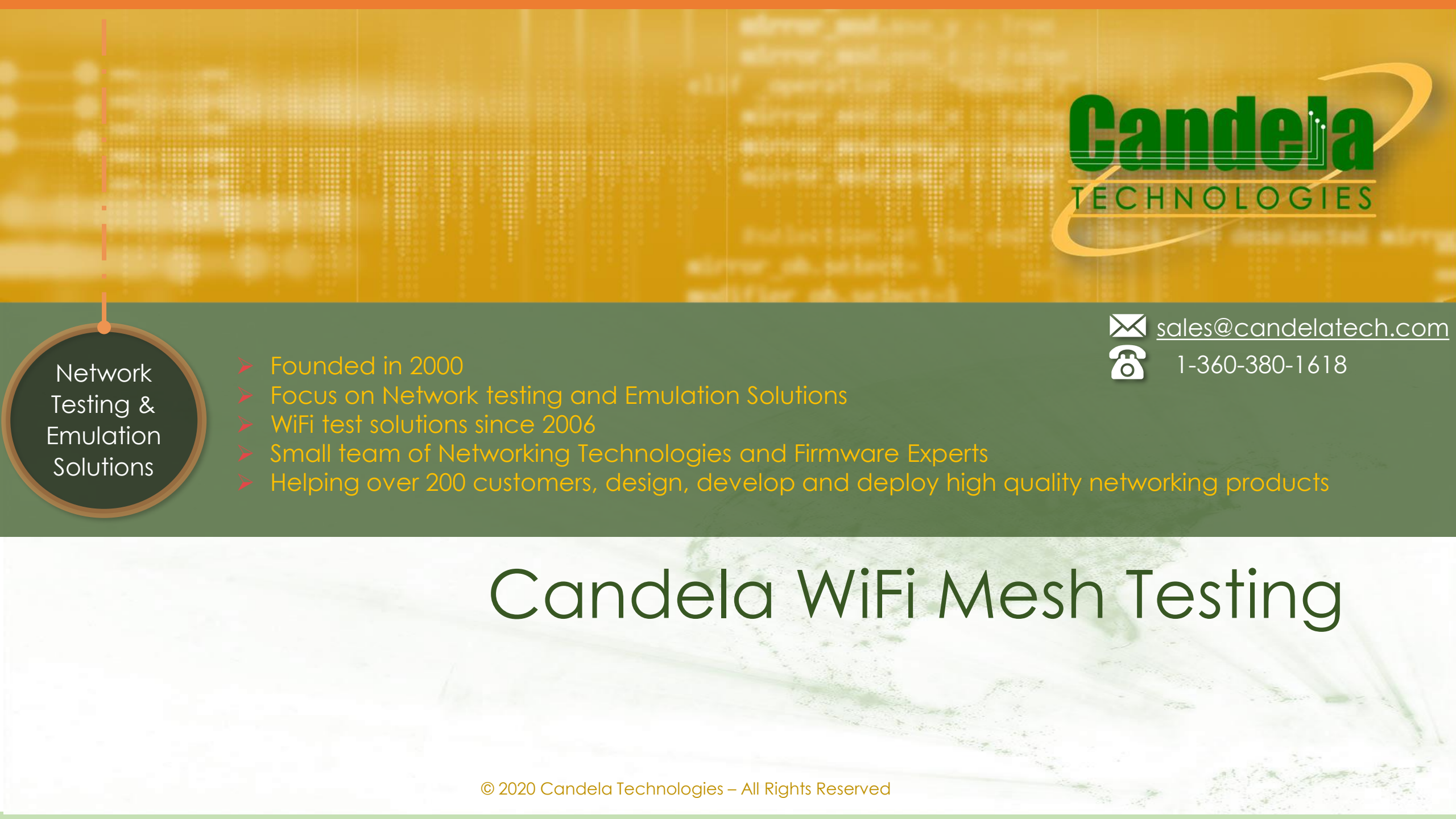

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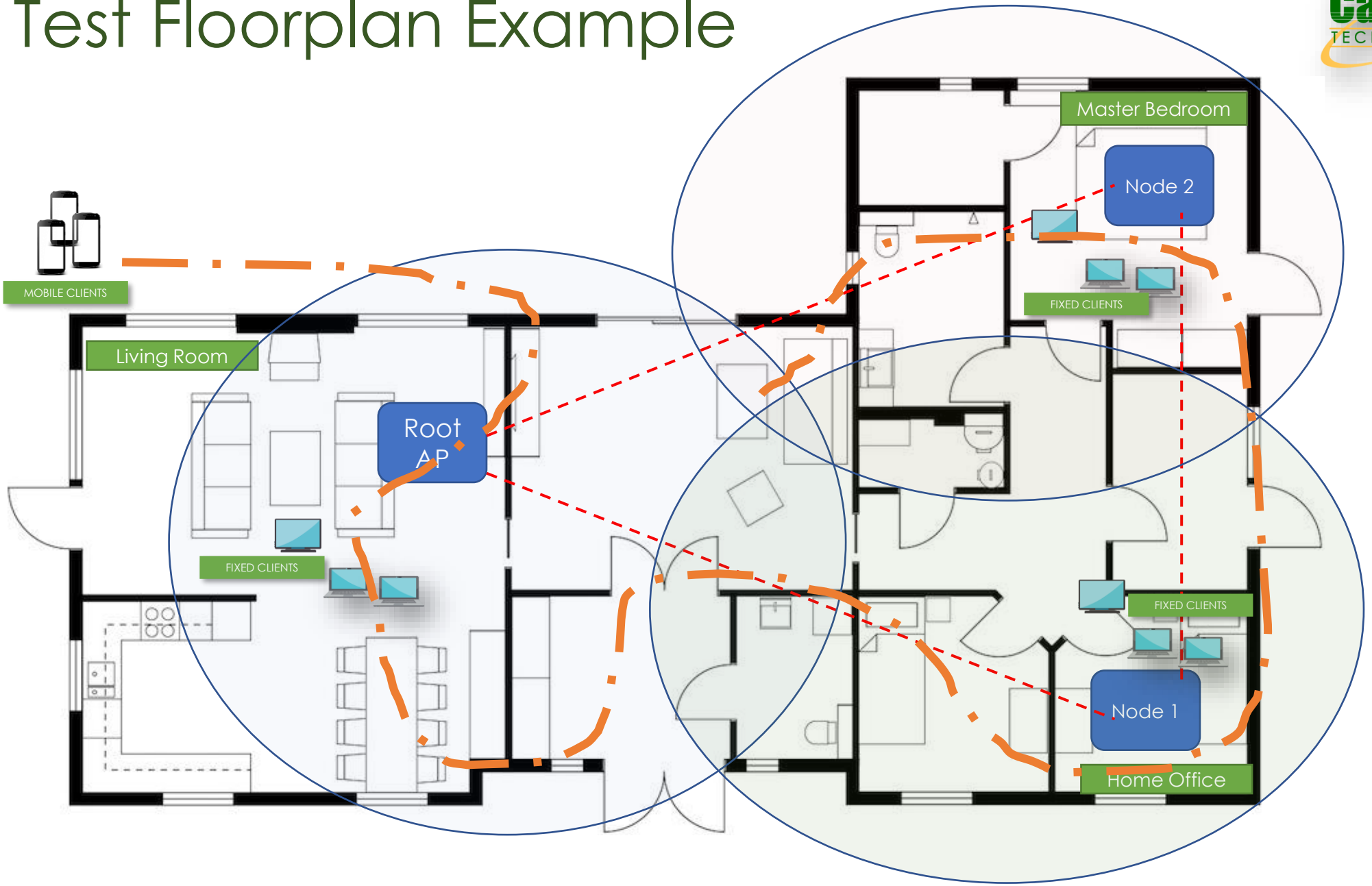
Network Testing & Emulation Solutions

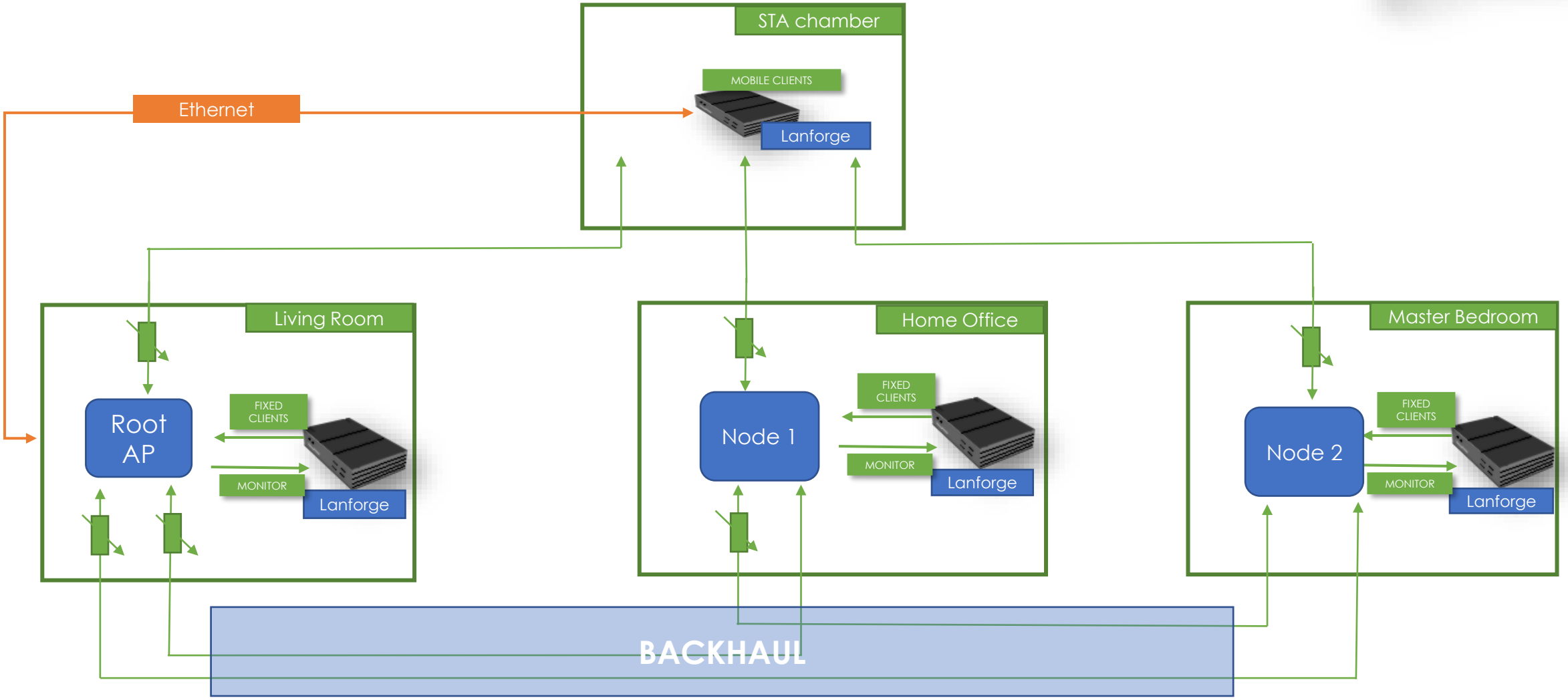
- Founded in 2000
- Focus on Network testing and Emulation Solutions
- WiFi test solutions since 2006
- Small team of Networking Technologies and Firmware Experts
- Helping over 200 customers, design, develop and deploy high quality networking products

