

A hand is shown from the bottom left, holding a glowing, translucent globe of the Earth. The globe is illuminated from within, giving it a bright, ethereal appearance. The background is a gradient of light blue and white.

Beidou/Compass and its Unique Contributions to GNSS - New Applications in China

Unicore Communications ,Inc.

和芯星通科技（北京）有限公司

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- **GNSS Evolution**
- **The 3rd Generation of GNSS**
- **New Features from Beidou/Compass System**
- **Receiver Design for the 3rd Gen GNSS**
- **New Applications**
- **Concluding Remarks**

GNSS Evolution



	1 st Gen GNSS	2.5G GNSS			
	Transit Doppler				
Space	<ul style="list-style-type: none"> • Polar orb: 10 sv • Height: 1100km/106min • Freq.: 150/400MHz • Nav: Orb&clk 	<ul style="list-style-type: none"> • 30 SVs • 20000km/12hrs • Freq.: L1/L2/L5 • Modulation: BPSK/QPSK • Nav: Orb/clk 	<ul style="list-style-type: none"> • 24 SVs • 19130km/11.25hrs • Freq.: L1/L2/L3 • Modulation: BPSK/QPSK • Nav: Orb/clk 	<ul style="list-style-type: none"> • 35 SVs • 24000km/14hrs • 36000km/24hr • Freq.: B1/B2/B3 • Modulation: QPSK • Nav: Orb/clk 	<ul style="list-style-type: none"> • 30 SVs • 24000km/14.7hrs • Freq.: E1/E5/E6 • Modulation: QPSK/BOC • Nav: Orb/clk
Control	<ul style="list-style-type: none"> • Ground tracking, injection, master stations. • Manged by USA 	<ul style="list-style-type: none"> • Ground tracking, injection, master stations. • Managed by USA 	<ul style="list-style-type: none"> • Ground tracking, injection, master stations. • Managed by RU 	<ul style="list-style-type: none"> • Ground tracking, injection, master stations. • Managed by China 	<ul style="list-style-type: none"> • Ground tracking, injection, master stations. • Managed by EU
User	<ul style="list-style-type: none"> • Measurements: Doppler • Position fix every few hours • geodetic and timing 	<ul style="list-style-type: none"> • Measurements: Doppler, Range, Phase • Continuous nav & timing • Geodetic 	<ul style="list-style-type: none"> • Measurements: Doppler, Range, Phase • Continuous nav & timing • Geodetic 	<ul style="list-style-type: none"> • Measurements: Doppler, Range, Phase, 2-way range • Continuous nav & timing • Geodetic • Short message service 	<ul style="list-style-type: none"> • Measurements: Doppler, Range, Phase • Continuous nav & timing • Geodetic

What Do We Need from 3rd Gen?

There are more applications, a greater dependency on GNSS and more concern about GNSS vulnerability

- **More satellites are needed**
 - Assured availability, especially in urban canyons, mountainous areas, under foliage, etc.
 - Positioning accuracy (geometry improvement)
 - RAIM/Robustness
- **More frequency diversity and more modulation modes**
 - Resistance to interference
 - Reduce multipath
 - Reduce TTFF and improve sensitivity by having different signal components, e.g. pilot and data
 - Improve performance of high accuracy applications
- **Communication capability**
 - Two-way communication capability and/or one-way receiving capability
 - Receive signals from each other among satellites in different constellations
- **Managed by different authorities**
 - Avoid intentional denial or accuracy degradation
 - Bounded inaccuracy due to accidental system failure
- **Minimum extra cost for user terminals**

Defining the 3rd Gen GNSS

- **The 3rd GNSS System: Meeting requirements in the previous slide. It is actually an open architected GNSS operated by different authorities.**
- **The 3rd GNSS system has 3 segments:**
 - Space segment: all navigation satellites, and receiving signals from each other
 - Ground segment:
 - different operating authorities responsible for satellites
 - different organizations provide satellite orbit and clock information for variety of applications
 - User segment: GNSS receivers with communications capability
- **Extendable by any party under following guidelines:**
 - Compatibility
 - Interoperability
 - Interchangeability
 - Minimum extra cost for the user segment

