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## Department of Computer Science and Engineering, HKUST


# RIScan: RIS-aided Multi-user Indoor Localization Using COTS Wi-Fi


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## Abstract and Background


**The multi-user indoor localization system is very helpful in many daily scenarios. For instance, in museum, it can provide**

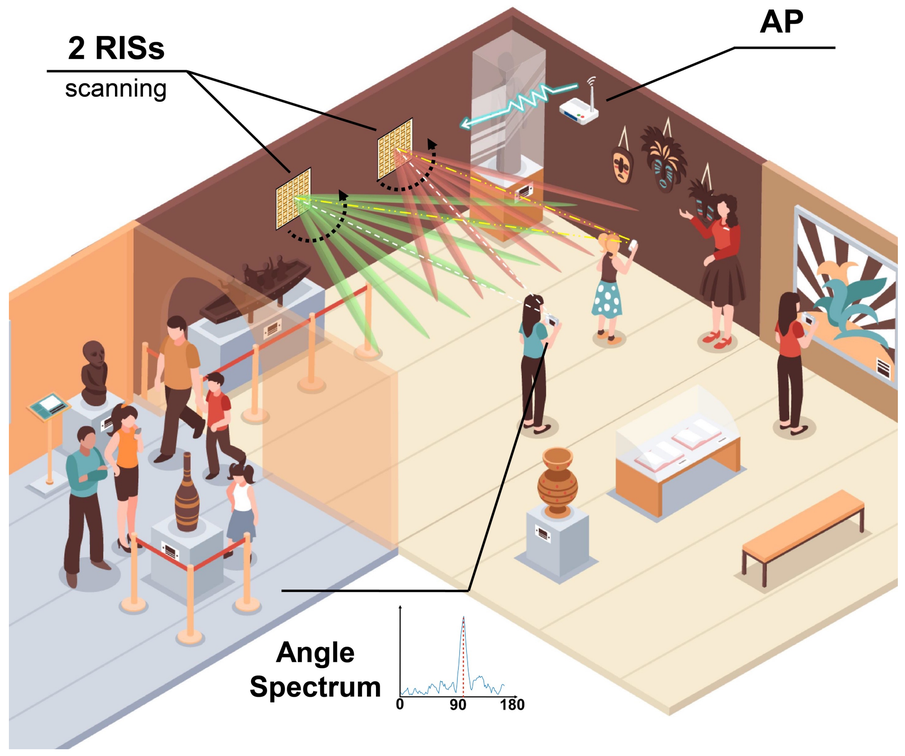
- **Indoor Navigation** help visitors quickly find the exhibits they are interested in
- **Smart interaction with showcases** automatically display the introduction of exhibits when they walk close

**A practical multi-user localization system should meet the following two essential requirements which state-of-the-art systems cannot satisfy with at the same time**

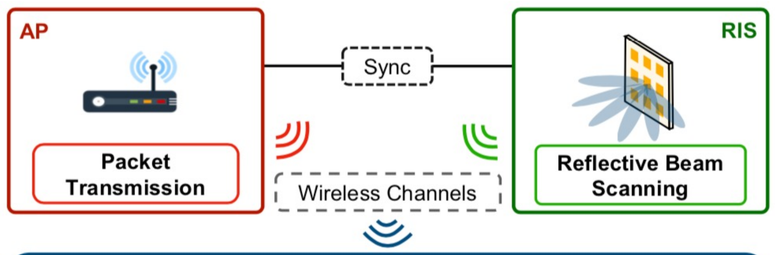
- **Low localization latency** for each client
- **High robustness** to dynamic interference from surrounding people

