UPGRADE
Un Système de Localisation en Intérieur Utilisant un Récepteur GNSS Standard

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GROUPE NAVIGATION
GET - INT
EVRY - FRANCE

Plan de l'exposé

- Introduction
- Les approches à base de répéteurs GNSS
- Les expériences en 2-D
- Les expériences en 1-D
- Discussions

- Les performances de localisation
- Les débits des systèmes sans fil

→ GéoServices « Location Based Services »

Les GéoServices se situent à la convergence

Localisation / Communication / Contenus

Les GéoServices réclament une localisation

- dans divers environnements
- avec une précision qui dépend de l'application
- et une continuité du service

Il n'existe pas actuellement de

« technologie universelle »

SYNTHESE DES PERFORMANCES

INTERIEUR

EXTERIEUR

Réseaux de capteurs R+++++- - -+ WLANS+++

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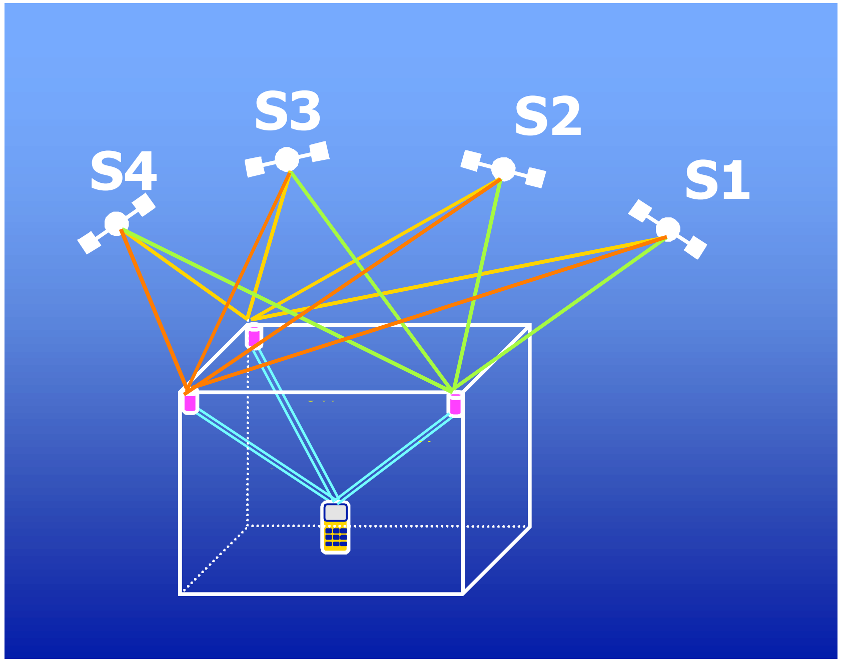
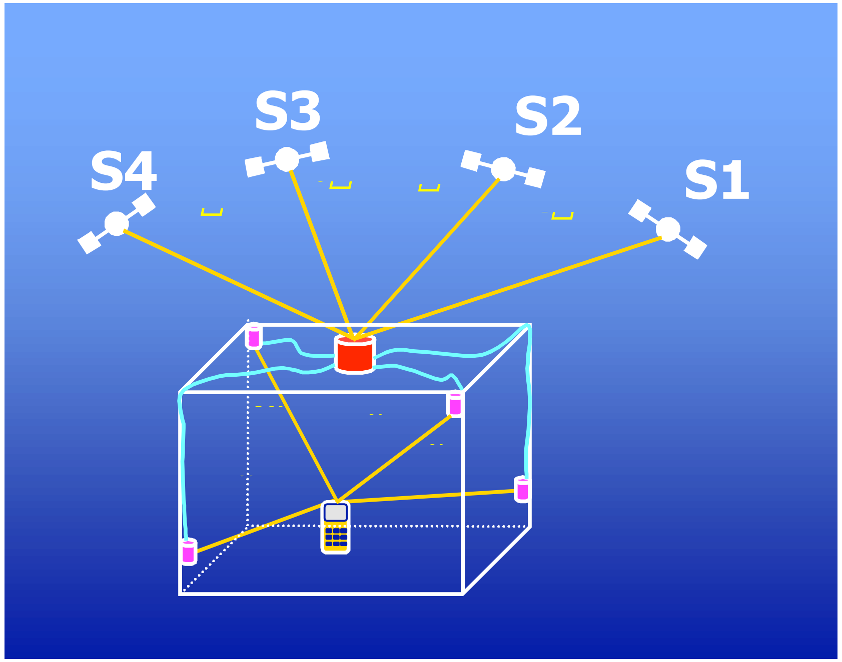
Répéteurs GNSS

