

Exploiting Multi-Path for Safeguarding Wireless Communication Systems Against Randomly Located Eavesdroppers

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[1] Shu Sun, T. Rappapport, R. W. Heath, Jr., A. Nix, and S. Rangan, `` MIMO for Millimeter Wave Wireless Communications: Beamforming, Spatial Multiplexing, or Both?," IEEE Communications Magazine, December 2014.
 [2] S. Zihir, O. Gurbuz, A. Karroy, S. Raman, and G. Rebeiz, "A 60 GHz 64-element wafer-scale phased-array gith full-reticle design," in Microwave Symposium (IMS), 2015 IEEE MTT-S International, vol., no., pp.1-3, 27-20 May 2015.





Physical layer encryption

Tx uses multiple antennas to degrade eavesdropper's channel

Does not rely on upperlayer data encryption or secret keys

PHY LAYER SECURITY

LIMITATIONS

Traditional PHY encryption not suitable for mmWave systems (hardware limitations)

Recent mmWave PHY techniques are not suitable for mainlobe security



Typical communication model





Enhancing Secrecy with random path selection





Enhancing secrecy with joint path and antenna selection

M antennas co-phased to transmit along the strongest path Remaining antennas cophased to transmit along a random path This induces noise-like signals at an arbitrary eavesdropper





Performance evaluation

<u>Setup</u>

- A transmitter (Tx) with a single RF chain is communicating to a single antenna receiver (Rx) via L/NLoS links.
- Strongest path is along AoD 40 degrees.
- Eavesdropper is located along AoD 40 degrees.

Assumptions

- Tx is equipped with ULA with half wavelength separation and N=32 antennas.
- Tx and Rx have perfect knowledge of their channels and path/antenna selection sequence.
- Tx and Rx are not aware of eavesdropper presence.

Secrecy Rate

$$R = [\log_2(1 + SNR_R) - \log_2(1 + SNR_E)]^+$$

$$SNR \text{ at } SNR \text{ at } eavesdropper}$$



different number of transmission paths



Conclusions

Address the problem of overlapped communication channel paths between the receiver and eavesdropper

Proposed two transmission techniques that enhanced the security of mmWave systems with NLoS channels

Proposed techniques enhance secrecy by employing path and antenna selection to jam potential eavesdroppers.

Proposed techniques require the number of paths L>1. For single path, LoS link, the proposed techniques can not safeguard against eavesdropping.



<u>Questions</u>

Please forward all questions/comments to the authors

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