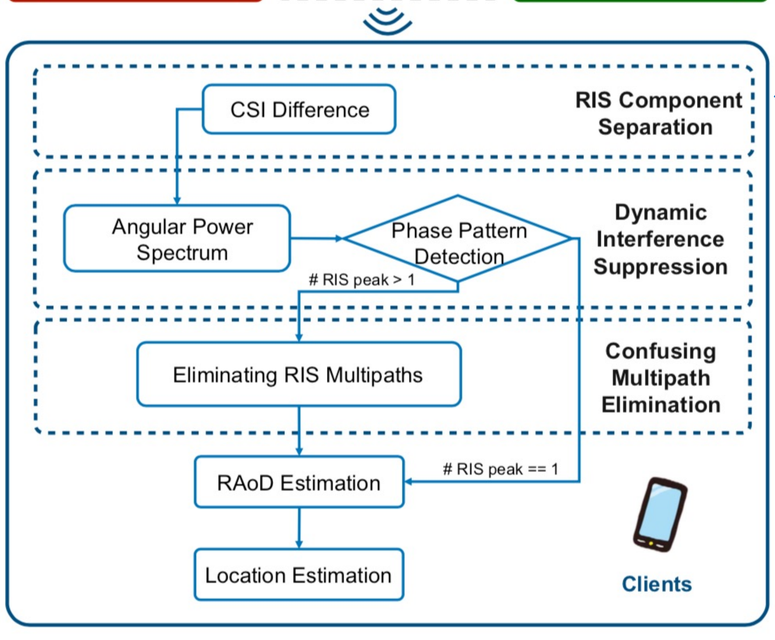
**We propose RIScan, a parallel multi-user indoor localization system with a pair of Reconfigurable Intelligent Surfaces (RIS). We achieve it by**

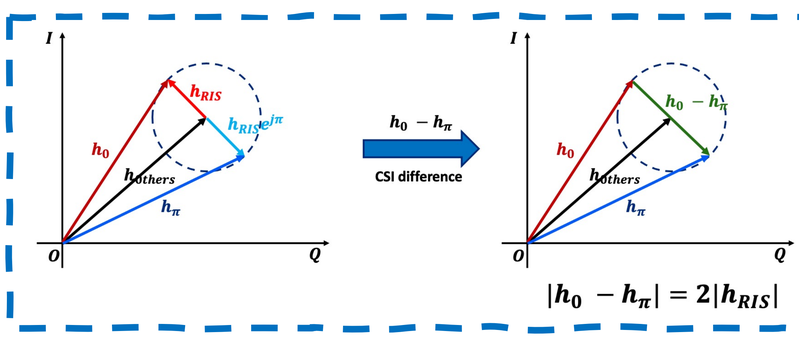
- Leverage RIS to perform **Wi-Fi beam scanning** to let all clients obtain their RIS angle of departure (RAoD) in a single scan simultaneously
- Combine the direction estimation results from two RIS anchors and get the position with **triangulation**

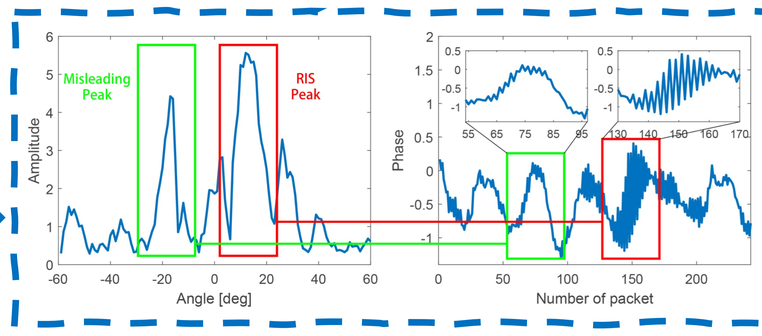

## System Overview and Key Design Highlights



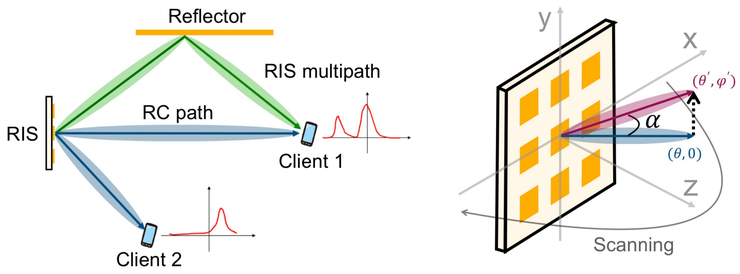




- To separate RIS component from overall channel state information
- Set **a phase constant of pi to RIS component**
- **Channel difference**