- **New type of measurements**
 - RDSS two-way ranging capability
- **New services on communications**
 - E.g. Short Message Service
- **More satellites and better frequency diversity**
 - 35 more satellites
 - New frequencies, more signal components and more modulations
 - Mid/high orbit satellites for better ITRF maintenance
 - GEO satellites: improve DOP, availability and TTFF
- **Better accuracy and integrity**
 - Wide area differential corrections and integrity broadcast
 - Broadcast of precise ephemeris and satellite clock
- **Interoperability/Interchangeability improvement**
 - Providing transformation parameters among different coordinate and timing systems of GPS, Glonass and Beidou/Compass, Galileo, etc.
- **Improve the robustness in cases of service disruptions**

Typical Receiver Design



GPS

GPS Signal
Processing
Unit



GLONASS

Glonass Signal
Processing
Unit



Beidou

Beidou Signal
Processing
Unit



GALILEO

Galileo Signal
Processing
Unit

+

+

+

Tightly Integrated PVT Processing Unit for all Systems

Deeply Integrated Receiver Design



The 3rdG GNSS

The 3rdG Receiver

Signal Receiving

Any 4 (or more) GNSS satellites

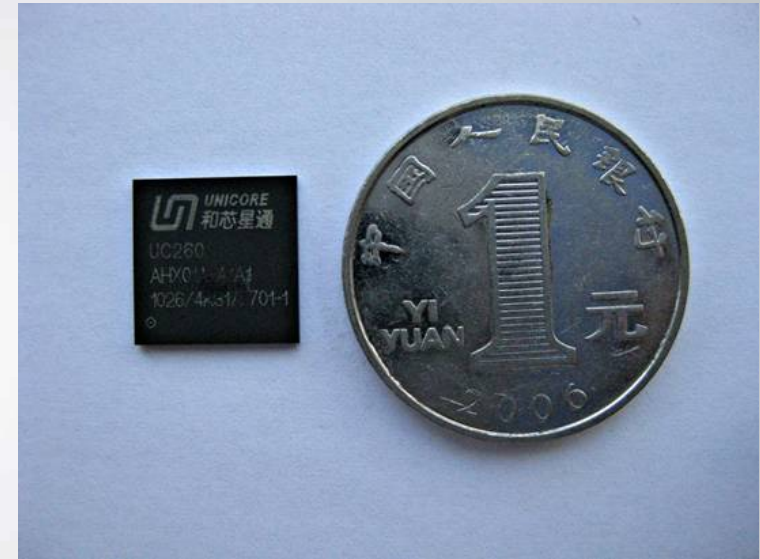
Baseband

- Unified and configurable baseband architecture
- Code generation unit to support all types of PRN codes
- Support BPSK, QPSK, BoC, mBoC, AltBoC, etc.
- Correlator, FFT and match filter to support all systems

PVT

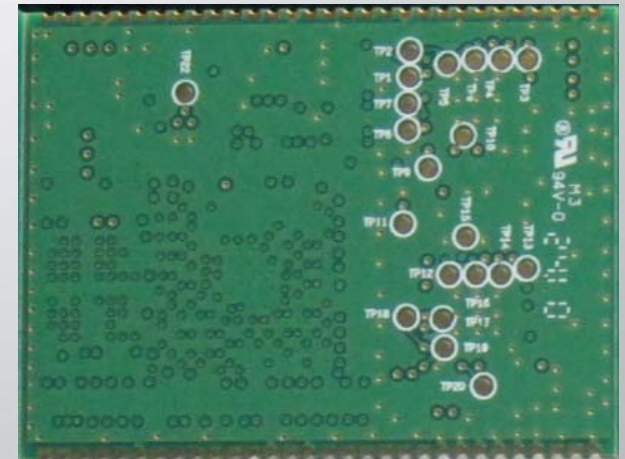
- Unified GNSS coordinate and time system
- PVT with Embedded RAIM for security and integrity

- **Antenna (multi-band receiving, overlay and separatability)**
- **Radio frequency (multi-channel and configurable)**
- **Baseband processing (re-configurable architecture for different modulation modes, different ranging codes, acquisition and tracking units, etc.)**
- **Position, Navigation and Timing computation (embedded coordinate and time transformation) to achieve positioning with any 4 (or more) satellites**
- **RAIM with integrity check for both inter-system and intra-system**
- **Both transmitting and receiving capabilities**
- **Low cost message receiving capability**



Unicore Beidou/GPS module with SMS for applications:

