

Zero-Configuration Robust Indoor Localization

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INDOOR LOCALIZATION

Objective

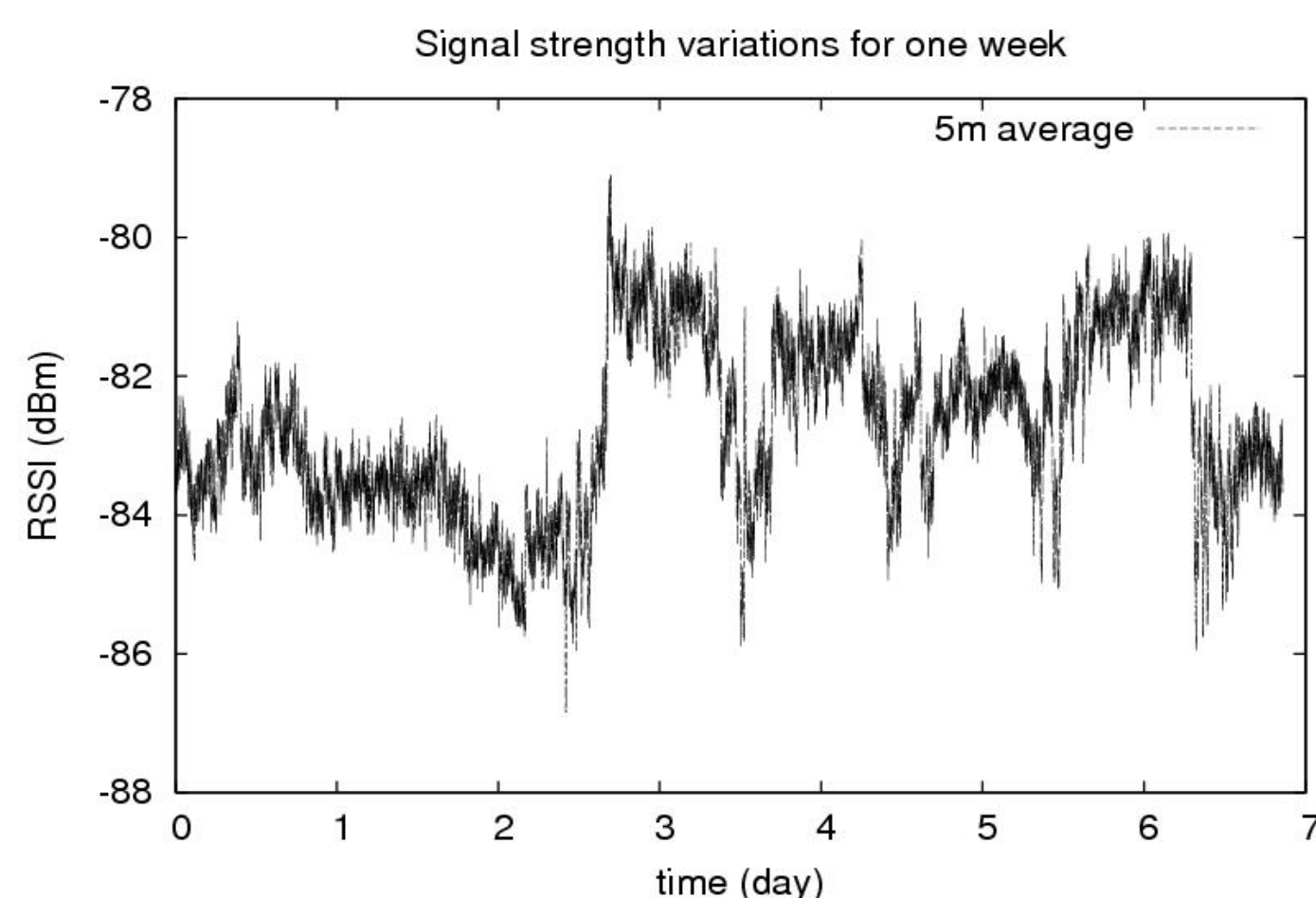
(1) **Fine-grained indoor localization and tracking** of 802.11-enabled devices with existing 802.11 (a.k.a. Wi-Fi) WLAN deployments.



(2) **Location-Aware Application:** Network management, wireless network attacker localizer, and visitor guidance.

Challenges

Time-varying signal strength: Received signal strengths (RSSs) fluctuate due to RF multi-path fading, human mobility, and other dynamic changes of the indoor environment.



- **Anisotropy of signal attenuation:** RF signals are attenuated differently along different directions.
- **Hardware cost:** Localization system usually employs expensive and specialized hardware.
- **Configuration overhead:** Frequent full-scale, on-site survey and training are expensive.

