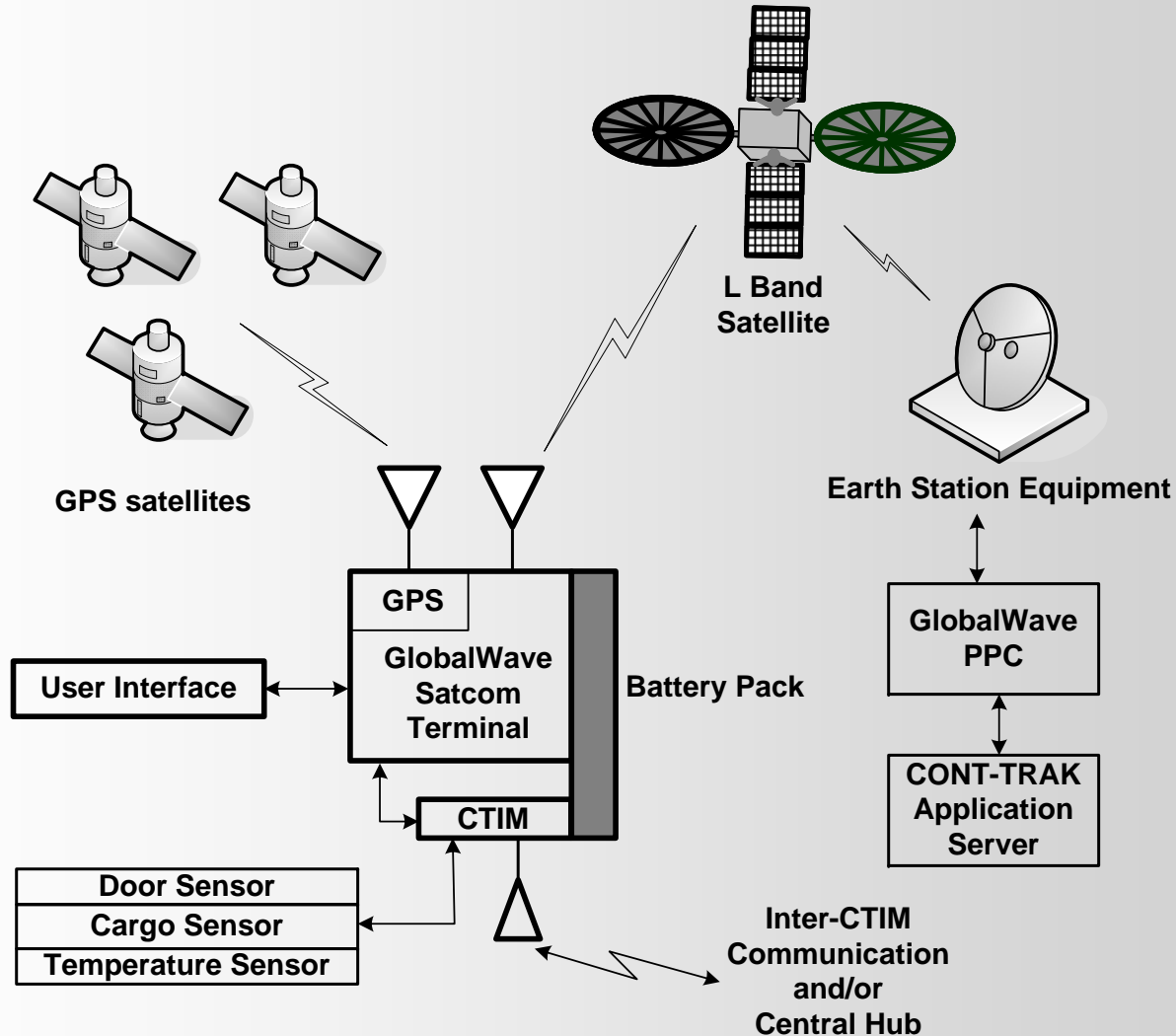
Commercial Solution

- ➤ GlobalWave (SkyWave)/Novacom Services Partnership
  - Global (land mass) Satellite Coverage
  - Proven track record of high quality and reliable network infrastucture
    - Commercial service commencement 1999
      - >120,000 fielded L-band satellite terminals (2008)
    - Operate over Inmarsat/MSV/Optus satellites
    - Several regional networks
  - Experienced integrators
    - Ability to offer complete solution
   - Terminal → Back Office Application