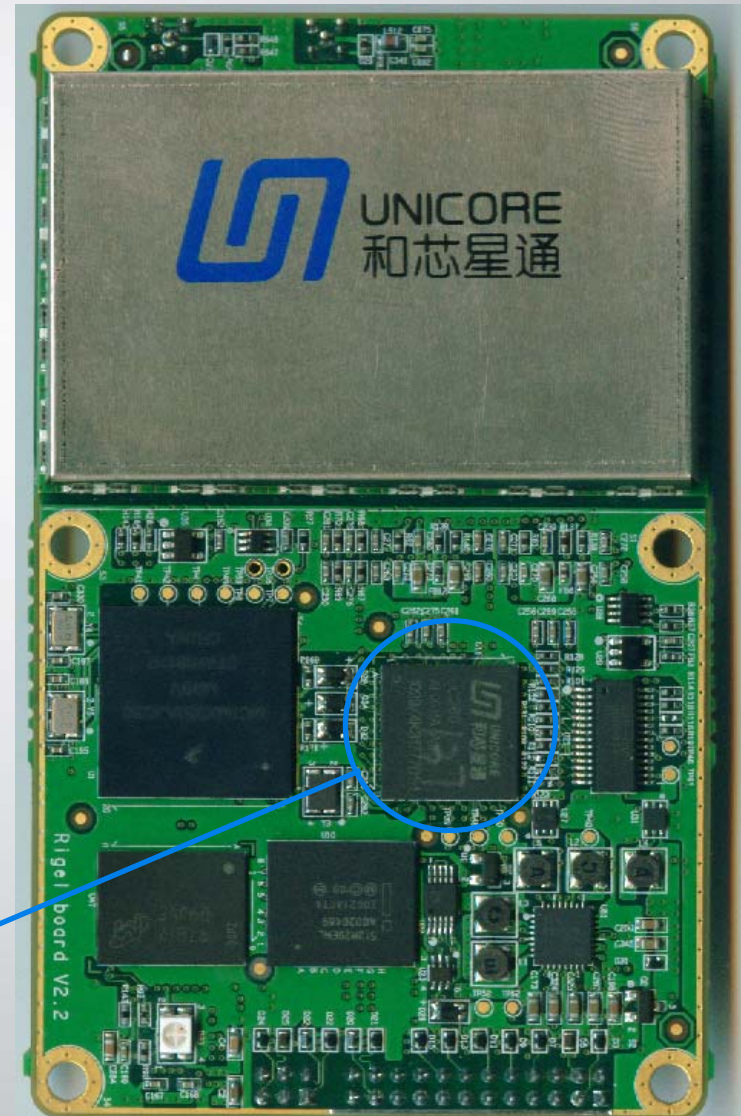
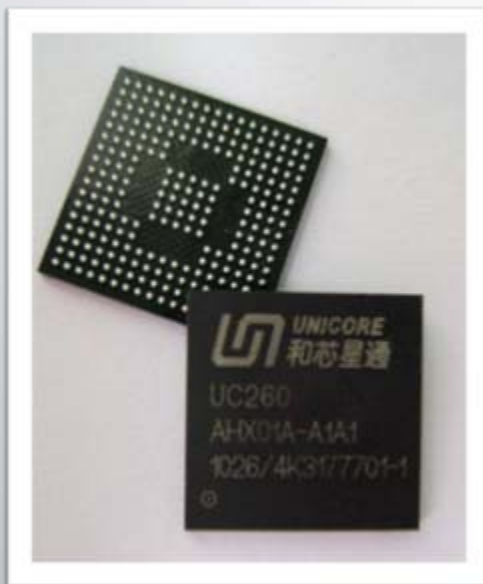
- Offshore fishing service
- Timing for China 3G standard – TD-SCDMA
- Disaster mitigation
- Fleet management rural areas