Architecture RnS



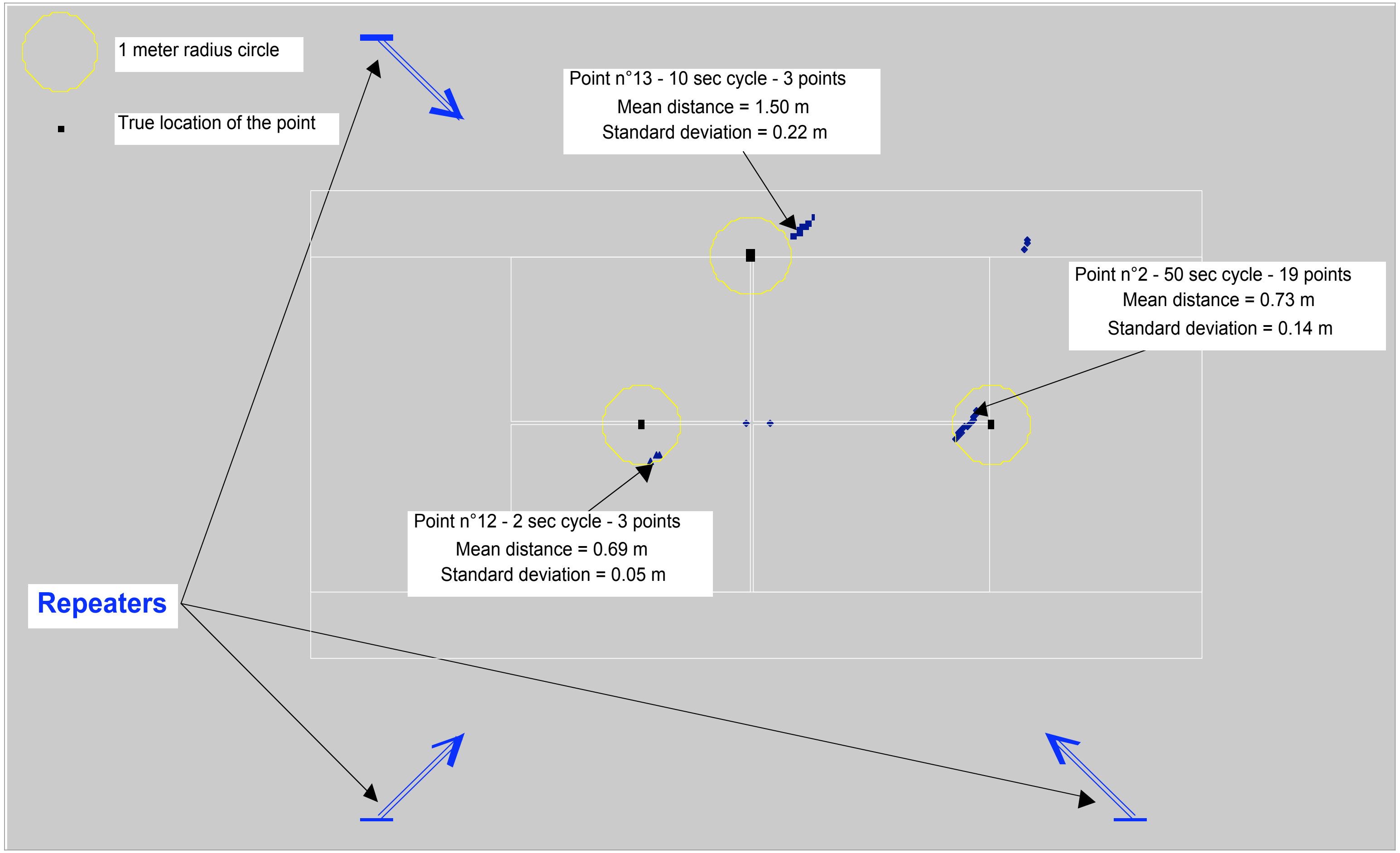


Architecture R1S

LES EXPERIENCES EN 2-D
le lieu d'expérience

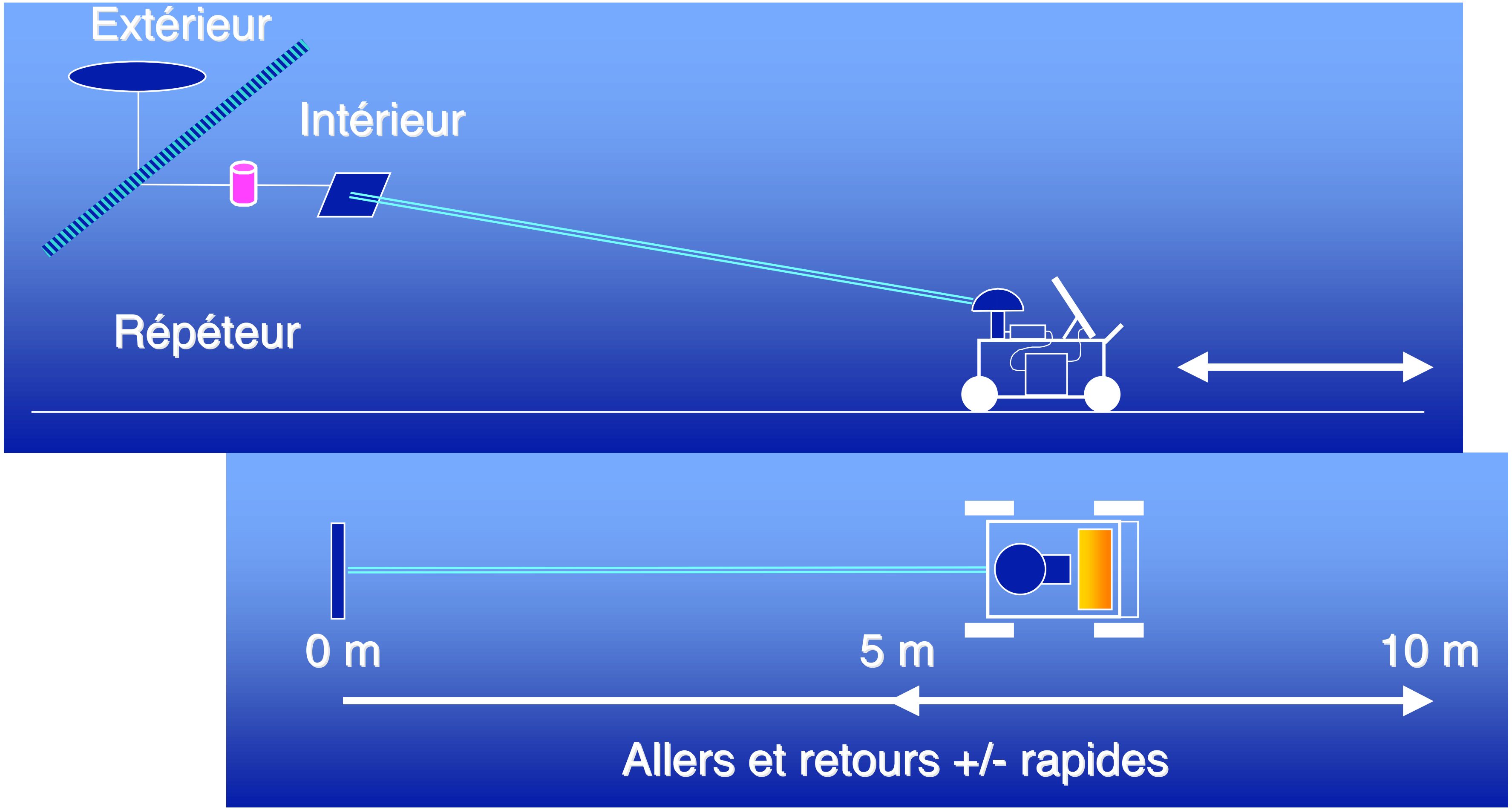
LES EXPERIENCES EN 2-D
la réception extérieur

LES EXPERIENCES EN 2-D
les résultats



LES EXPERIENCES EN 1-D
le principe

Objectif: vérifier qu'il est possible de suivre le mouvement d'un mobile.