System Description

SkyWave

esa

L Band Satellite

GPS satellites

Earth Station Equipment

GPS

GlobalWave Satcom Terminal

User Interface

Battery Pack

GlobalWave PPC

CTIM

CONT-TRAK Application Server

Door Sensor
Cargo Sensor
Temperature Sensor

Inter-CTIM Communication and/or Central Hub

OntTraK

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Technical Challenge (I)

➢ Wireless Network Frequency Selection

- ITU considerations and propagation characteristics provided 2 alternatives:
  - Dual frequency 868/915 MHz
  - Single frequency 2.4 GHz
- Options investigated/validated via
  - Propagation modeling – ray tracing model/simulation (CRC Ottawa)
  - Field measurements – working container yard (Halifax)

Technical Solution (I)

➢ 2.4 GHz

- Difference in propagation not quite as bad as modeling predicted
  - ~-15 dB on average vs ~-30 dB in modeling
    - > 100 measurements in several configurations
  - Multi-path did not appear to be a significant factor
- Reasonable range (up to 200 m (non LOS) in some cases) based on receiver sensitivity of -98 dBm
- Abundant COTS hardware
- World-wide operation

Technical Challenge (II)

➢ Communication in a stacked environment

- Containers are stacked when shipped

  - No satellite visibility
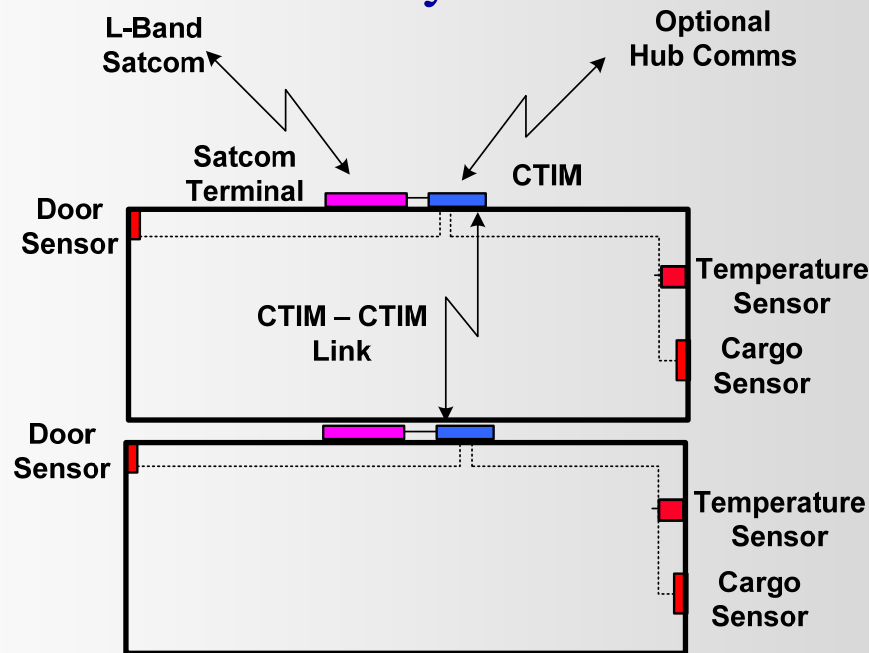
Technical Solution (II)