Candela WiFi Mesh Testing

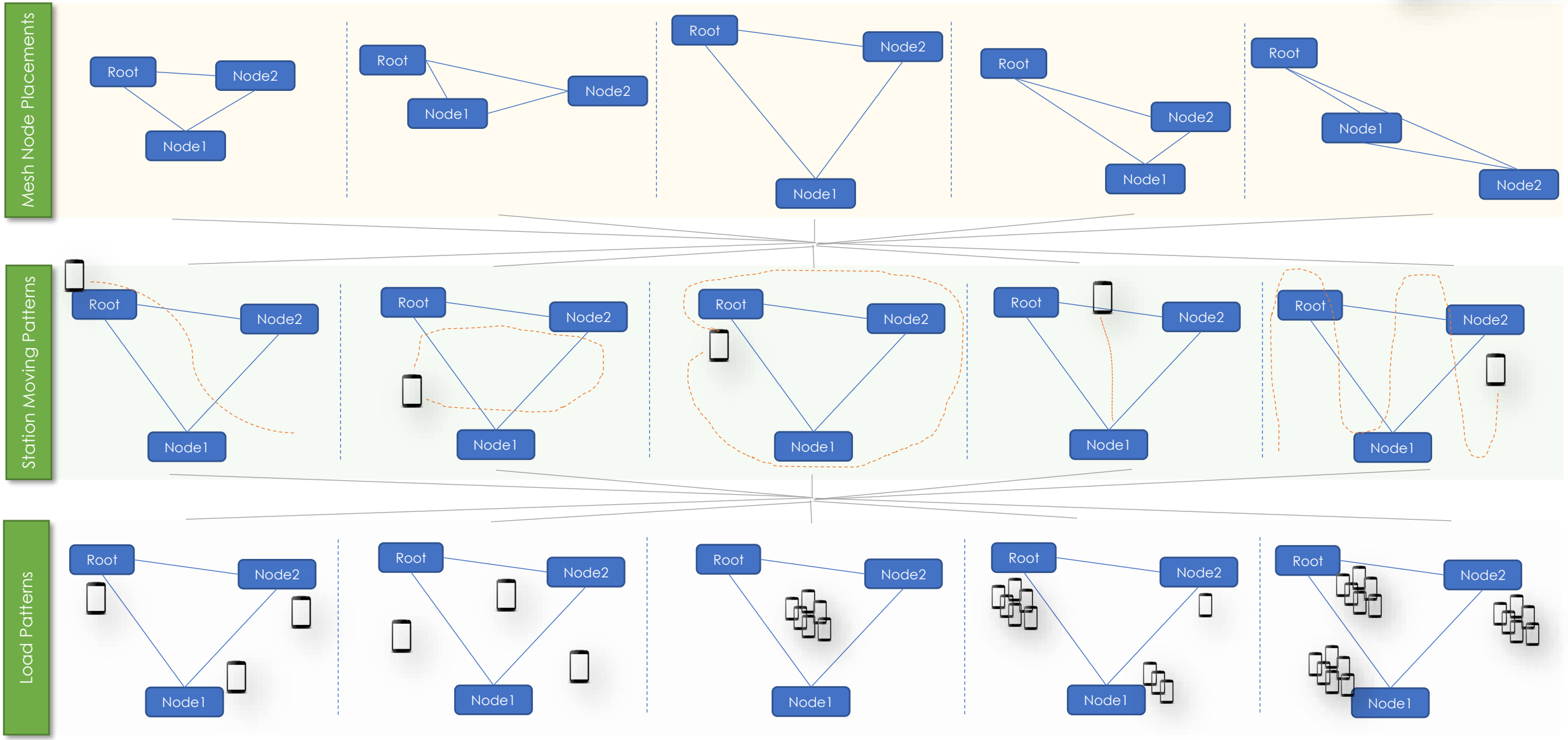
Mesh Test Floorplan Example



3 Node Testbed Example

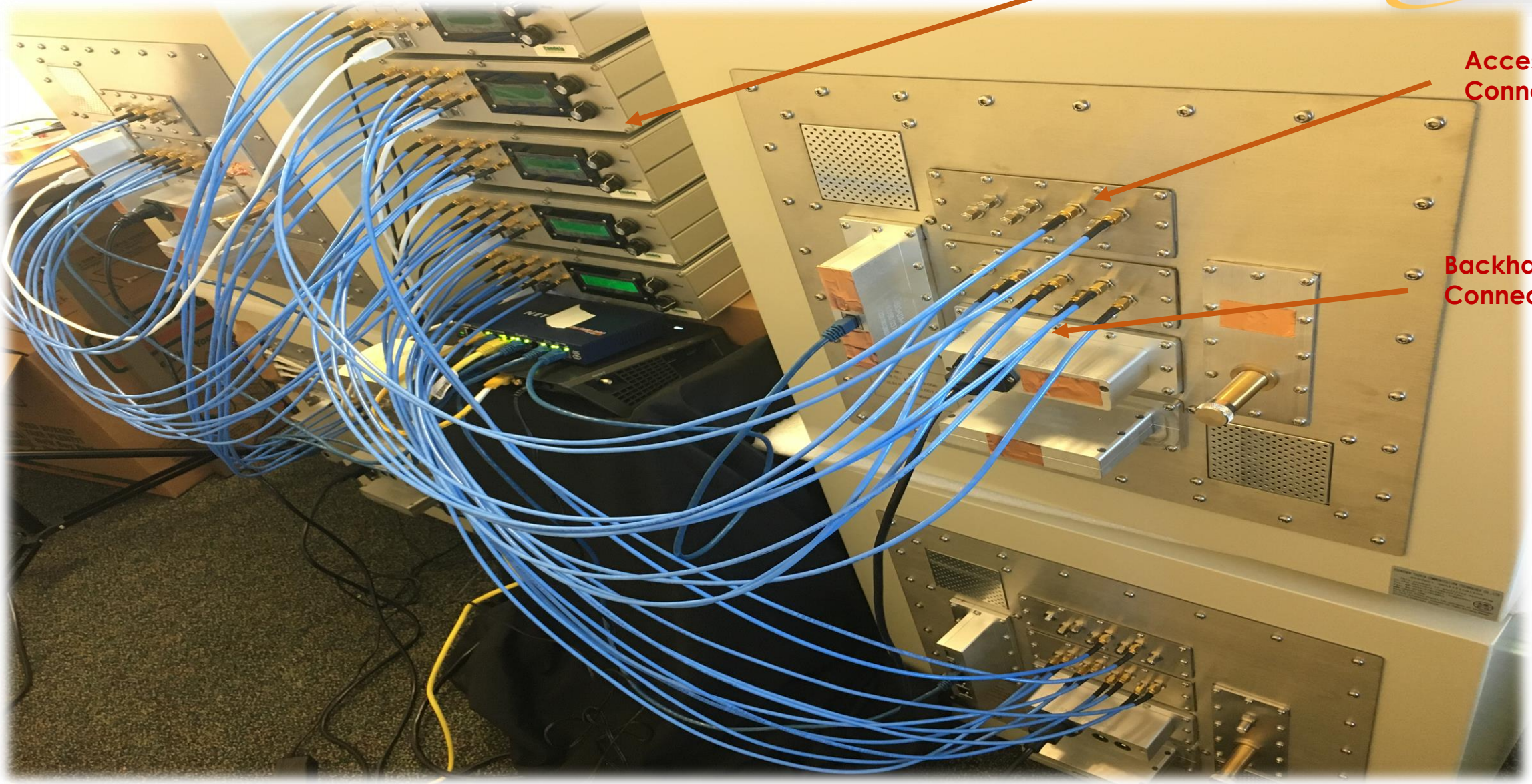