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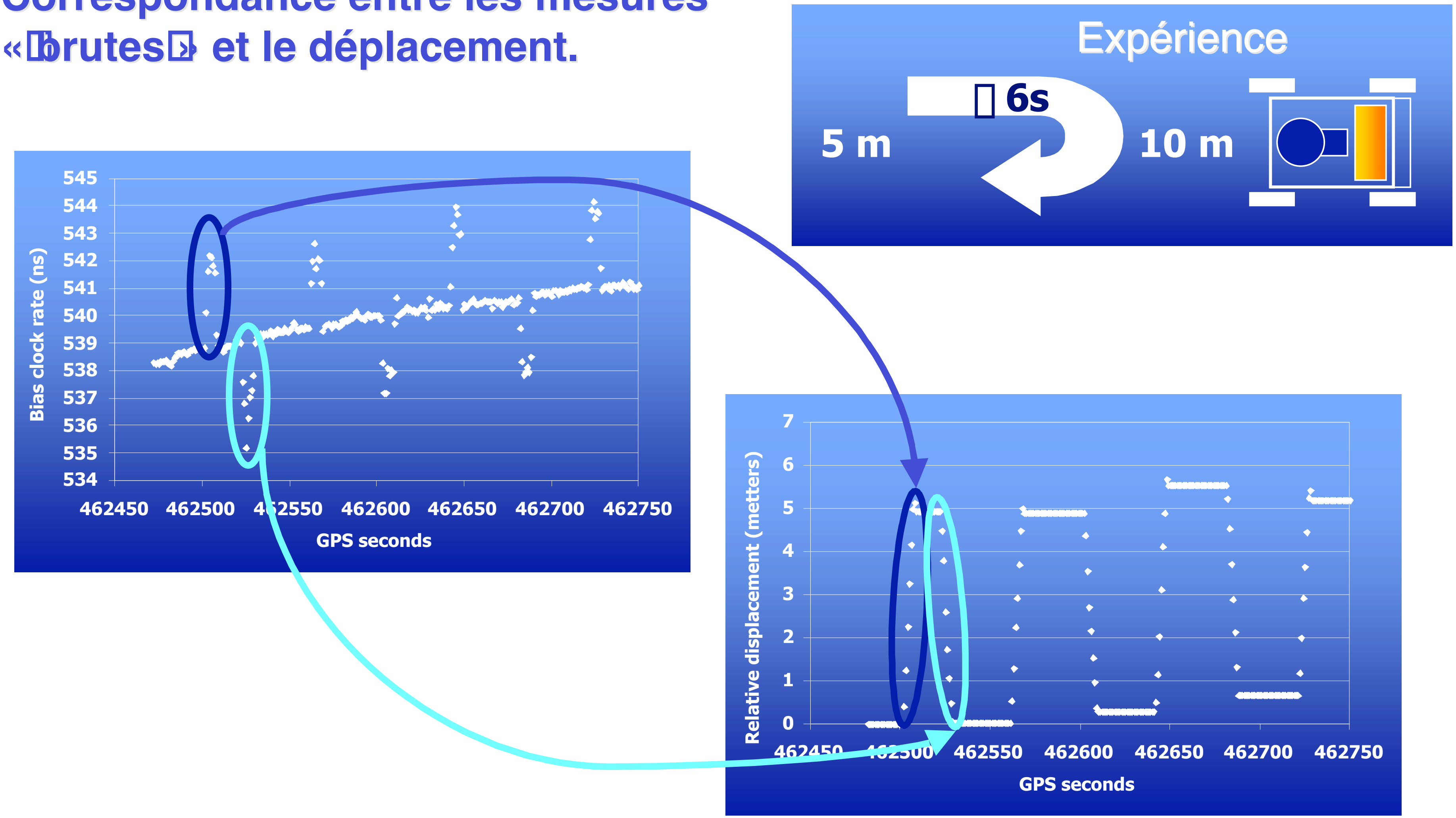
Correspondance entre les mesures « brutes » et le déplacement.



CONCLUSION ET TRAVAUX FUTURS

- Précision de positionnement absolu en 2-D dans la gamme 1-2 m
- Précision de déplacement relatif en 1-D < 1 m (améliorations possibles par optimisation du traitement du signal)
- Premiers résultats encourageants

- Système de positionnement 3-D
- Amélioration de la précision (approche différentielle, capteurs additionnels, fusion de données, …)

PLANCHES

POUR

DISCUSSIONS

An indoor GNSS navigation system should present:

- Easy implementation and easy use
- No, or few, GNSS hardware modifications
- Preferably only software changes
- About 1 meter accuracy (*x, y, z*)
- Low cost

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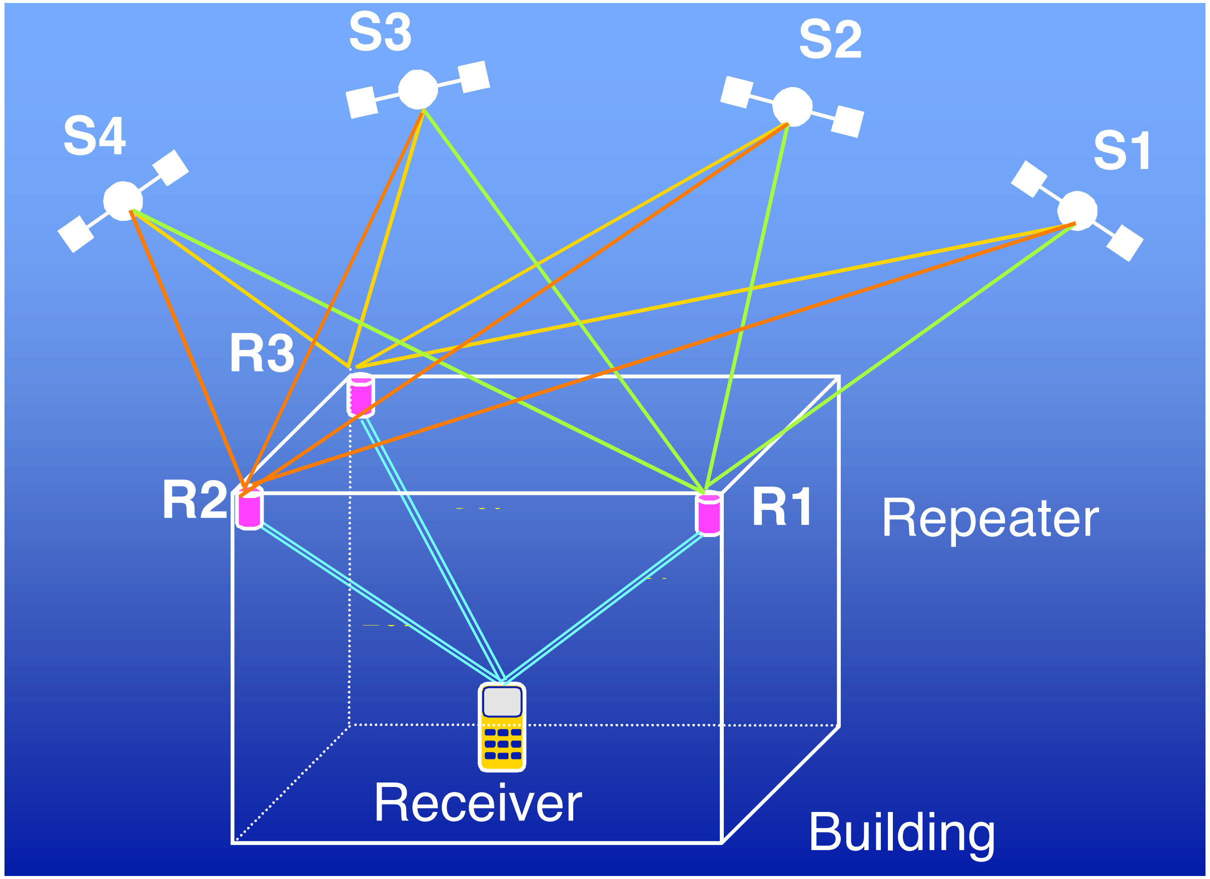
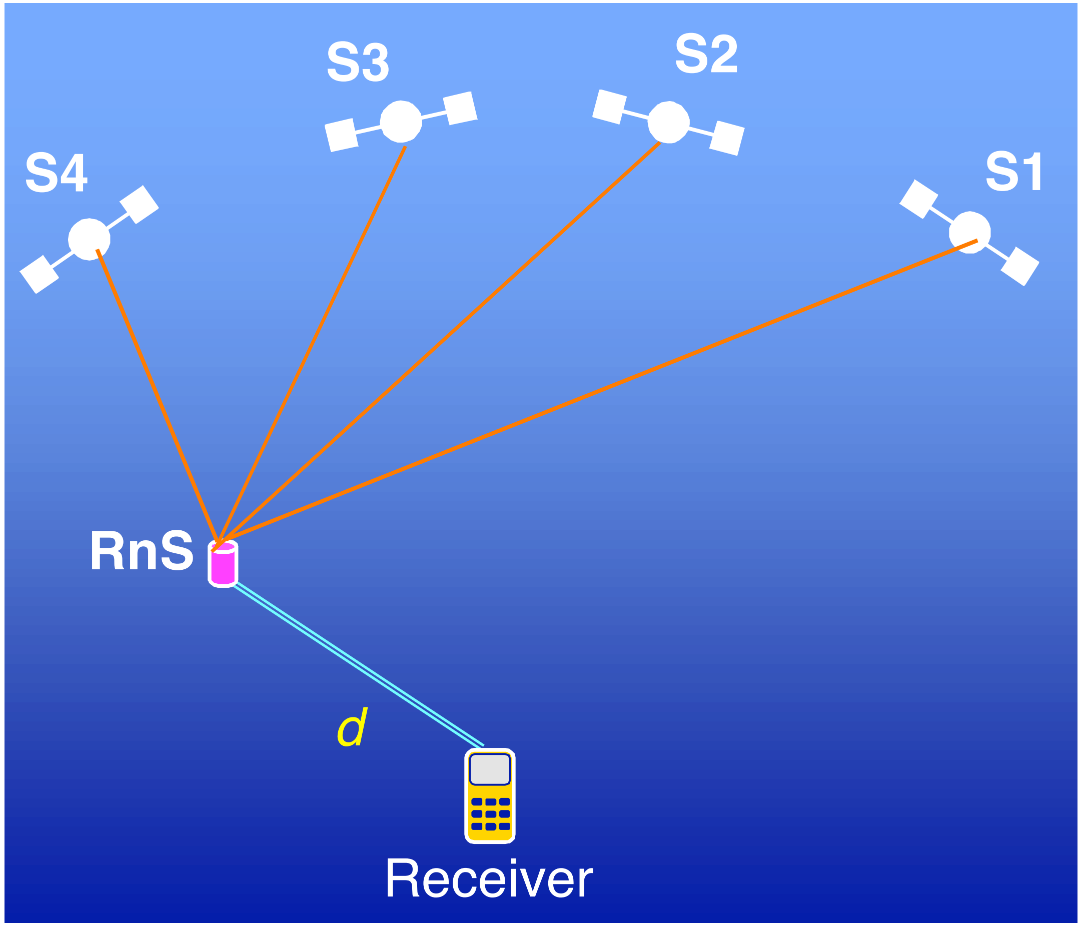
The RnS system: the global architecture