➢ CTIM: Container Tracking Interface Module

- Ability to establish/join a wireless network
  - Terminal/CTIM with satcom link (Type A) will provide routing of data to/from blocked terminals (Type B/C)
  - If a terminal is unable to communicate with an "A" or "B" terminal , it is truly blocked (Type E)
- Power efficient protocol
- Ability to interface various sensors
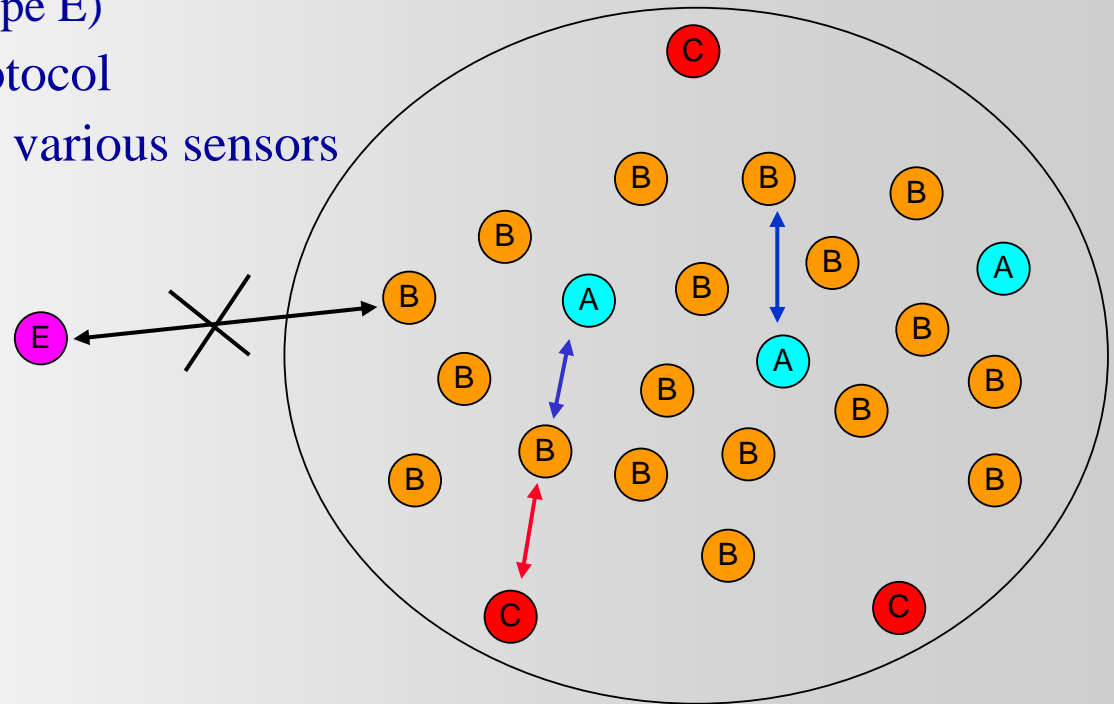
Technical Challenge (III)