Test Automation Variables



Testbed Picture - Front

Testbed Picture - Back

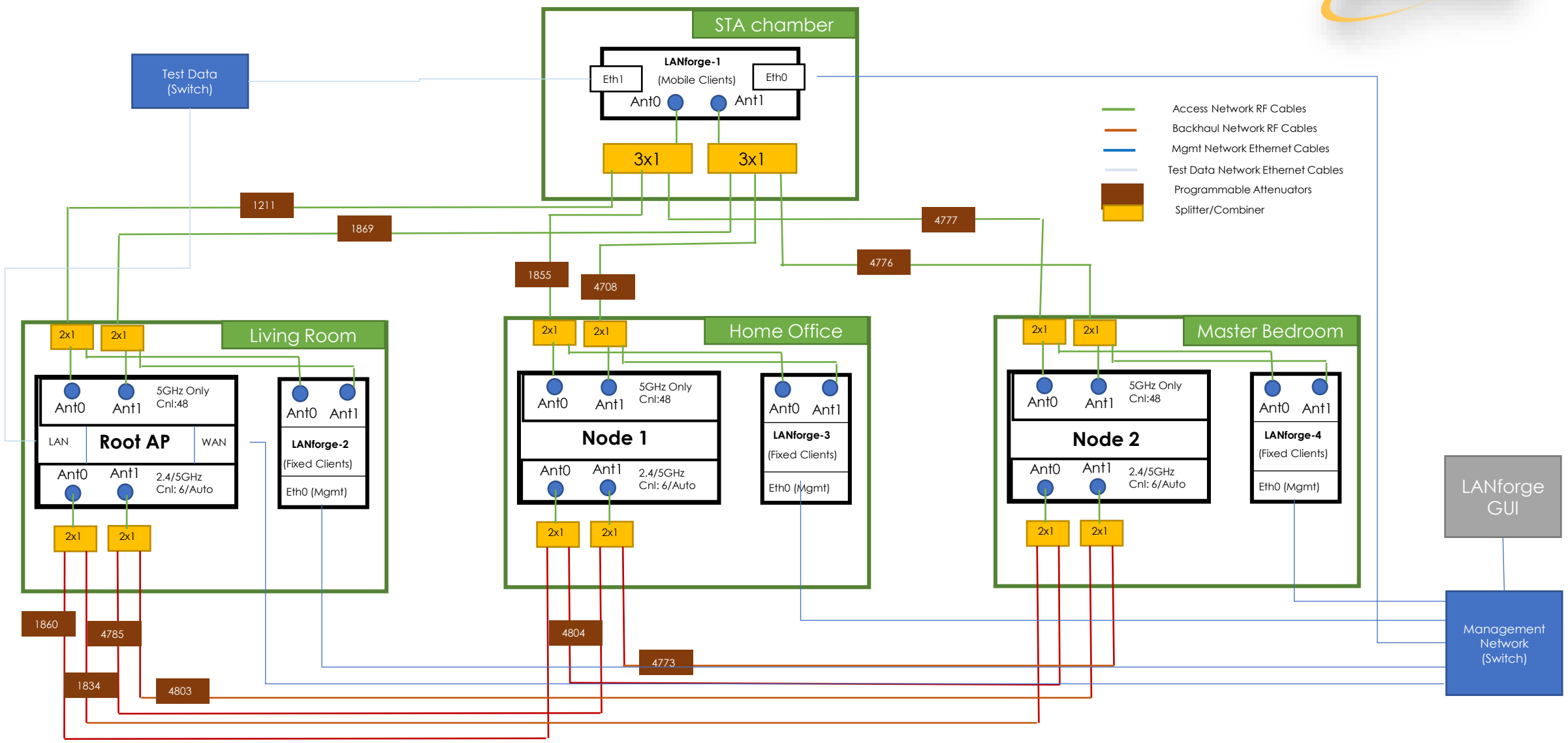


Testbed - Inside

