DOCKINGASSIST A Novel Vessel Navigation System Design Based on WiMAX and DGNSS

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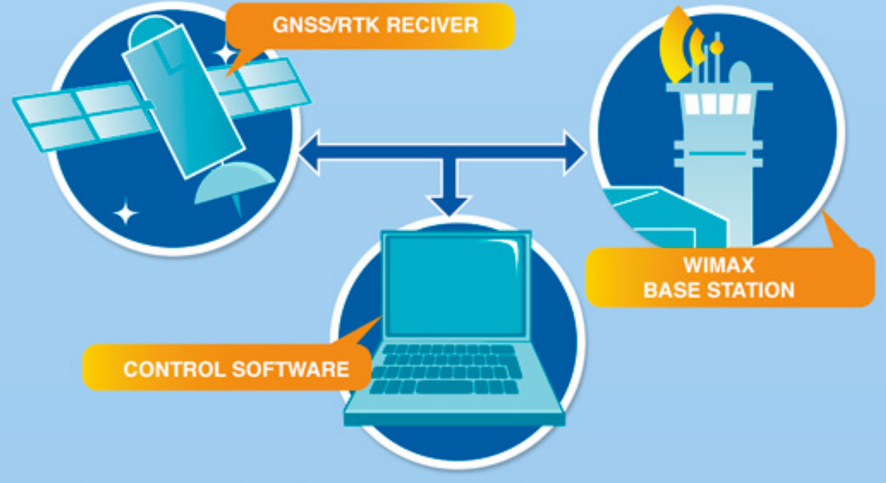
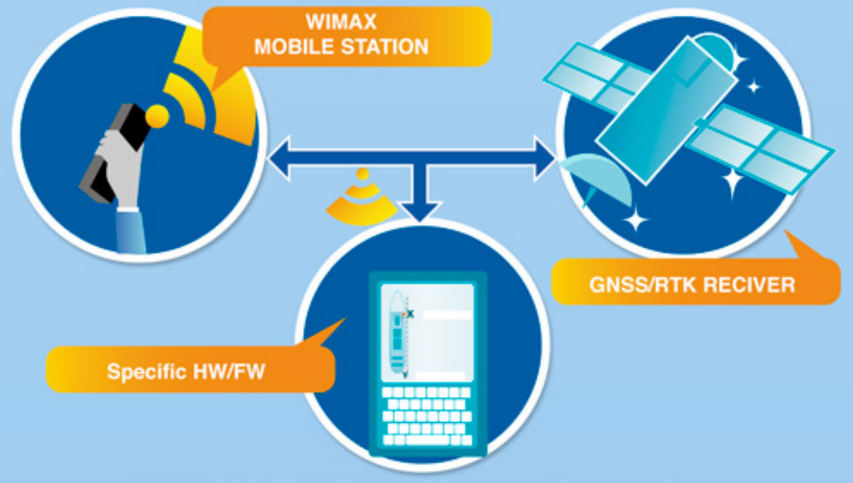
Abstract:

The **DOCKINGASSIST** system is a centralised, cost-effective, real-time navigation system that provides the necessary centimetre positioning and speed accuracy to ensure efficient and safe manoeuvring within a entire port area, thereby enhancing vessel trajectory and providing constant monitoring of moored/docked vessels. By reducing transit, this system will result in improved port traffic management and lower operating expenses, CO2 emissions and fuel usage, thereby lessening the environmental impact of shipping. The reduced transit time will increase throughput in ports with a low investment. Our solution is based on WiMAX technology transmitting DGNSS positioning data in harbours. We provide proof-of-concept results based on empirical measurements performed in a real harbour. We find that WiMAX fulfils the requirements for accurate vessel positioning and navigation in harbour environment while providing wireless network capacity also for other services.

System configuration:



DOCKINGASSIST base station configuration



DOCKINGASSIST PPU configuration

Performance comparision:

	Commercial PPUs	**DOCKINGASSIST** system
Radio network	UHF Modem	Mobile WiMAX (IEEE 802.16e)
Multiplexing	TDMA	OFDMA
Position data updating time	1 Hz (default)	Depends on the WiMAX frame duration, which typically is 5 ms (up to 200 Hz)
Number of vessels supported	Several	Up to hundreds of vessels
Data rate capacity	Tens of Kb/s (BAUD)	From Mb/s to tens of Mb/s in both uplink and downlink
Navigation and berthing capabilities	Navigation + berthing	Navigation + accurate berthing
GPS/DGPS/RTK capabilities	GPS/DGPS/dual freq. RTK	GPS/DGPS/dual freq. RTK
Coverage per BS	Tens of kilometres, according to the data sheet	From kilometres to up to tens of kilometres depending on the system parameters
Data transmission capabilities	BS – Rover: correction data streaming; Rover – BS: own position	BS – Rover: correction data, weather, etc.; Rover – BS: accurate position, heading, ROT streaming; And possibilities of sending other information

Main conclusions:

- A novel navigation system design based on **WiMAX** and **DGNSS** technologies was presented in the paper.
- **DGNSS** performance: the evaluated performance showed that **DOCKINGASSIST** system was more reliable than the commercial PPU receiver, and that the positioning accuracy are very similar (both using RTK reference data).
- WiMAX performance: **WiMAX** indicated that the system could attain more than 7.5 km coverage range in the harbour environment when using the 2.3 GHz frequency band. There are no restrictions caused by insufficient capacity for the positioning data.
- In comparison, the commercial PPU through a UHF link has not been able to provide proper RTK correction coverage for a radius of 7 km.
- **DOCKINGASSIST** is the first harbour navigation system using **WiMAX** technology.

DOCKINGASSIST