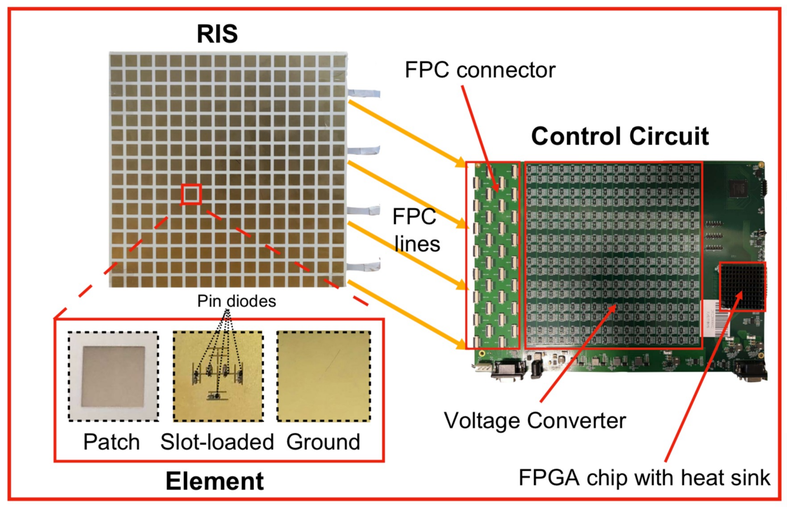


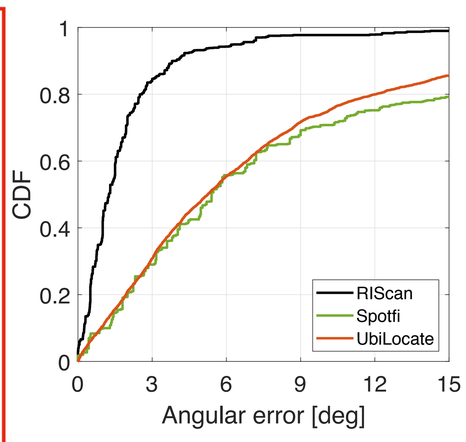

- For drastic CSI change
- Lead to **misleading peaks** in APS
- Use the **oscillating phase pattern of RIS peak**



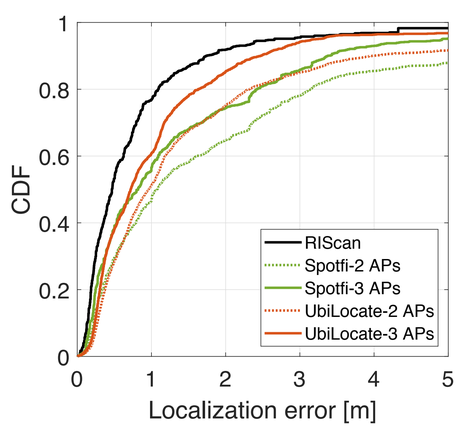

- The RIS multipath produced by some reflectors will cause RAoD error
- **The RIS multipath is fragile**
- Sightly change **the pitch angle of the RIS beam**

## Implementation and Experimental Results

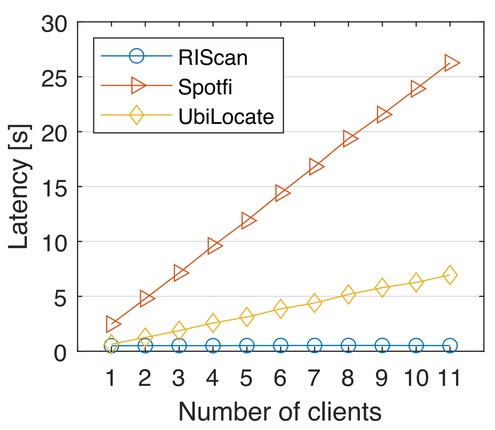



**The median angular error of RIScan is 1.3 degree**




**The median localization error of RIScan is 47cm**




**RIScan has the same localization latency of 544ms for each client**

## Our Related Publications


Li, C., Huang, Q., Zhou, Y., Huang, Y., Hu, Q., Chen, H., & Zhang, Q. (2023, November). RIScan: RIS-aided Multi-user Indoor Localization Using COTS Wi-Fi. In ***Proceedings of the 21st ACM Conference on Embedded Networked Sensor Systems*** (pp. 445-458).



### Acknowledgment

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