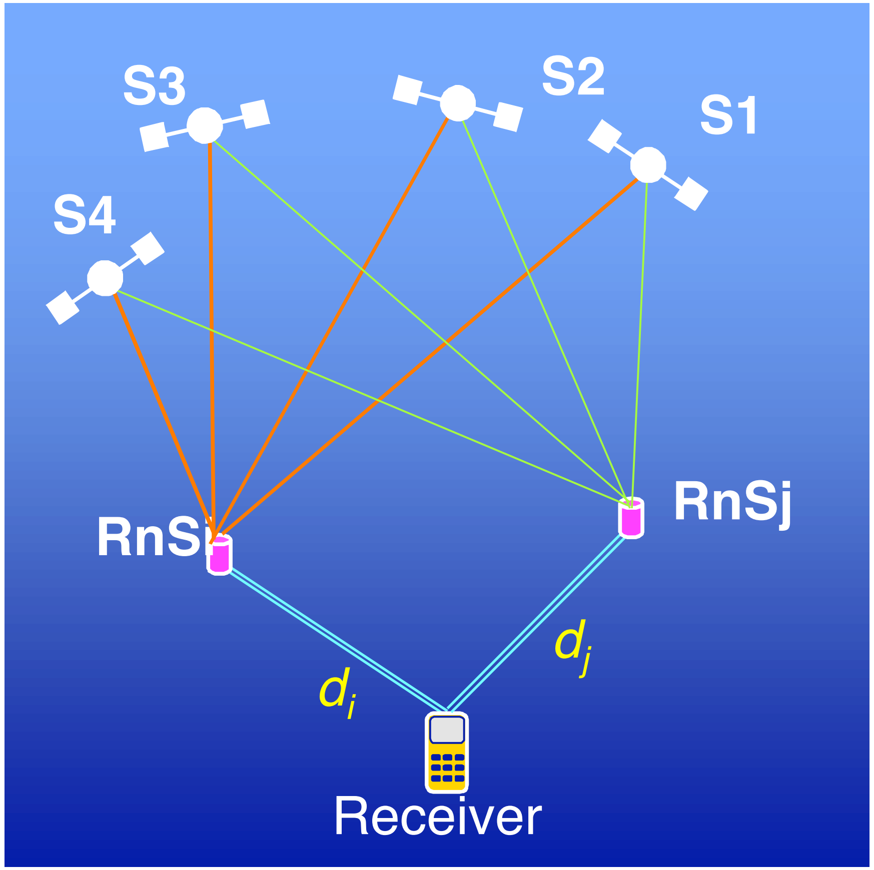
Repeaters that repeat the signals from all the satellites
Sequential mode

Location computed at the receiver's end



UPGRADE
The RnS system: the sequential running mode

4 measurements lead to a new set of equations



- The place
- The indoor antenna of the repeater
- The cycling machine
- The outdoor part of the repeater
- The indoor receiver
- The global system