➤ Continuous Global Tracking/Coverage

Operating Satellites
N.A. DGS: 4 Bms_ MSAT2 @ 101 W
Mexican DGS:S&W bms_MSAT1@106.5 W
Europe: NC Bm_I3 INDW @ 25 E
Africa: NW, SW Bm_I3 IOR @ 64 E
Mid East: NE Bm_I3 INDW @ 25 E
Australia: 1 Bm_Optus1 @ 160 E
China: To be NC Bm_I3 IOR @ 109 E
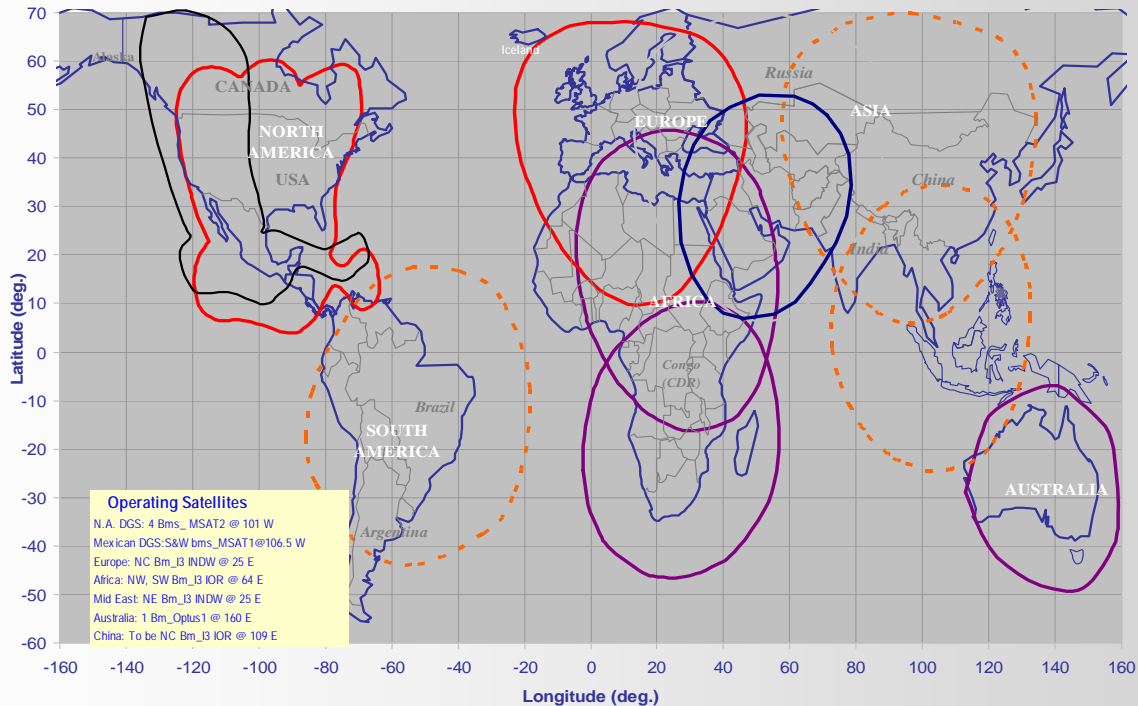
Technical Solution (III)
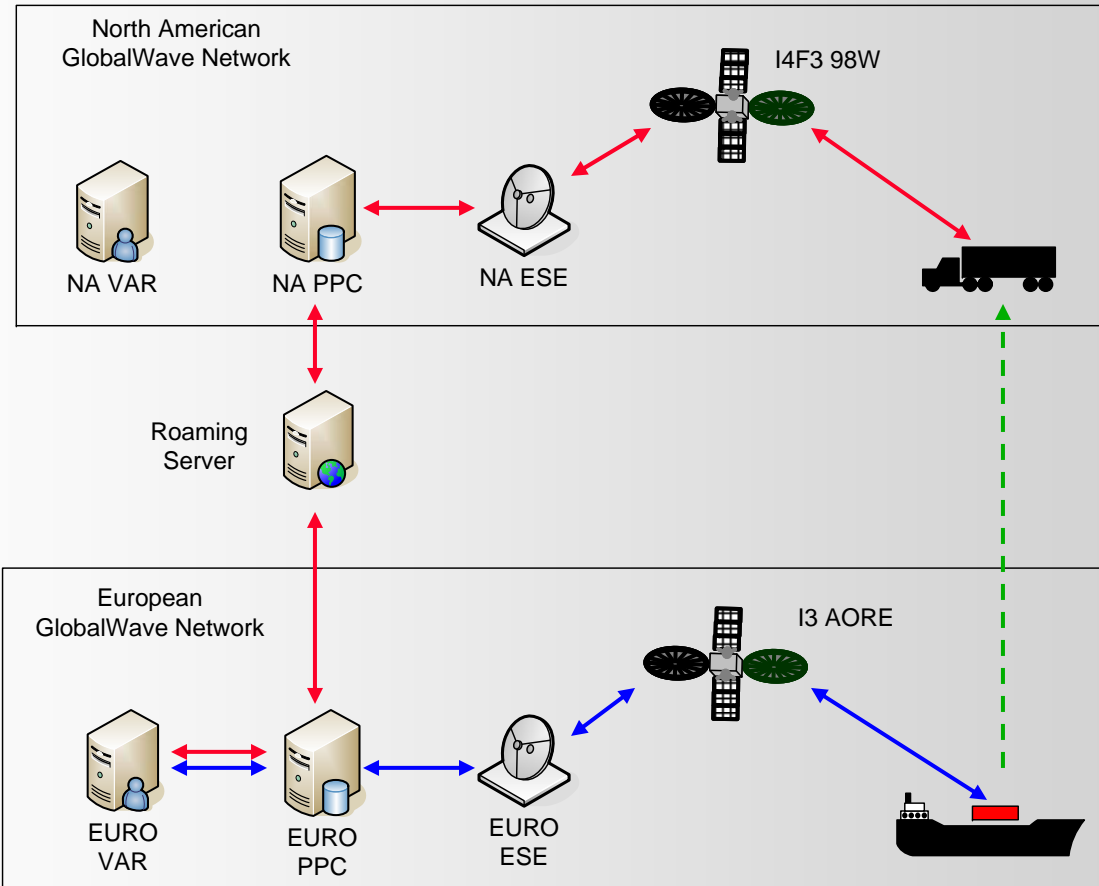
Technical Challenge (IV)