WAAS and High Precision Services UNICORE 和芯星通

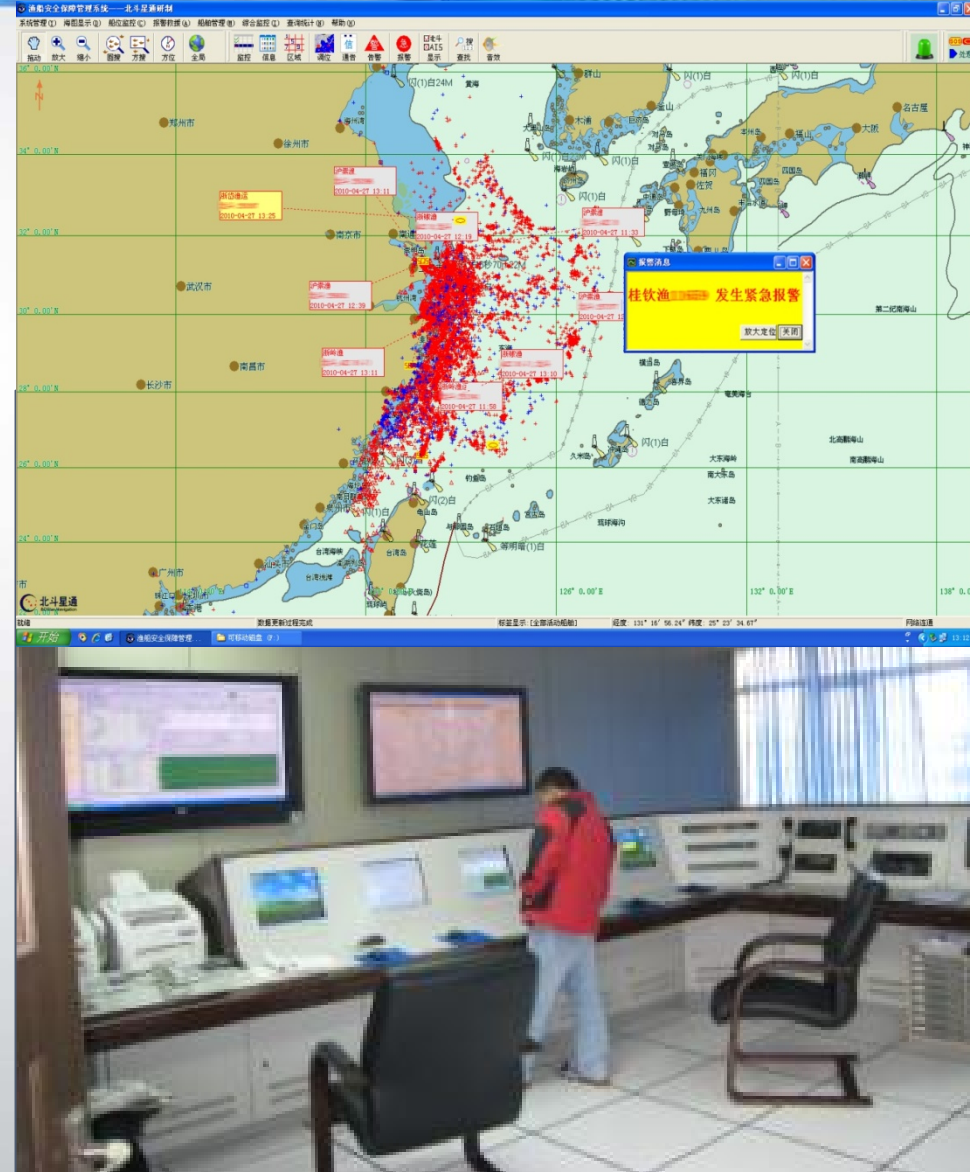
Unicore Beidou/GPS dual frequency OEM board with:

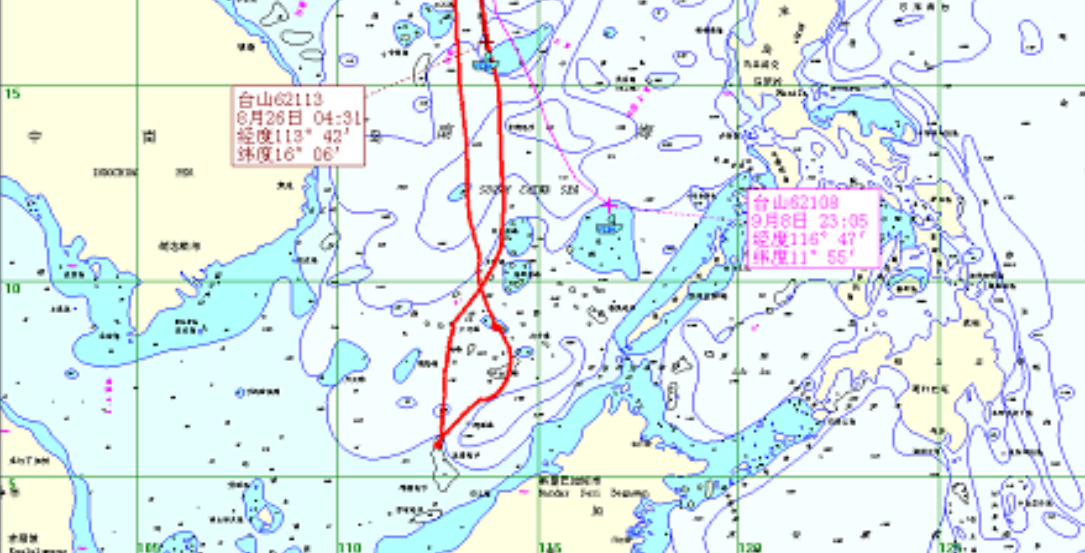
- WAAS information provided by Beidou (Compass)
- Potentially high accuracy orbit and satellite clock information provided by Beidou (Compass)



