# WARP) WIRELESS OPEN-ACCESS RESEARCH PLATFORM — RICE UNIVERSITY ARGOS
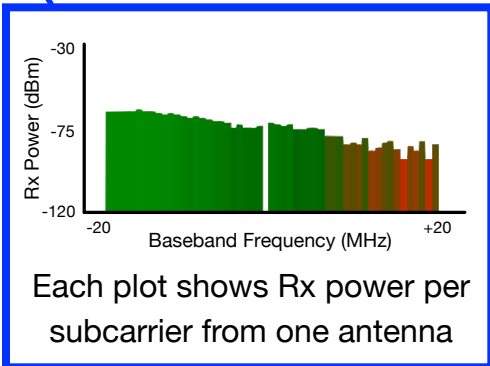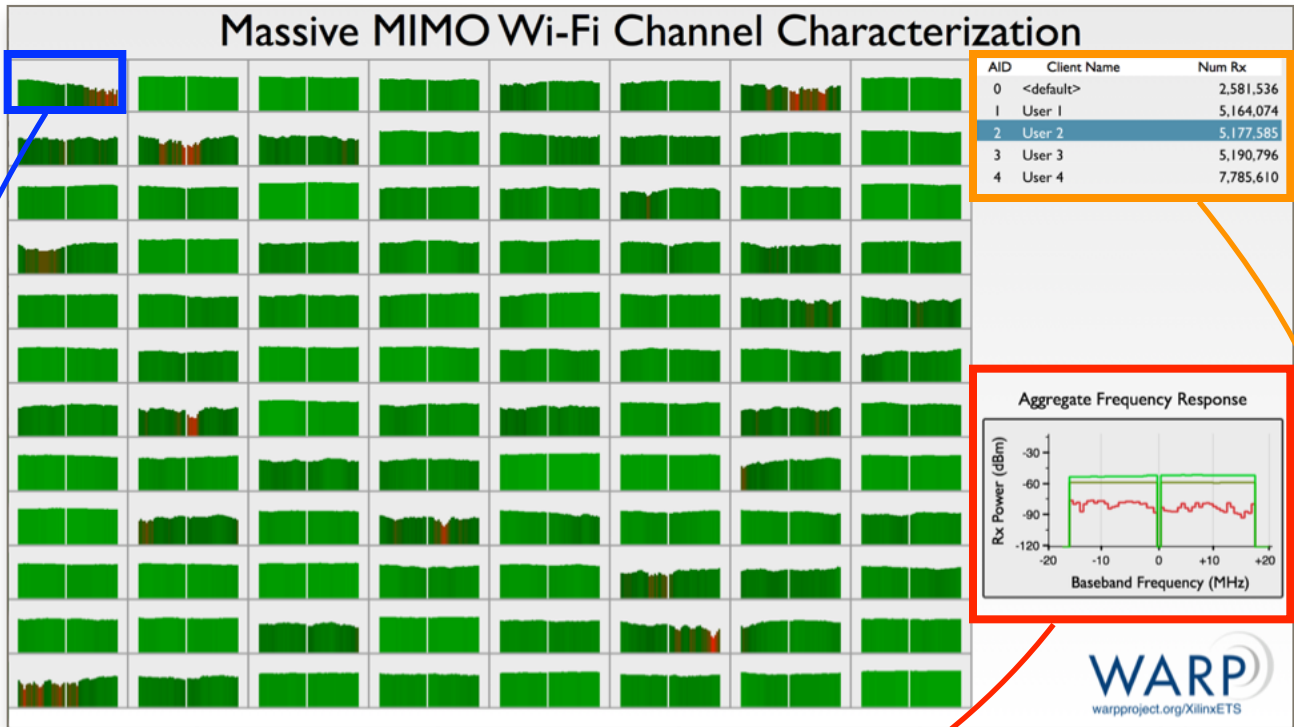
- The Wireless Open-Access Research Platform enables prototyping of high performance wireless systems
- The Rice University Argos project uses WARP to study practical massive MIMO techniques
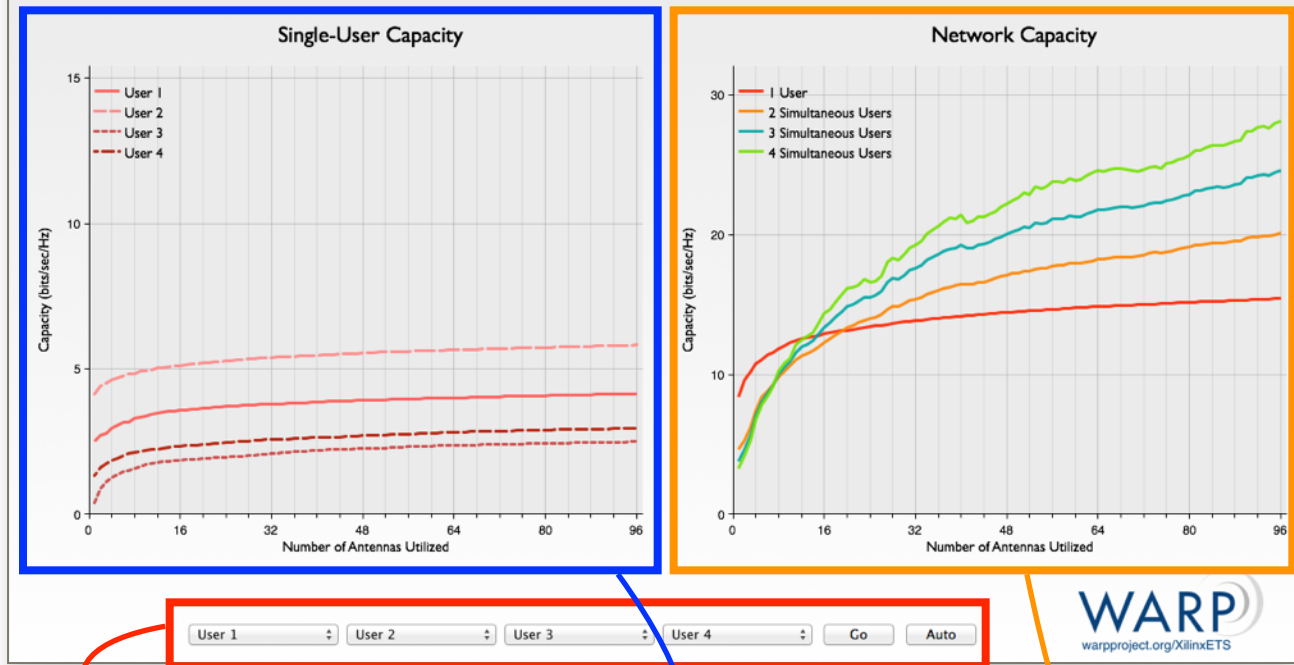
## Demonstration Description