- Back Office Application and Integration
  - Integration of Cont-Trak application server with existing applications
  - Interface to GlobalWave PPC to
    - Send data to terminals/CTIM's
      - Polls, configuration etc
    - Receive data from terminals/CTIMS
      - Position reports, sensor alarms, in-transit profiles (ex. temperature)
  - Provide a WEB accessible and feature-rich front end customized for container tracking

Technical Solution (IV)

Sensor Data Integration

Position Data Integration

Implementation - Physical Design

GlobalWave
MT3550

CTIM

CTIM Network Establishment
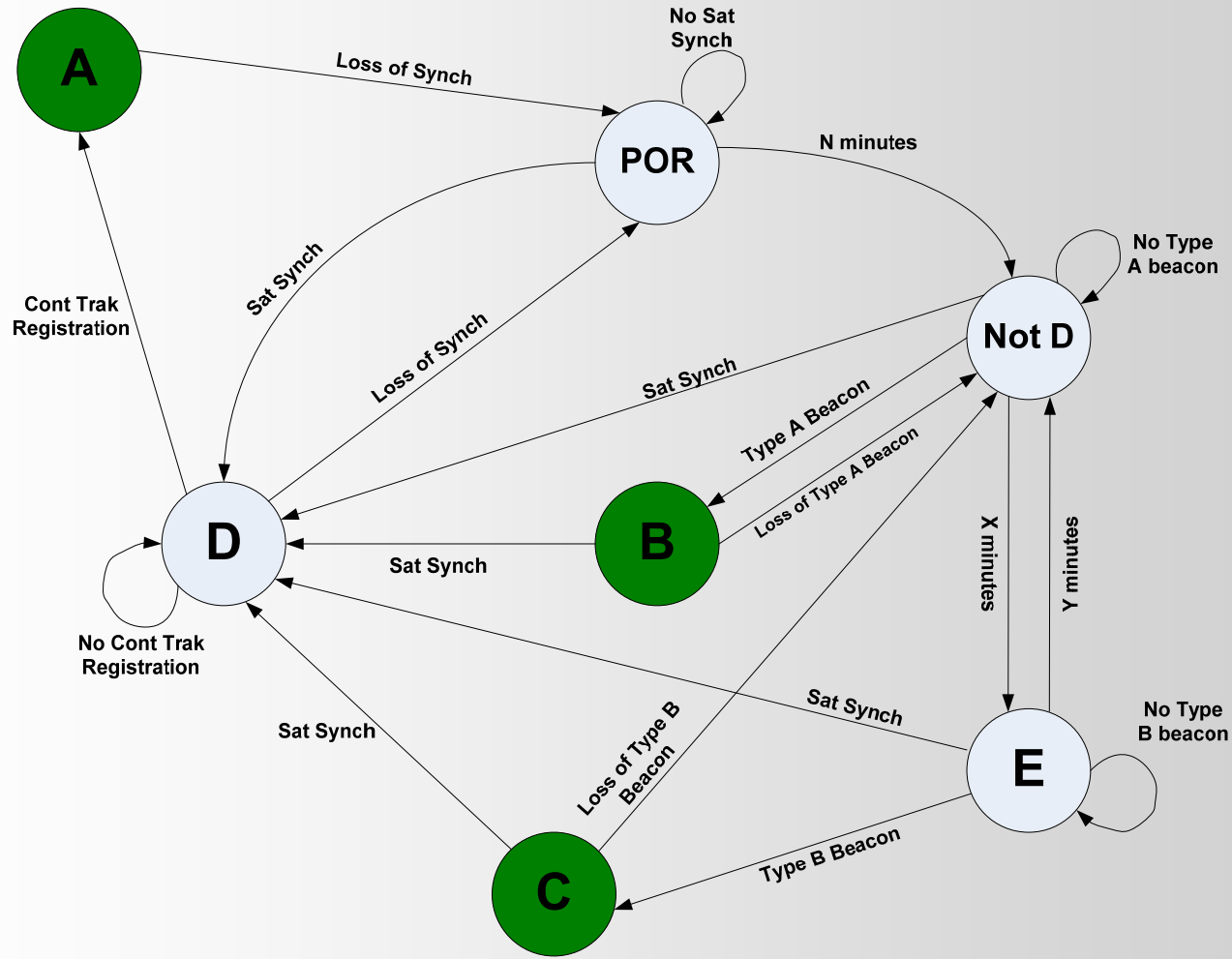
Key Performance Data