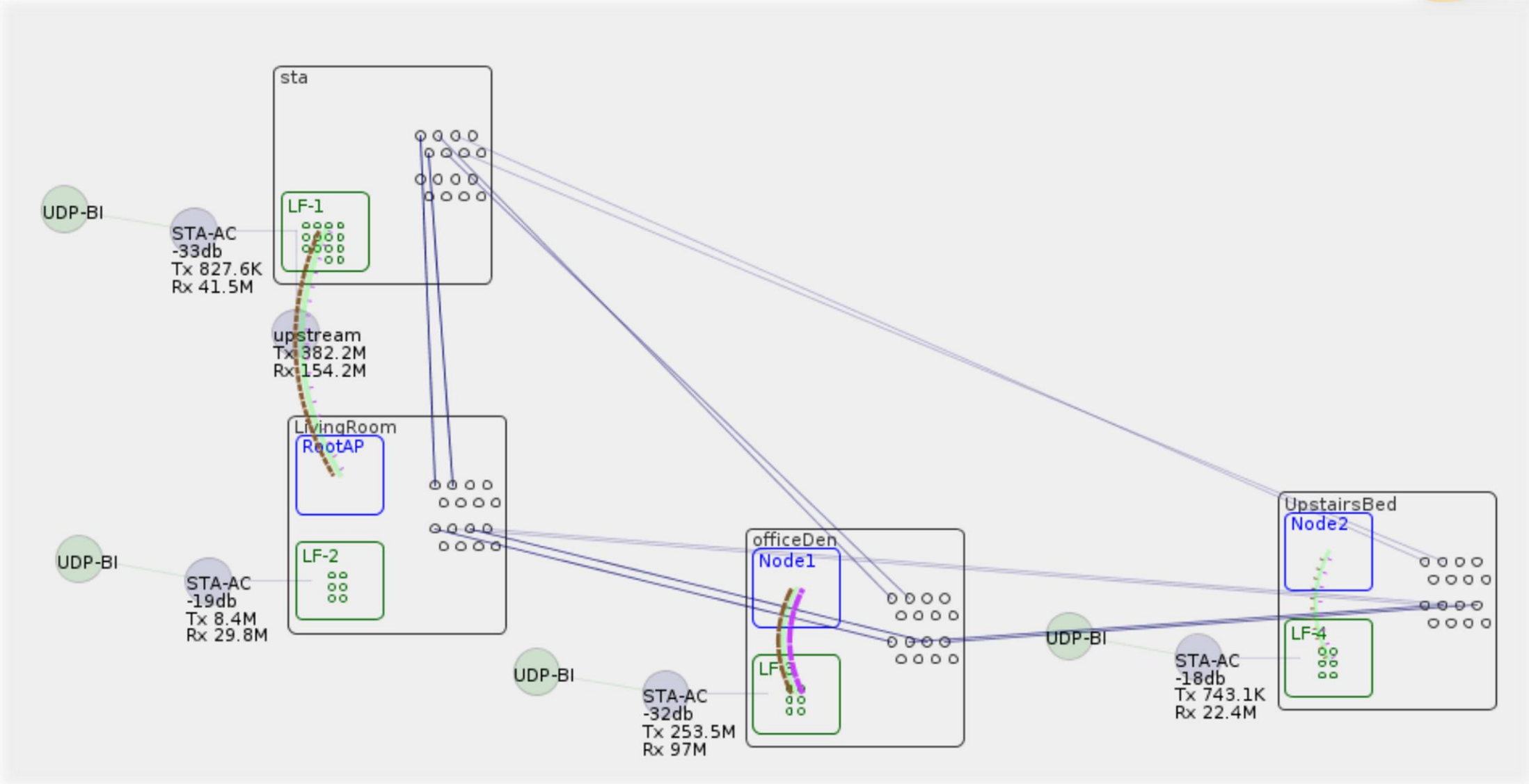
LANforge systems doing Fixed clients, Mobile clients, Background traffic, interference, monitoring, roaming etc…