Offshore Fishing Mngt System

- System: Beidou with SMS + China Mobile + GIS + Internet Business
- Functions:
 - Offshore fishing, monitoring, safety, emergency aid
 - Fishing and on-line business services



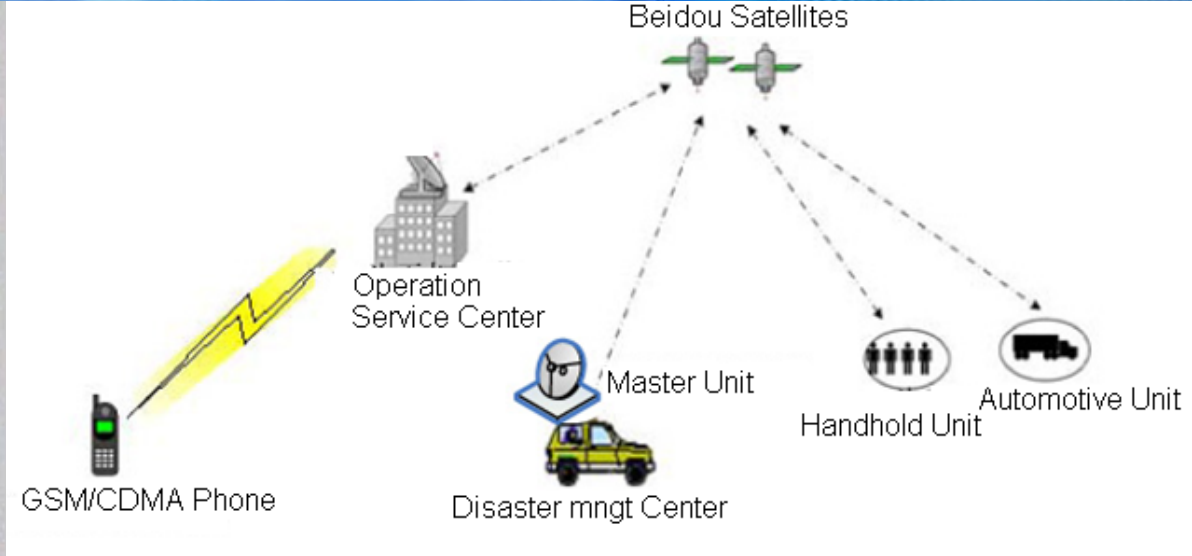
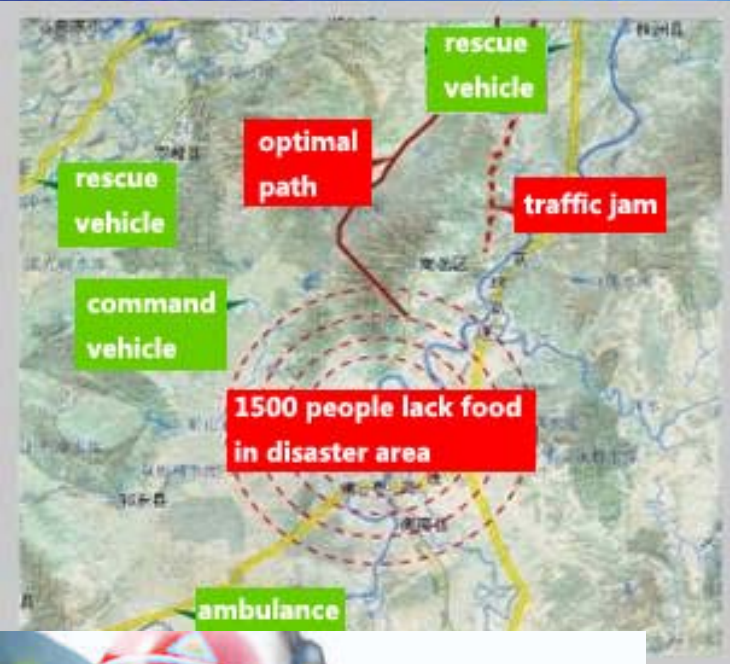