➢ Up to 30 type A's per network

- Up to 19 B's per A (no constraint on number of C's)

➢ B-C communication

- Relative stagger to A of 0.5 seconds

- Communication on a different channel
  - 60 MHz spacing

➢ 2.8 years expected life (19 Ah pack)

- Assumes 20% A, 10% B, 10% C, 60% E

➢ Range Measurements (validated in container yard)
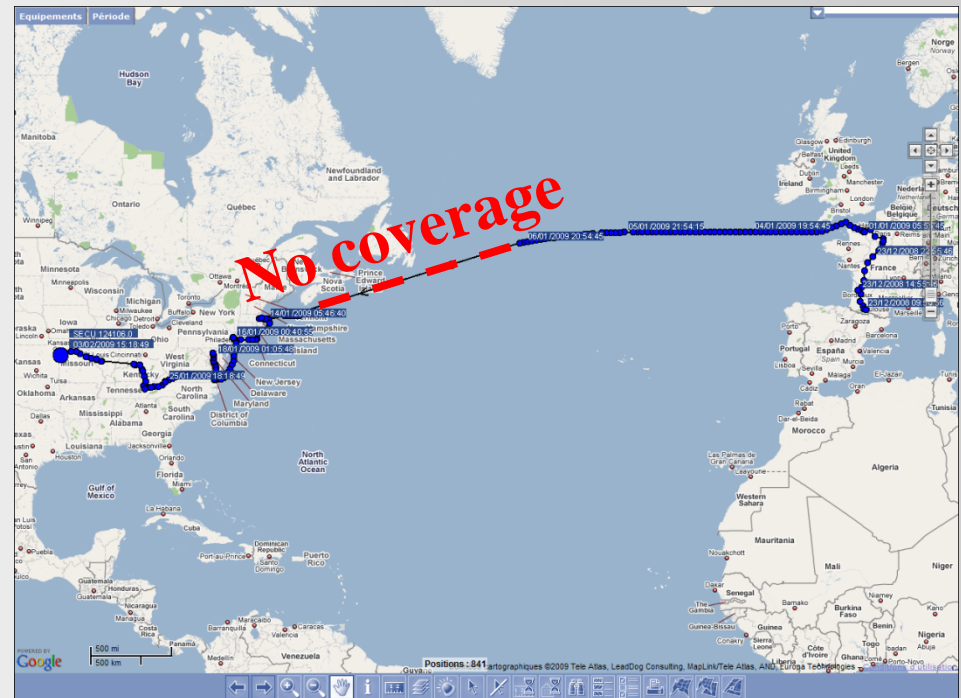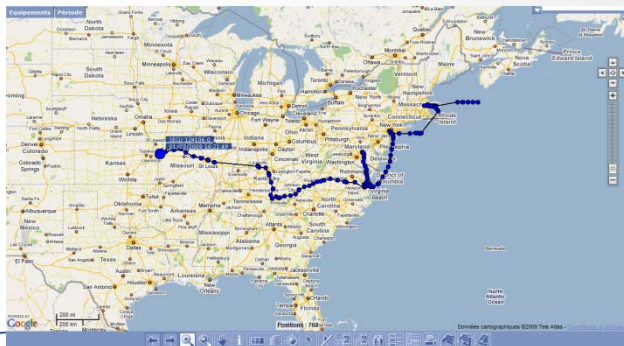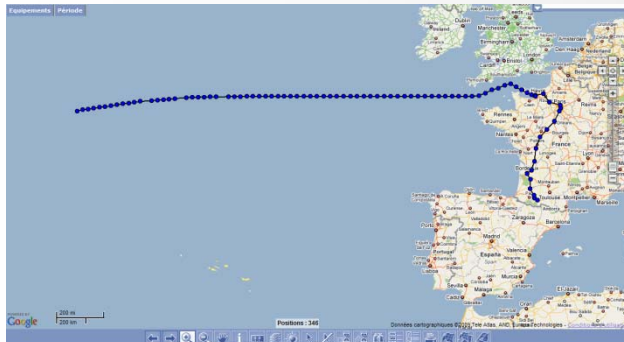
- 280 m CLOS