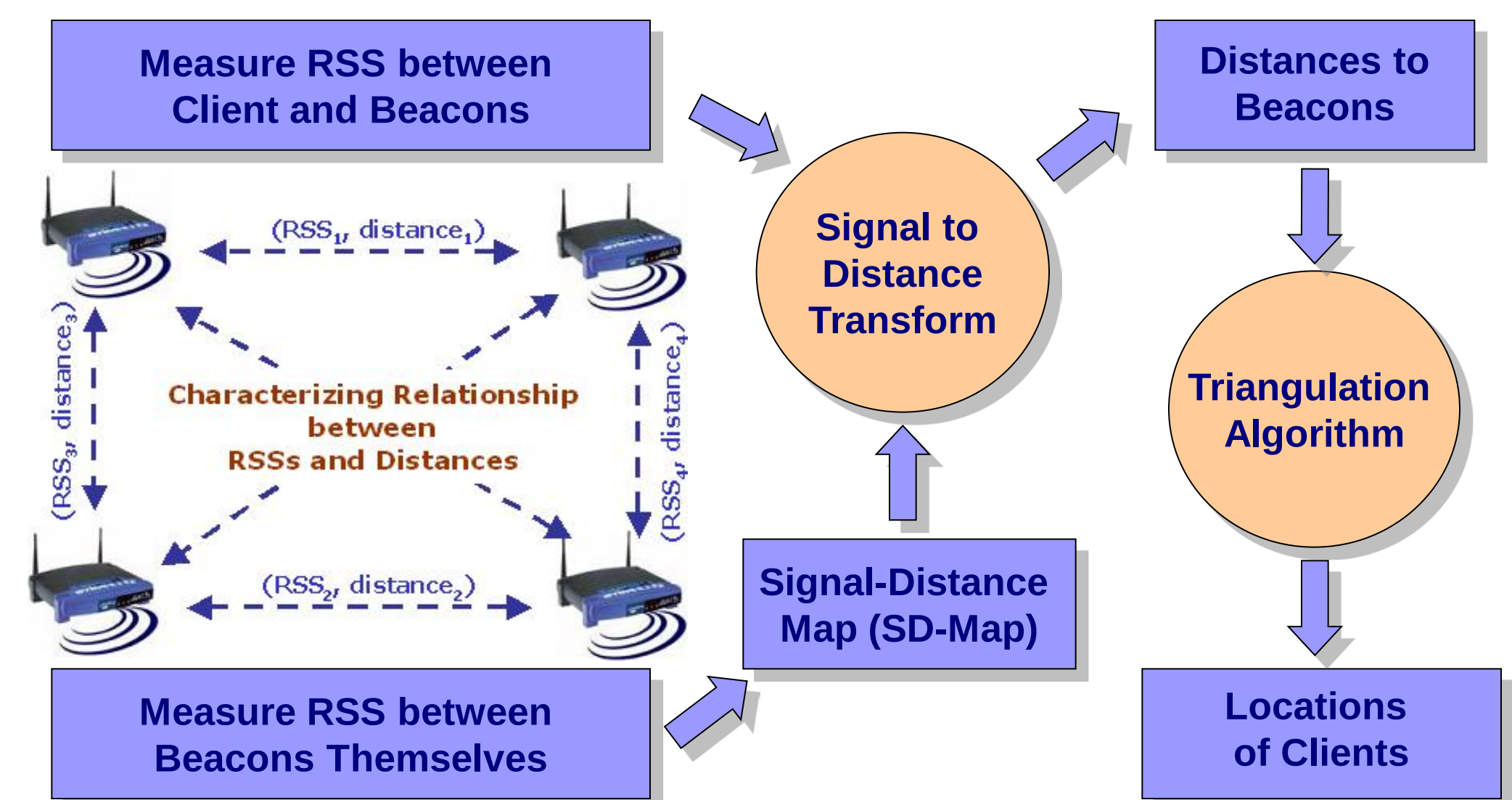
OUR APPROACH

Key Features

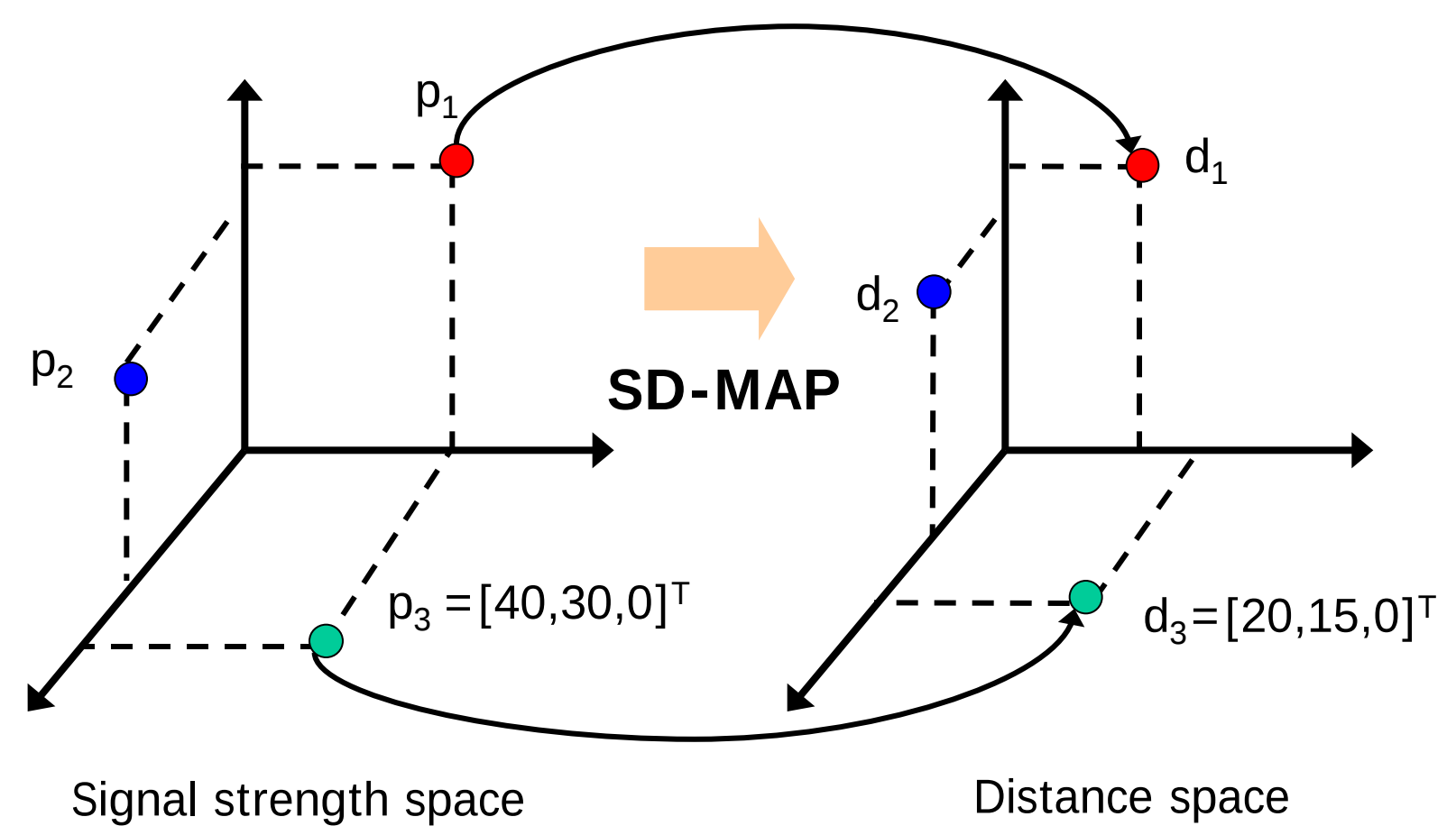
- **Zero configuration:** Our localization system auto-configures itself on-line and adapts to the system dynamics
- **Robustness:** We compensate for time-varying and noisy 802.11 signal with the truncated singular value decomposition.
- **Accuracy:** We achieve an accuracy of 2m (median error) for indoor localization.
- **Cost:** Our system is grounded on the innovation that turns the off-the-shelf 802.11-enabled devices (Linksys WRT54G) into wireless monitors. These routers are inexpensive (\$50 per router).

Algorithm

Basic idea: The localization algorithm takes as input the on-line measurements of received signal strengths (RSSs) between 802.11 APs and between a client and its neighboring APs.



Signal-Distance Map (SD-Map): Transformation matrix from a signal strength embedding space to a distance embedding space, which is obtained by truncated singular value decomposition (TSVD) technique.



Implementation

Wireless monitors: Linksys WRT54G wireless routers (v2.2) with a third-party firmware (Sveasoft, Alchemy pre7a) and Kismet (802.11 layer2 wireless network sniffer) drone for MIPS machines.

Measurement server: Linux machine with a web interface for administration (in Perl) and Kismet server.

Localization client: Graphical user interface and localization algorithm written in Java 1.4 using Netbeans.

PERFORMANCE

Localization errors w/o wireless client assistance. M is the number of wireless monitors.