Mesh AP Nodes under Test

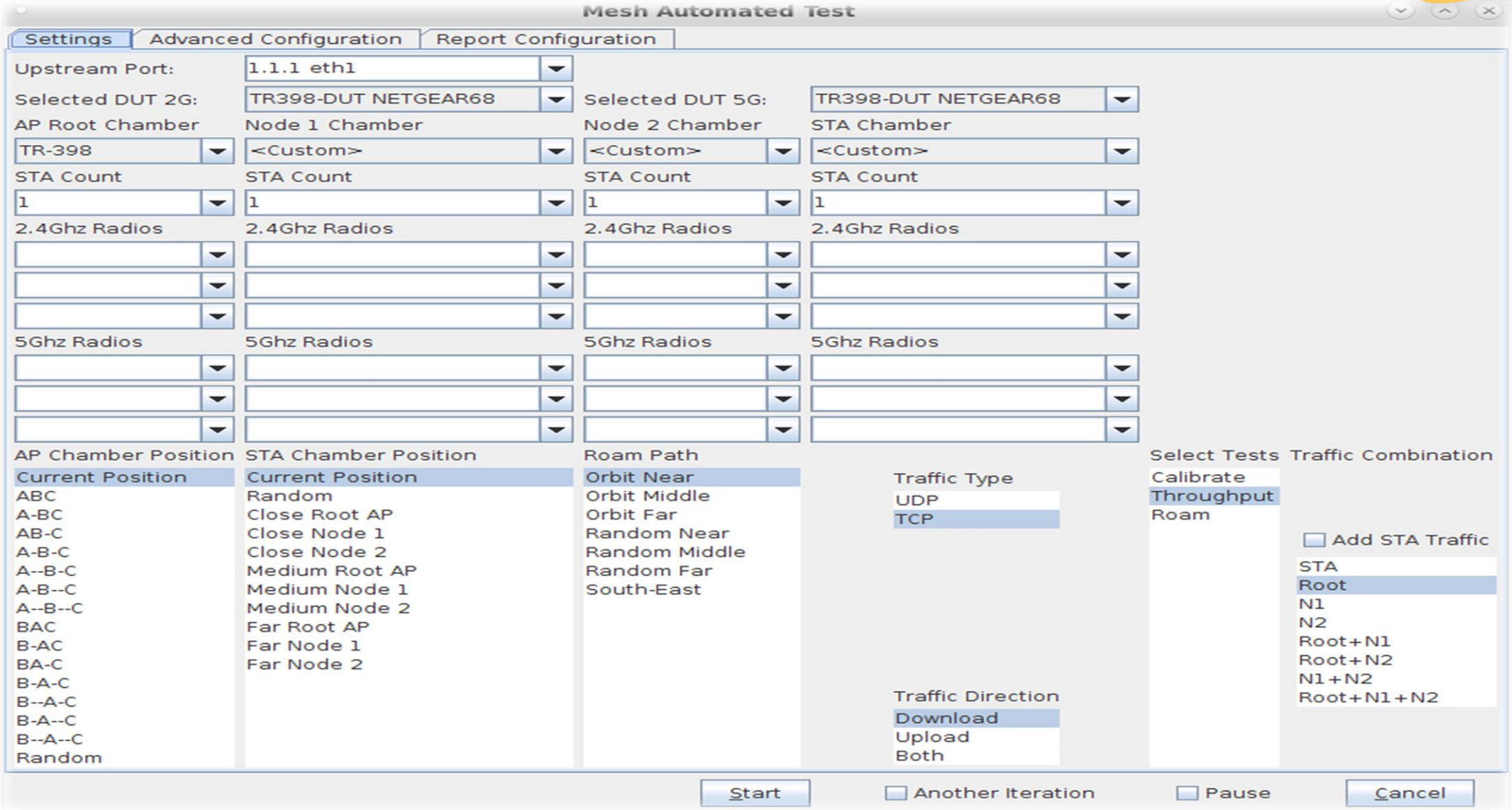
More Detailed Testbed Diagram Example (2x2 MIMO/ Triband/ Root + 2 Node Config)