- 110 m obstructed

Installation Example
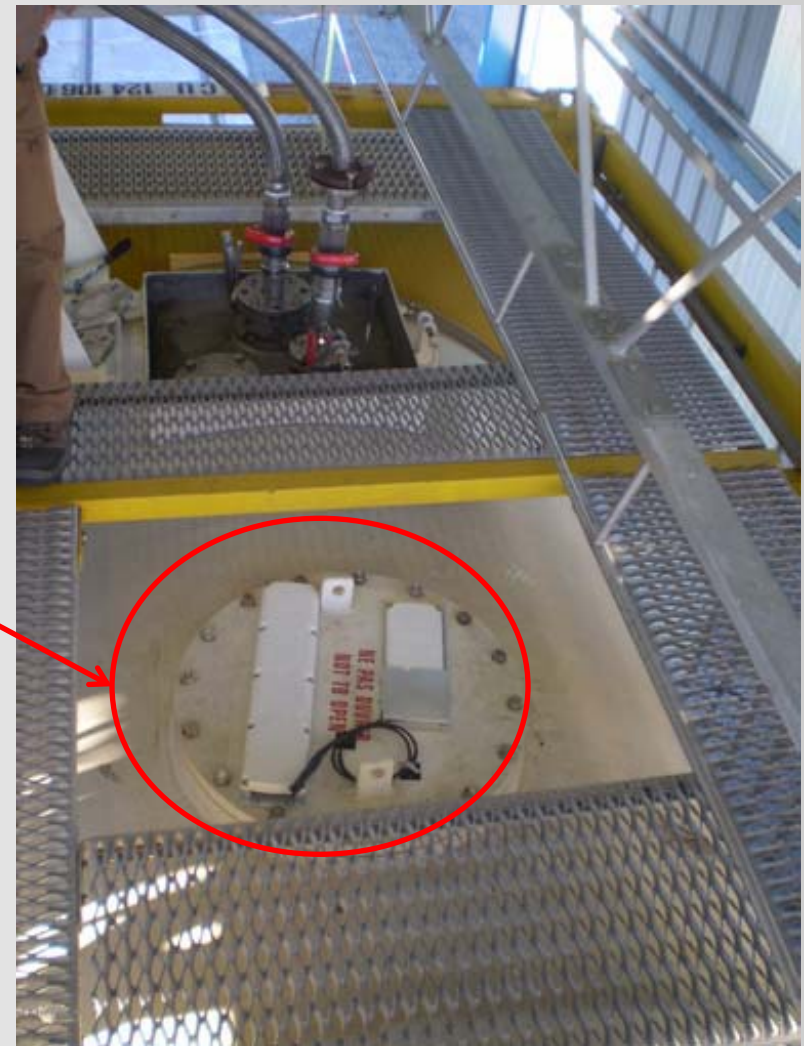
- ➢ Customer: Arkema
- ➢ Type: Cylinder-shaped tank
- ➢ Product: Chemical liquid
- ➢ Date : 23rd December 2008

Europe to North America Trial

➢ Customer: ARKEMA

➢ Unit installed in Lannemezan (South of France) 23 December 2008

➢ Left European coverage 6 January 2009

➢ Appeared on North American Network 8 January 2009

Commercial Update

➢ GlobalWave acquired by SkyWave in June 2009

➢ Commercialization deferred to focus company resources on new satellite network development

▪ IsatData Pro – commercial launch Q3 2011

- Seamless global coverage
- Higher data capacity (optimized for 1000's of bytes vs. 10's)
- Low latency
- Broadcast Service
- Low power mode(s) and capability

SkyWave Satcom Network Comparison

	ISATM2M	GlobalWave	IsatData Pro
Forward Message Length	100 Bytes	38 Bytes	10,000 Bytes
Return Message Length	10 Bytes	11 Bytes	6,400 Bytes
Latency	< 30 seconds	< 30 seconds	4 -18 seconds for 100 Bytes 38 - 48 seconds for 1 kB
Acknowledged	Optional	Yes	Yes
Broadcast	Yes	Bulletin Board	Yes
Coverage	Global, non-polar	Regional	Global, non-polar

Commercial Update (con't)