- Massive MIMO is an emerging technology for significantly improving capacity in wireless networks
- Theory predicts huge gains – achievable gains depend on actual wireless channel characteristics
- We use an array of custom FPGA-based Wi-Fi receivers to analyze wireless channels in real-time



**Massive MIMO Wi-Fi Channel Characterization**

| AID | Client Name | Num Rx |
|---|---|---|
| 0 | <default> | 2,581,536 |
| 1 | User 1 | 5,164,074 |
| 2 | User 2 | 5,177,585 |
| 3 | User 3 | 5,190,796 |
| 4 | User 4 | 7,785,610 |

Aggregate Frequency Response

Each plot shows Rx power per subcarrier from one antenna

Aggregate plot shows max/mean/min subcarrier power across antennas

Table of currently associated Wi-Fi clients with number of channel observations

## Demonstration Resources

- **WARP v3 Nodes:**
  - Xilinx Virtex-6 LX240T FPGA
  - Dual programmable 2.4/5GHz RF interfaces
  - Dual-RF FMC module (FMC-RF-2X245) for quad-antenna configuration
- **Rice Argos Array:**
  - 96 RF interfaces (24 WARP v3 nodes w/ FMC-RF-2X245 modules)
  - Centralized clocking and networking

- **Mango 802.11 Reference Design:**
  - Real-time 802.11 PHY in Xilinx System Generator
  - MAC in dual-MicroBlaze
  - Open-source for WARP users

## More Information

- **Demonstration Details:** http://warpproject.org/XilinxETS
- **Rice University Argos:** http://argos.rice.edu
- **Mango Communications WARP v3 Hardware:** http://mangocomm.com
- **Mango 802.11 Reference Design:** http://mangocomm.com/802.11