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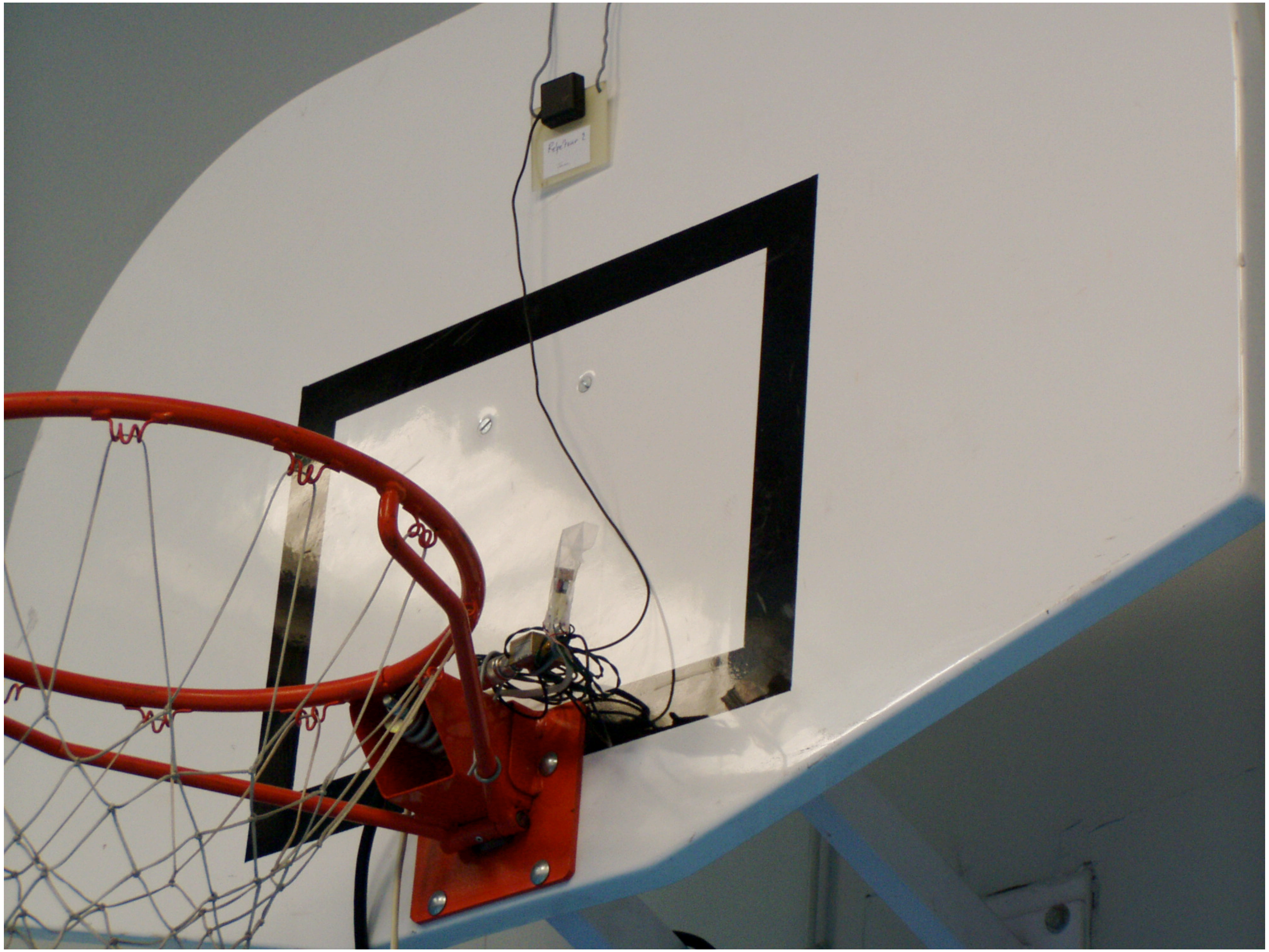
2-D experimental set-up: the place

UPGRADE
2-D experimental set-up: the indoor antenna of the repeater



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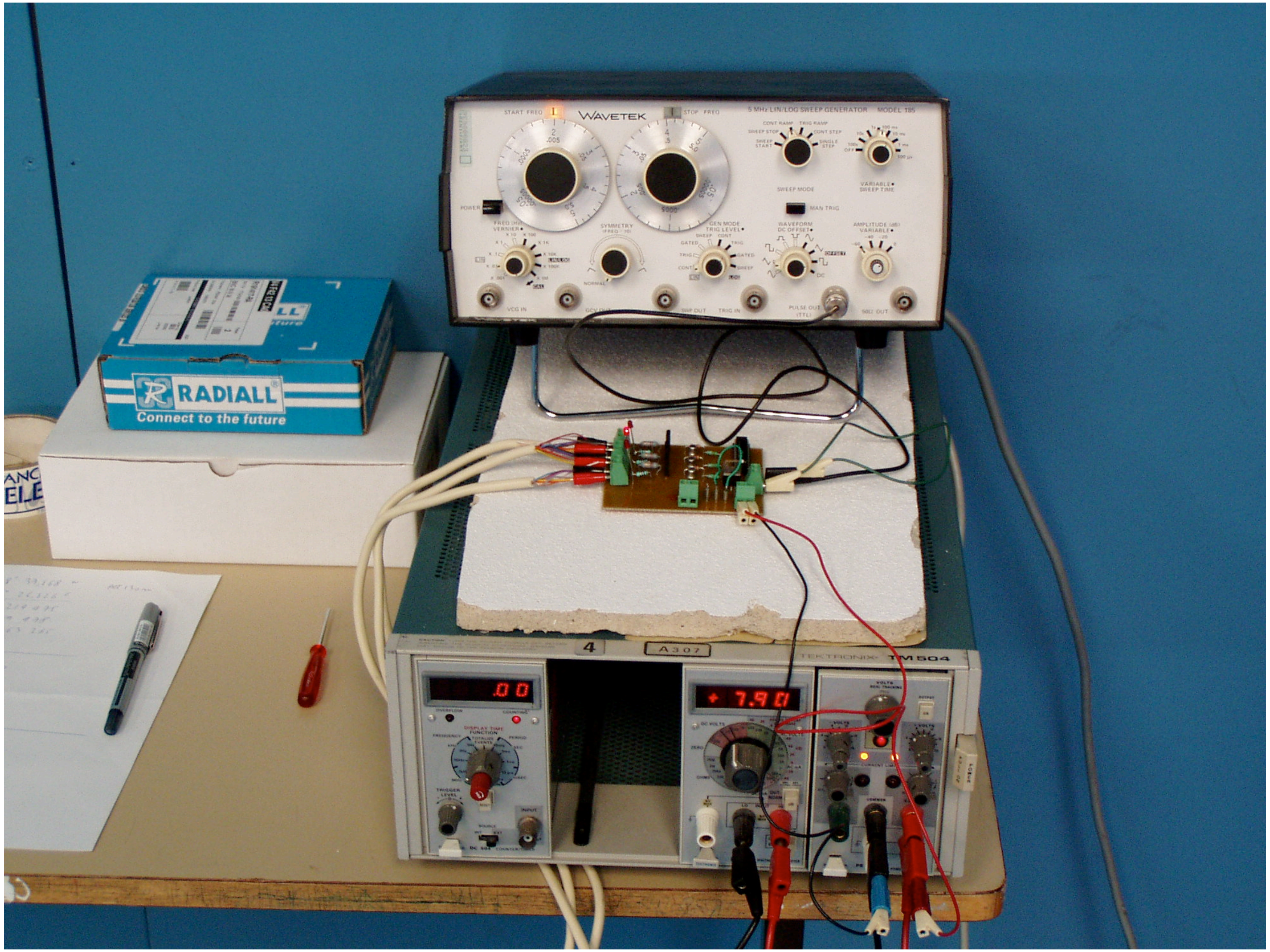
2-D experimental set-up: the cycling machine



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2-D experimental set-up: the indoor receiver