- System: Beidou RDSS/SMS + China Mobile + GIS + Internet Business
- Functions:
 - Monitoring,
 - Communications,
 - and Management



Wen Chuan Earthquake Example

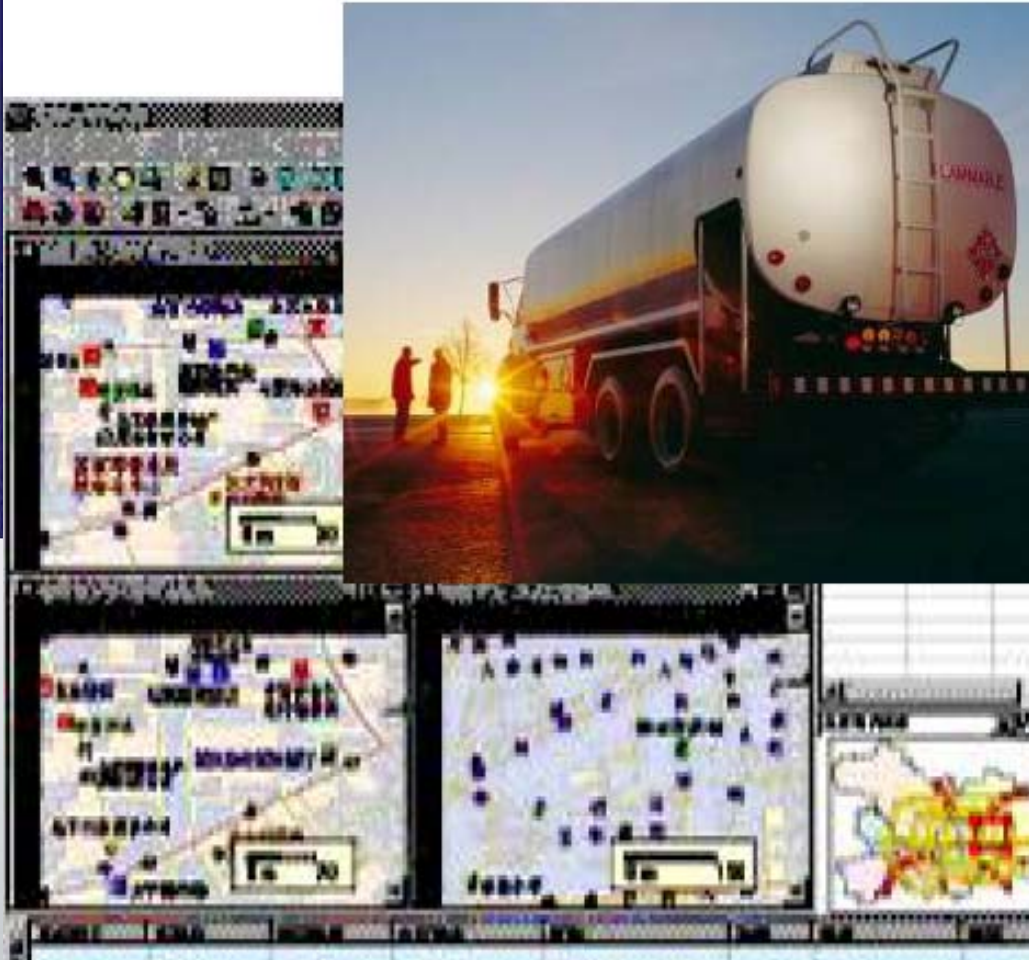


Fleet Management For Rural Areas



Qinghai-Tibet Railway
Monitoring and Control System

Dangerous Truck Tracking and Control System



- **The 3rd Generation GNSS is coming, based on open platform which can be enhanced by any satellite system**
- **Compatible, interoperability and interchangeability should be essential requirements for future systems**
- **China Beidou/Compass provides significant enhancements over the current GNSS**
- **Unicore has designed deeply-integrated receivers for the 3rd Generation GNSS**
- **With such enhancements and receiver technology achievements, wider applications have been, and will be, explored.**

A hand is shown from the bottom left, holding a glowing, semi-transparent globe of the Earth. The globe is illuminated from within, giving it a bright, ethereal appearance. The background behind the globe is a dark blue gradient with some faint, circular patterns.

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THANKS