

IBAS : Internet-Based Augmentation System for GNSS

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Overview

- The importance of “GNSS augmentation”
- The introduction of “IBAS”
- Results
 - Experimental Environment
 - Positioning error
 - Sample application
- Future work
- Summary

Background

- The importance of discovering geographical location information of a node increases.
 - In mobile and ubiquitous computing, the position of a node is not fixed.
- There are many positioning devices.
 - GPS, RF-ID, Wireless LAN etc...
 - In the near future, we will use several devices at once.

GNSS's effectivity and limits

- Global Navigation Satellite Systems (GNSS) is the one of the effective positioning device.
 - GNSS can be used in the outdoors of all over the Earth.
 - ~~The infrastructure has been established (No more infra.)~~
- GNSS has limits on accuracy.
 - To enhance the accuracy, it is necessary for a node to receive the error correction data (D-GPS, RTK-GPS).
- GNSS can't be used in low electric intensity area.
 - To enhance the availability, it is necessary for a node to receive the assist data (A-GPS).

Existing Augmentation Systems

- Error correction
 - D-GPS by FM radio, medium wave beacon
 - RTK-GPS by D-MCA radio
 - Global Differential by fixed satellite
- A-GPS
 - Cellar phone network (au by KDDI “Ez NaviWalk”)

Advantages in the Internet-Based System

- Service Area
 - If only connected to the Internet, users can access to the system in anywhere.
- Interactivity
 - It comes to possible to send dedicated correction data to each user.
- Device dependency
 - Users are able to select various connection devices according to their circumstances.

Existing Internet-based system

- GPS Earth Observation NETWORK (GEONET)
 - collects and provides satellite wave observation data
- DGPS-IP
 - provides D-GPS correction data
- Internet-Based Global Differential GPS (IGDG)
 - provides error correction data for satellite information
- Signal-In-Space through the InterNET (SiSNeT)
 - provides error correction data for satellite information
- "Propagate server model"
 - provides D-GPS and RTK-GPS correction data

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System comparison

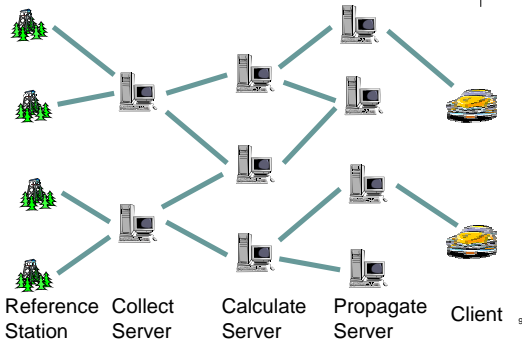
	Scalability	Reusability of reference stations	Extensibility
GEONET	×		
DGPS-IP	×	×	×
IGDG	×		
SiSNeT	×	×	
Propagate server model			

We have proposed the Internet-Based Augmentation System for GNSS (IBAS)

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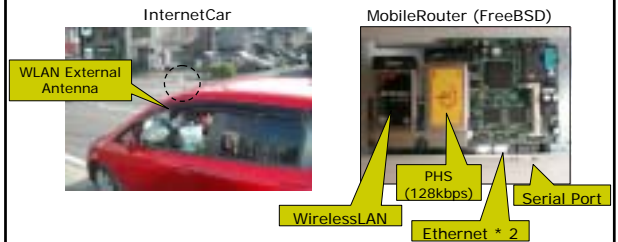
System architecture of IBAS



Reference Station Collect Server Calculate Server Propagate Server Client 9

Experimental environment

- We have experimental environment on "iCar".



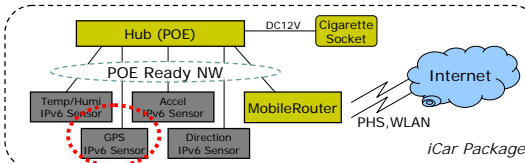
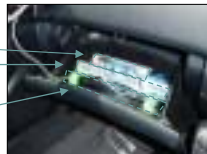
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InternetCar (iCar)

- iCar Package
 - Hub (POE Ready)
 - IPv6 Sensors
 - GPS, Temp, Humidity
 - Direction, Accell
 - MobileRouter
 - PHS, WirelessLAN



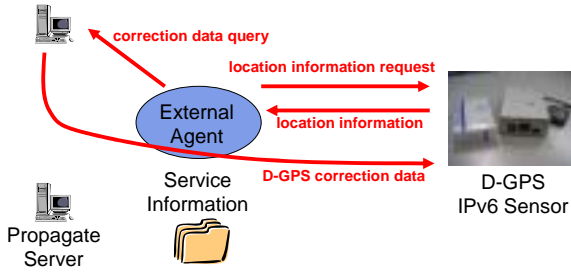
D-GPS IPv6 Sensor

- H/W : H8 micro computer + GPS receiver
- OS : μ ITRON
- Supports IPv6
- Supports SNMPv1
 - We can obtain location information with "SNMP get request".
 - We can input D-GPS correction data with "SNMP set request".



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Protocol procedure

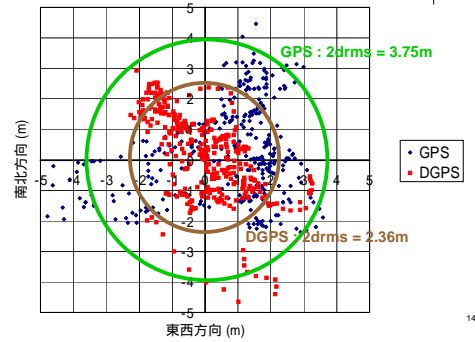


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Horizontal positioning error



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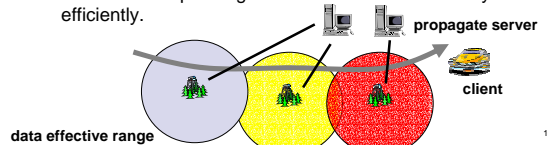
Application example



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Future work

- Study on location-based information distribution model
 - Augmentation data has effective range and period.
 - Now, users (or "external agents") select services and propagate servers explicitly according to their location.
 - We need to examine the model for distributing the information depending on location and time to many clients efficiently.



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Summary

- In order to enhance the usability of GNSS, We proposed "IBAS : the Internet-Based Augmentation System for GNSS".
- IBAS is comparable in positioning error to the existing system, and its architecture has advances in scalability, reusability of data, and extensibility.
- As future work, we will examine the model for the distributing location-based information.

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