The practical implementation of the theory is given by the following equations

$$\begin{cases} c\Delta t_{cal}\left(t_{rep1}\right) = c\Delta t_{osc}\left(t_{rep1}\right) + del\left(rep1\right) + d_1 \\ c\Delta t_{cal}\left(t_{rep2}\right) = c\Delta t_{osc}\left(t_{rep2}\right) + del\left(rep2\right) + d_2 \\ c\Delta t_{cal}\left(t_{rep3}\right) = c\Delta t_{osc}\left(t_{rep3}\right) + del\left(rep3\right) + d_3 \end{cases}$$

where

$\Delta t_{cal}\left(t_{repi}\right)$ is the computed clock bias at time t_{repi}

$\Delta t_{osc}\left(t_{repi}\right)$ is the clock bias rate at time t_{repi}

$del\left(repi\right)$ is the induced delay of repeater i

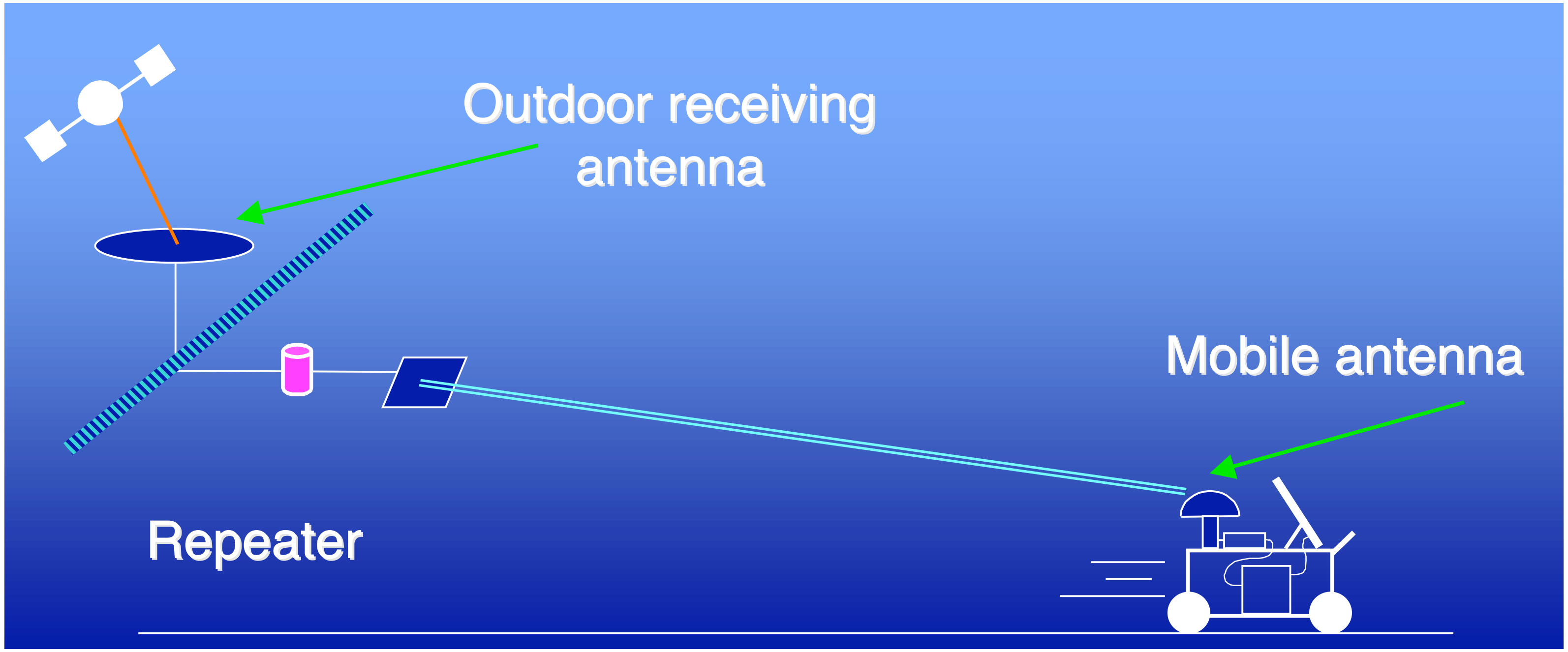
d_i is the distance between the mobile receiver and repeater i

Within which we stated that

$$c\Delta t_{osc}\left(t_{repj}\right) = c\Delta t_{osc}\left(t_{repi}\right) + \sum_{k=i+1}^{j} \delta\left(c\Delta t_{osc\,k}\right)$$

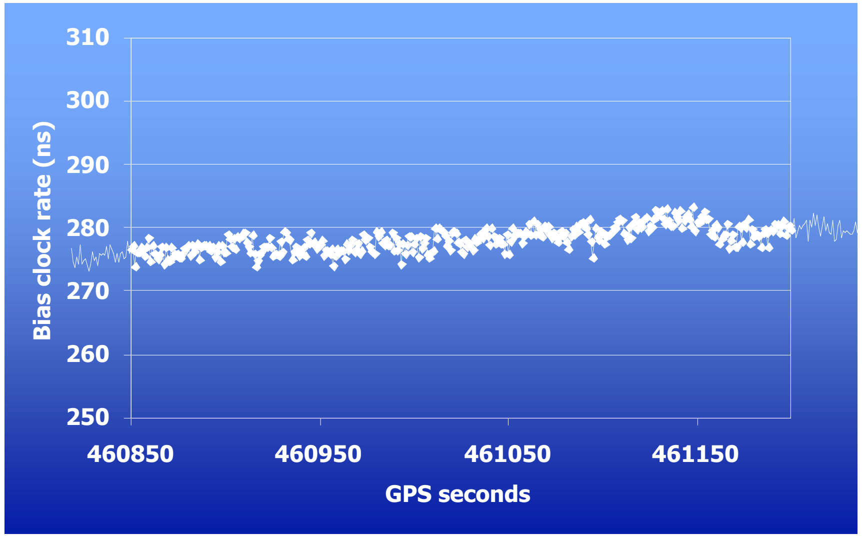
where

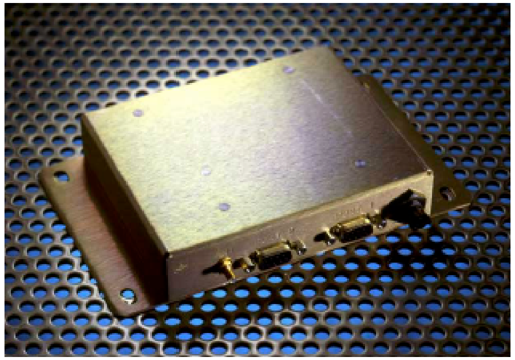
$\delta\left(c\Delta t_{osc\,k}\right)$ is the measured clock bias rate at time t_{rep_k}



- When the mobile antenna does not move
  - internal natural drift of the internal oscillator
- When the mobile antenna moves
  - doppler due to antenna displacement

