Localization as a Feature of mmWave Communication

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INTRODUCTION

- mmWave is a promising concept of future wireless communication;
- Localization is a key enabler of a context-aware Future Internet;
- Idea: introducing localization ➔ a desired feature of future wireless networks ➔ in mmWave ➔ a future wireless communication concept;

SYSTEM ASSUMPTIONS

- mmWave employs directionality ➔ Angle of Arrival (AoA);
- Large bandwidth ➔ Tight synchronization ➔ Time of Flight (ToF);
- Beam-search is a necessity ➔ multiple modalities for localization;

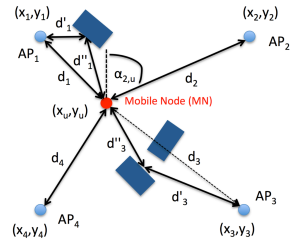
Popular physical layers used in localization

Physical layer	Bandwidth	Raw resolution
IEEE 802.11a/g	20 MHz	15 m
IEEE 802.11n	40 MHz	7.5 m
IEEE 802.11ac	<160 MHz	>1.9 m
UWB	>500 MHz	<0.6 m
IEEE 802.11ad	**>2 GHz**	**<15 cm**

x100 better than WiFi a/g!

mmWave-BASED LOCALIZATION SERVICE

- Set of static mmWave anchors (APs);
- mmWave mobile node (MN) with an unknown location;
- APs and MN adopt directional signal transmission and reception;
- MN communicates with APs using Line-of-Sight (LoS) or Non-Line-of-Sight (NLoS);



EVALUATION MODEL

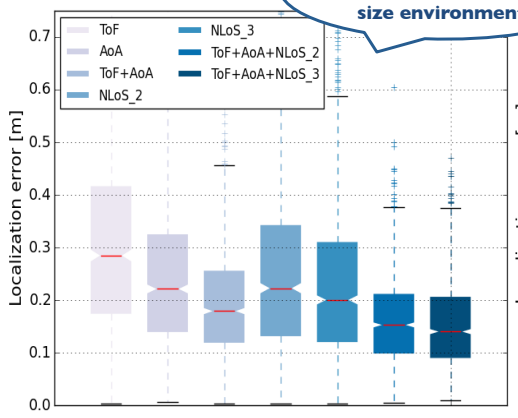
- Square space with a mmWave AP in each corner;
- Random obstacles and randomly selected MN's location;
- Distances (RSS, ToF) and angles (AoA) to all APs are calculated;
- Gaussian-distributed variability is added to the RSS, ToF, and AoA;
- Localization algorithms are applied to estimate MN's unknown location;
- Localization errors are obtained and the procedure is repeated x10000.

EVALUATION RESULTS

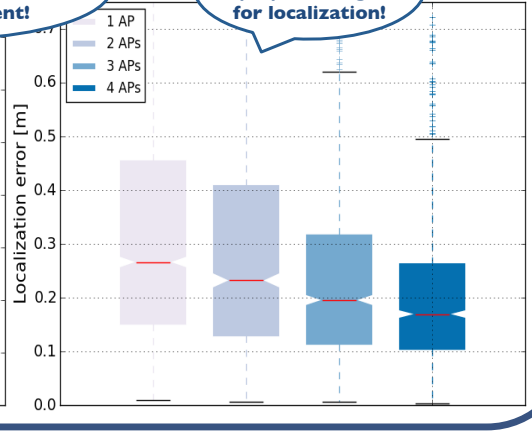
- Combination of ToF and AoA in both LoS and NLoS ➔ high accuracy with a small number of localization anchors;

- **Decimeter level accuracy!**
- **High availability!**

Median accuracy of <15cm in a 25x25m^2 size environment!



Only 1 anchor (AP) is enough for localization!



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