

## **Session 7: Towards NextG Wireless and Cellular Systems**

*Transcribed by: M. Taimoor Tariq, Ammar Tahir (UIUC)*

### **Towards Dual-band Reconfigurable Metamaterial Surfaces for Satellite Networking**

*Kun Woo Cho, Yasaman Ghasempour, Kyle Jamieson (Princeton University)*

Author presents Wall-E a dual band electronically configurable smart surface that can allow dynamic beamforming between mobile devices. This helps improve performance and reliability of wireless systems.

#### **Questions:**

- 1. The frequency difference is so high, so when you place your device in a different**

We run optimizations where there are defined phase distributions for uplink downlink.

- 2. Can you compare with the status quo of using dish antennas along with wifi routers?**

Antenna at the receiving side is very high gain, our system can serve users inside and outside the building.

- 3. Do the limitations you discuss apply to the whole frequency spectrum or just in the 10-15 GHz?**

We have focused on Ku radio frequency bands. But because of variations, I am not sure if we will be able to scale beyond 70 Ghz.

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### **Bringing WiFi Localization to Any WiFi Devices**

*Tianxiang Li, Haofan Lu, Reza Rezvani (UCLA); Ali Abedi (University of Waterloo); Omid Abari (UCLA)*

Use FSA along with a probing channel to find direction to localize devices with a single transceiver chain.

#### **Questions:**

- 1. Will this affect normal functioning of AP?**

We are still investigating. FSA can have an effect on normal functioning because frequency depending on direction can affect performance of target device..

- 2. How does it move for moving targets given the probe rate?**

Mobility is a big issue and the probing rate is at 10 seconds so it may not work well but we are exploring other ideas such as different sub channels instead of different carriers. In that case we will not need to probe.

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### **Boosting the Sensing Granularity of Acoustic Signals by Exploiting Hardware Non-linearity**

*Xiangru Chen (Duke University); Dong Li (University of Massachusetts Amherst); Yiran Chen (Duke University); Jie Xiong (University of Massachusetts Amherst)*

Use non-linearity of the microphone to improve the performance of sensing granularity (upto 15-20 cm) using acoustic signals.

**Questions:**

**1. Can you just identify just amplitude or more than that (e.g. speed of vibration)?**

Our system has measurement granularity of sub-mm, so we can achieve very fine grained movements. It doesn't have to be continuously vibrating.

**2. How can you refine the limit of this approach?**

The BW we use for this work is the resolution for resolving multiple targets. The working range for our system is 20 cm so we assume that in this work we have a shorter range. E.g. for our work if we use 20 Khz transmission signal, the

**3. You are creating inter modulation so you should be careful there is not an object of higher frequency in the modulation**

That's true

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**Trust-free Service Measurement and Payments for Decentralized Cellular Networks**

*S.V.R. Anand (Kaleidoscope Blockchain Inc.); Serhat Arslan (Stanford University); Rajat Chopra (Kaleidoscope Blockchain Inc.); Sachin Katti (Stanford University); Milind Kumar Vaddiraju (Banyan Intelligence); Ranvir Rana (Kaleidoscope Blockchain Inc.); Peiyao Sheng (Kaleidoscope Blockchain Inc.); Himanshu Tyagi (Indian Institute of Science and Kaleidoscope Blockchain Inc.); Pramod Viswanath (Kaleidoscope Blockchain Inc.)*

If the payment might ask for throughput for shorter periods of time and might be better for them, but if your application is not working well with burstier workloads, then they can always try to change the service they have negotiated. The system allows negotiation and allocation at very fine granularity.

**Questions:**

**1. How does the user top-up their wallet? What is user interaction with core?**

You can have an application on the phone.

**2. Would existing carriers want to use this as well?**

Since no single carrier can have full coverage in the US, carriers would be interested in deploying this to improve their service.

**3. What necessitates the use of Blockchain? Is it trust between the user and the service provider? Is the service provider so evil that the user needs a distributed ledger?**

When there is a payment involved, we need to avoid double spending. A simple credit card company could handle that but given the dynamic nature of the system, with

contracts happening every minutes, every hour, that motivates us to eliminate the need for a centralized third party.

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### **End of Session Discussion**

**1. Initial directions of privacy?**

On the blockchain, you cannot actually track when a user sent payment and for which service. This gives a certain sense of privacy.

**2. If we don't know target device because of MAC addresses randomization, its meaningless,**

The target device always probes with a fixed, even random address.

**3. There are 11 channels in the 2.4GHz band, are they enough?**

We can do interpolation between two channels e.g. if channel 11 is higher and channel 10 is lower, we can interpolate device's direction somewhere between corresponding angles.

**4. Penalty due to soft handovers between satellites in Wall-E?**

Since there are many more configurations in Wall-E and you need to do beam alignment again in Wall-E. But for this, you can use multiple beams to do beam alignment asynchronously.

**5. On the internet today there is some sort of contract, when you look at Helium, it doesn't make any guarantees on performance. When I connect with one of these micro cellular networks, I send data and the network claims it's delivered. What proof do I have that the network actually did its job**

The micro payments and the micro SLAs allow us to evaluate the performance of the network. I evaluate the end to end throughput and cancel the payment if i don't get the downlink throughput i was expecting.

**6. Difference between this and Helium?**

When I sign the consumer contract, we do not explicitly define a performance requirement but only start sending payments based on the service I receive. As long as I send enough money to the bridge, I will keep sending the money. When my performance isn't met, I will stop and cancel the contract.

**7. What applications are you envisioning for Acoustic sensing applications considering the small distance?**

Sensing range is 15-20 cm. Range is very limited due to path attenuation as well as non linearity aspect. We can detect the vibration of machines to detect faults, etc.