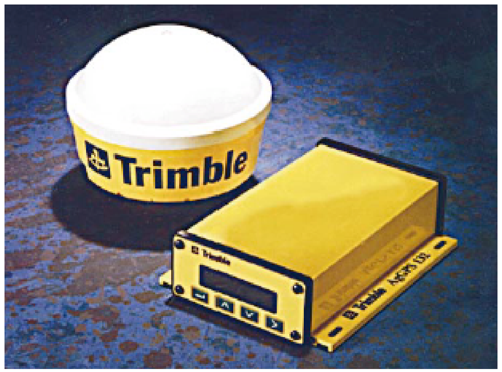
Natural oscillator drift versus time for both receivers

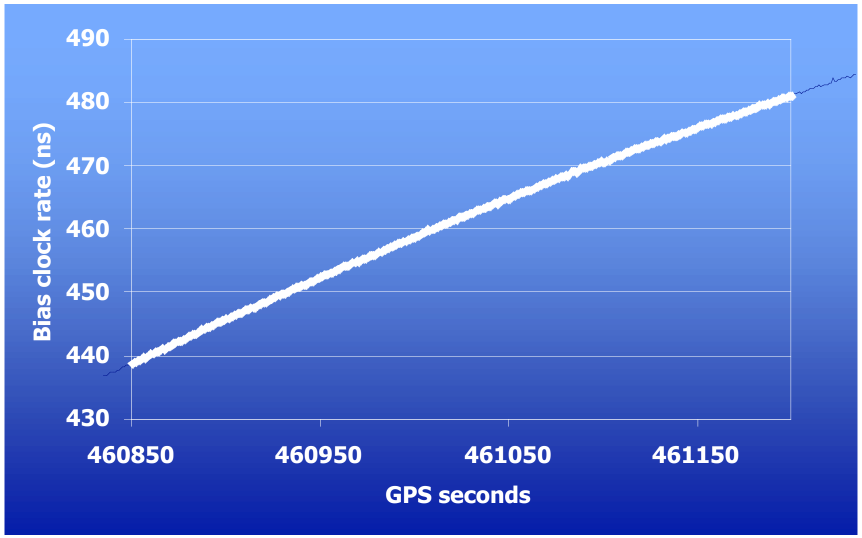




Ag132

Lassen LP





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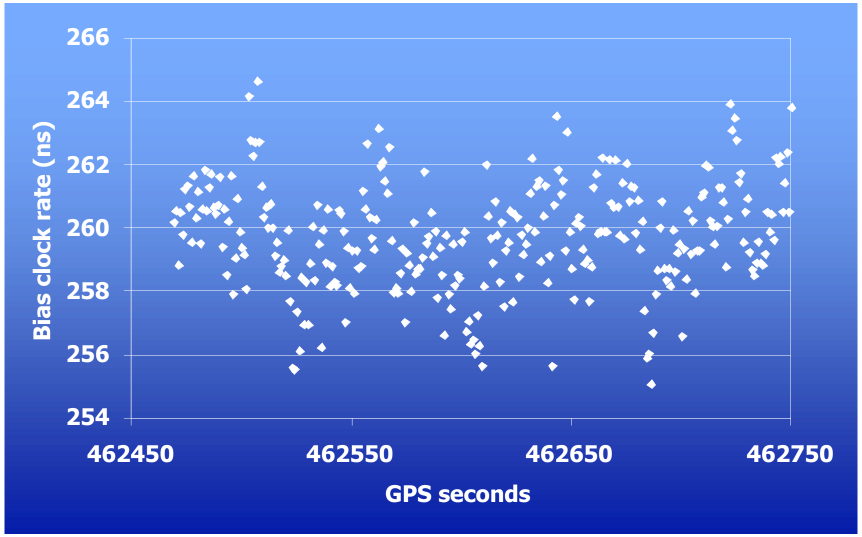
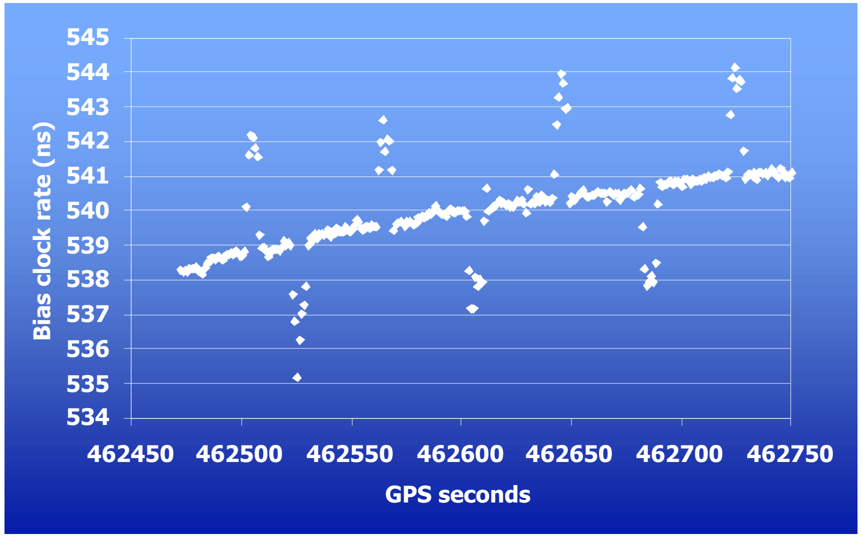
1-D relative displacement experimental results: Preliminary remark