➢ IsatDataPro Global Coverage: 58 Beam Network
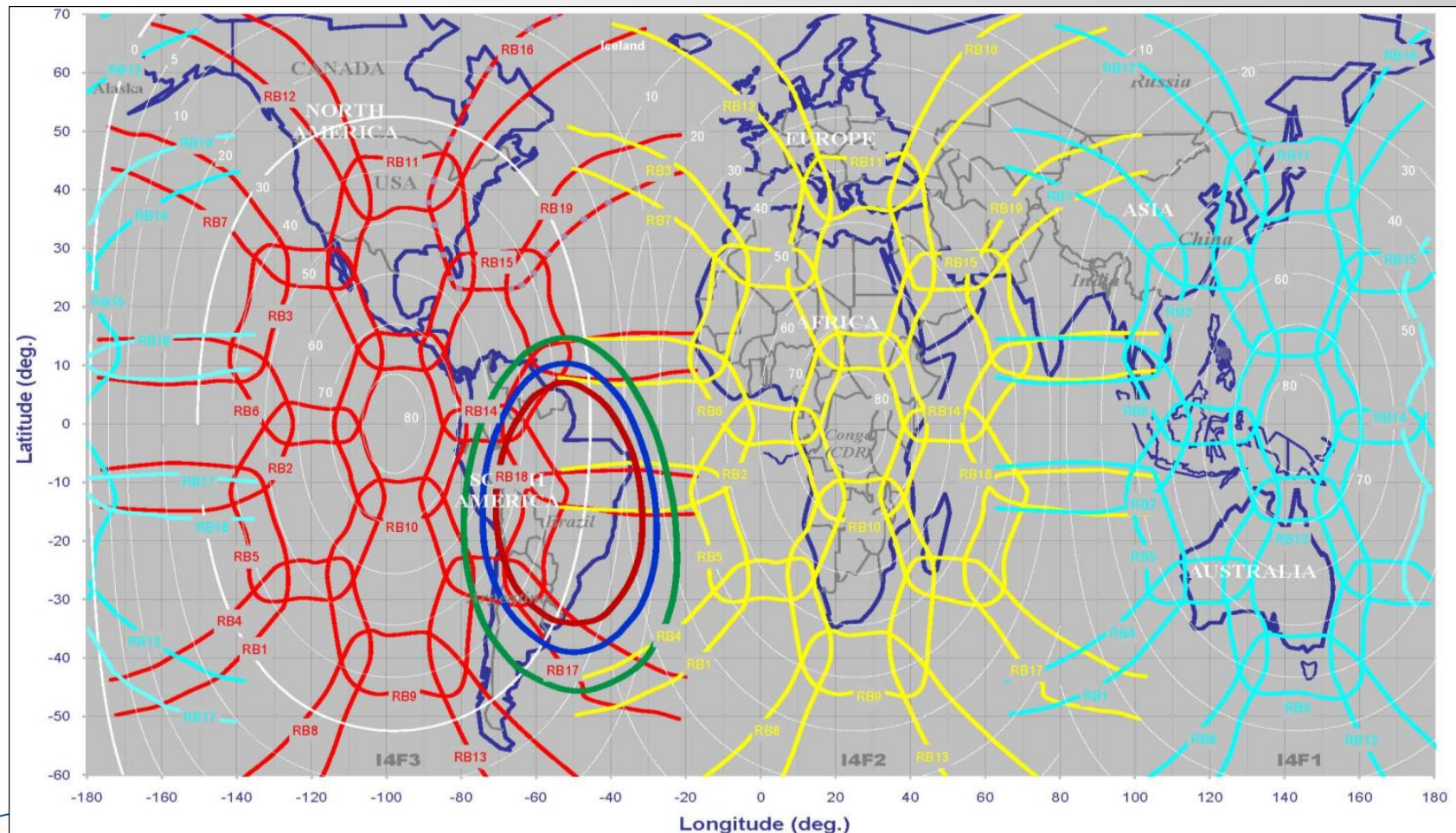
Commercial Update (con't)

➢ Next steps:

- Transition CTIM prototype product and protocol to commercial product
  - optimize power efficiency
  - finalize physical form factor
  - design expanded to support volume manufacturing
    - Factory introduction, functional test, etc.
- Transition satellite technology to IsatData Pro Network
  - Entered 3-year partnership with Canadian Government to commercialize
    - Transport Canada – Security Division

SUMMARY

➤ A satellite based container tracking solution has been developed

- Prototype product and protocol
- Roaming capability to interconnect GlobalWave regions
- User based application server
- Initial trials in yard and end user environments

➤ Ongoing initiative to commercialize technology through migration to new Global IsatDataPro network