Lassen LP versus Ag132 raw measurements



Lassen LP



Ag132

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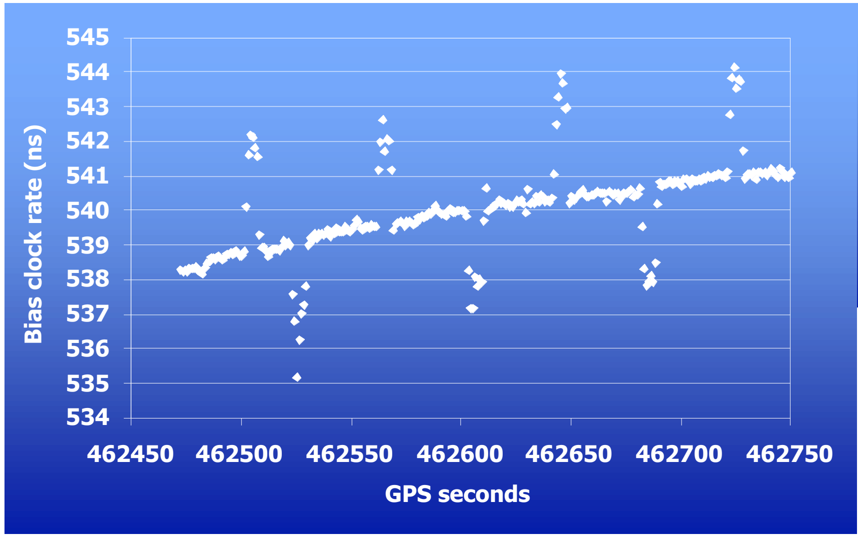
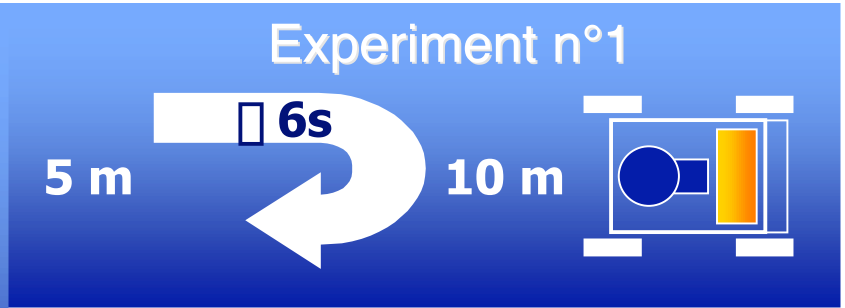
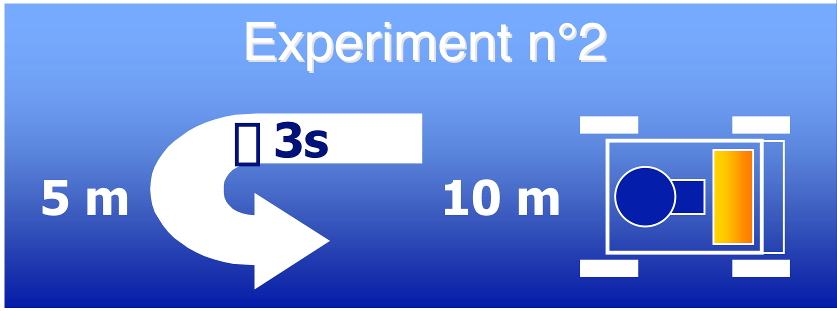
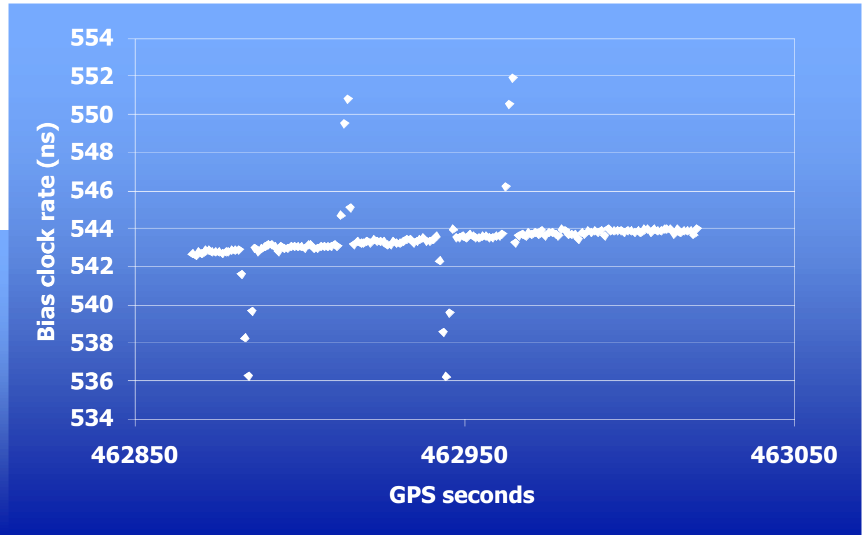
1-D relative displacement experimental results: The raw results

Measurement results for two displacement schemes

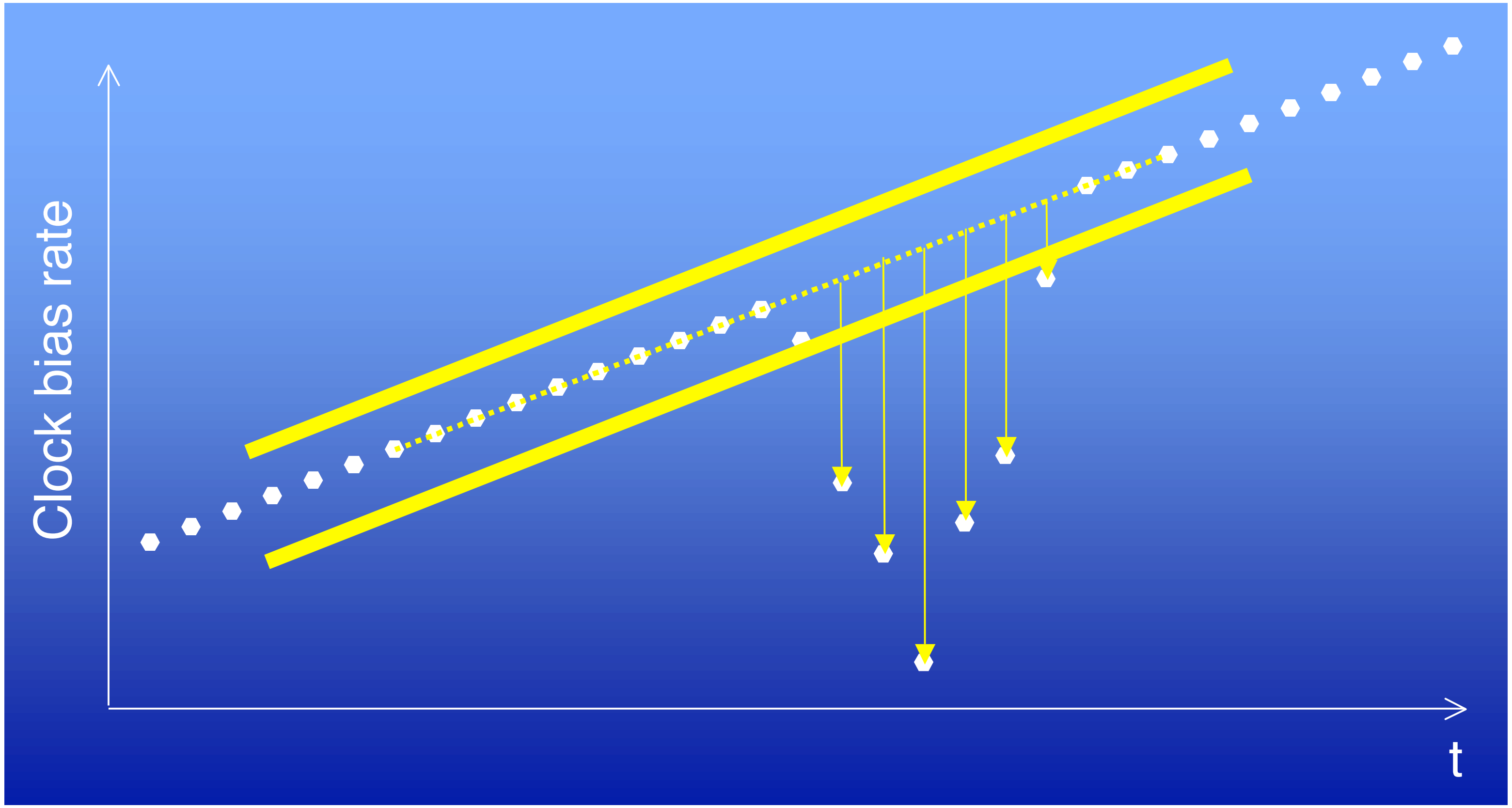








Compensation approach



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Experimental results: 1-D relative displacement

Compensation of the natural oscillator drift: linear regression approach