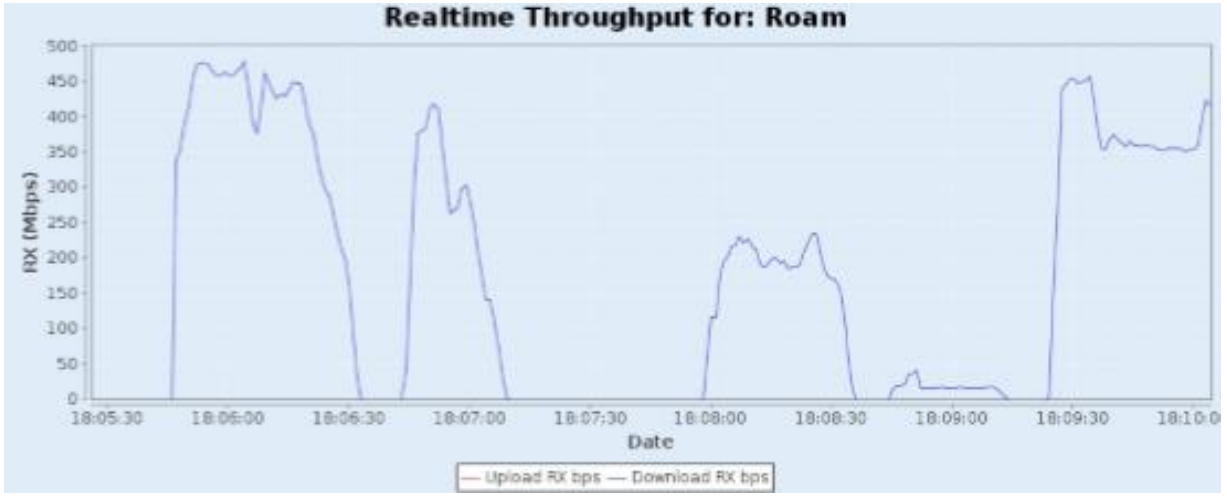
LANforge Chamber View

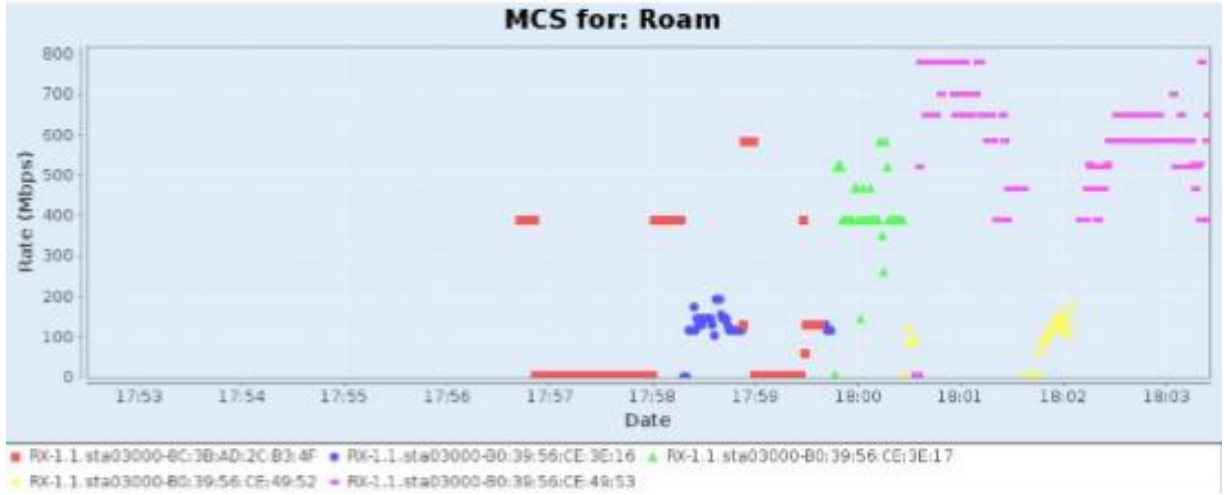


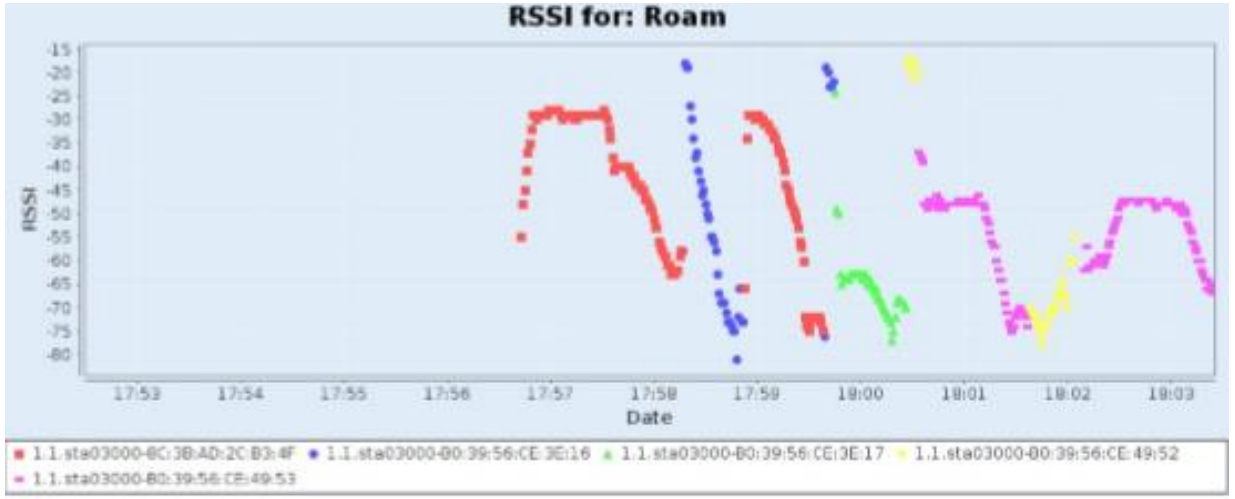
Mesh Automated Test GUI Settings

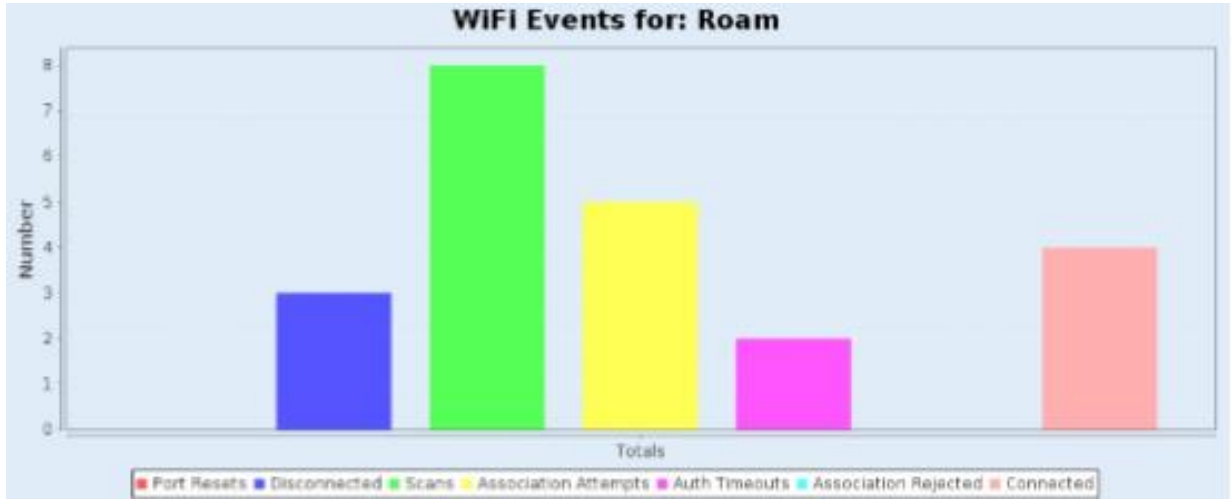


Mesh Roam Test Results









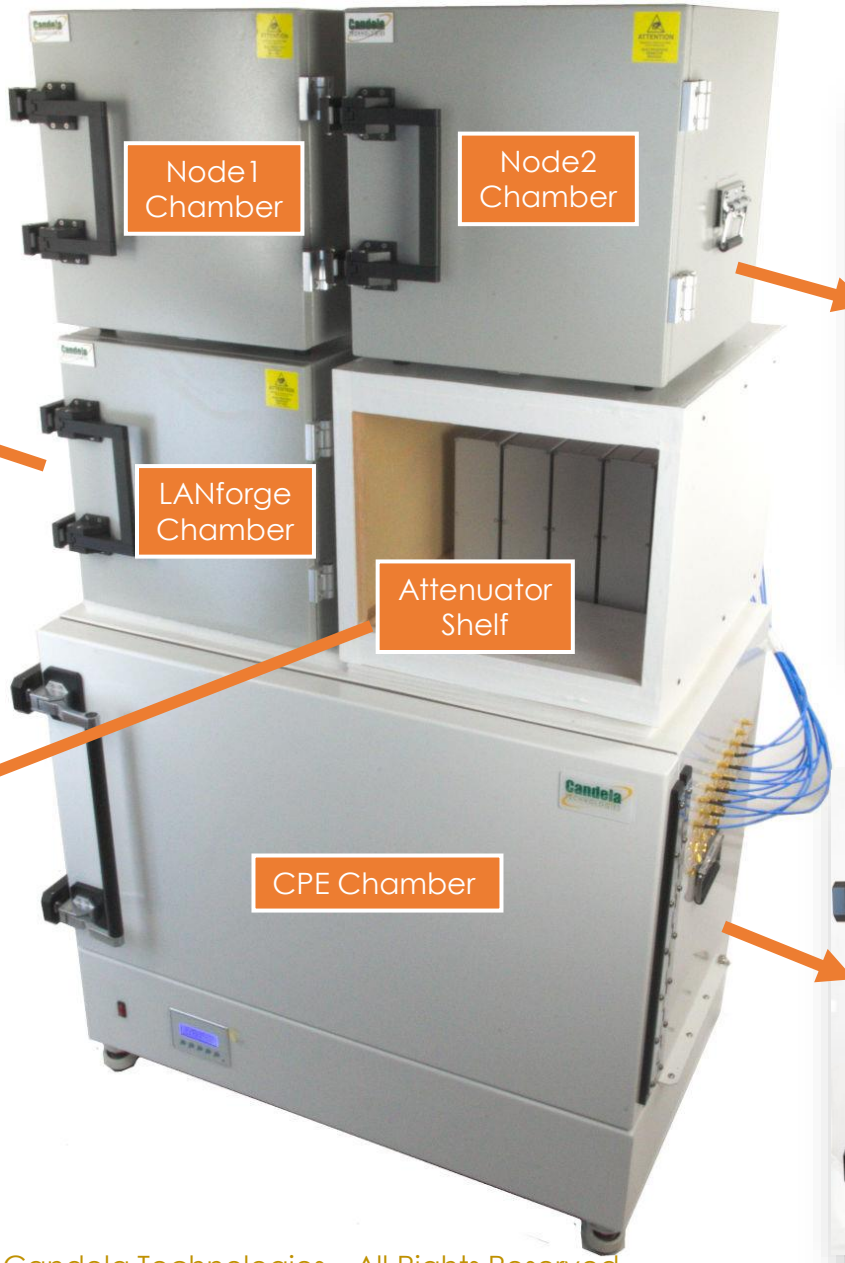
Testbed Building Blocks

- ✓RF enclosures
- ✓Programmable Attenuators
- ✓RF & Ethernet Cables
- ✓Splitters/Combiners
- ✓LANforge Hardware for Station Emulation
- ✓LANforge-MESH Test Application Software

Key Tests

- ✓ Measure maximum upstream and downstream throughput that can be achieved per each hop in the mesh.
- ✓ Repeat test 1 on different channels, Channel Bandwidths, MIMO types.
- ✓ Measure the maximum number of stations each node in the mesh can handle.
- ✓ Measure the connection times and number of connection drops for the stations for each node in the mesh over time.
- ✓ Repeat 1,2,3 and 4 with different distance settings between the nodes in the mesh.
- ✓ Measure the maximum possible distance between the nodes in the mesh where they can all still maintain connectivity.
- ✓ Test how the mesh backhaul can rate adapt and find the best possible channel in a noisy environment.
- ✓ Force a disconnect on a specific link on the mesh and measure time taken to find the next best path in the mesh.
- ✓ Create different levels of co-channel and adjacent channel interference and measure overall performance.
- ✓ Run performance test with different mixes of voice, video and data traffic and measure quality of experience.
- ✓ Repeat tests 1 through 10 with different security types (Open, WPA-PSK, WPA-Enterprise)
- ✓ Test load balancing and band steering capabilities of the nodes in the mesh by creating different amounts of stations and traffic loads on different nodes in the mesh.
- ✓ Test handoff delays for stations handing off been various nodes in the mesh.
- ✓ Measure roaming performance with different security methods and fast roaming methods and 802.11k/v/r
- ✓ Measure performance over distance for stations connecting to each mesh node.

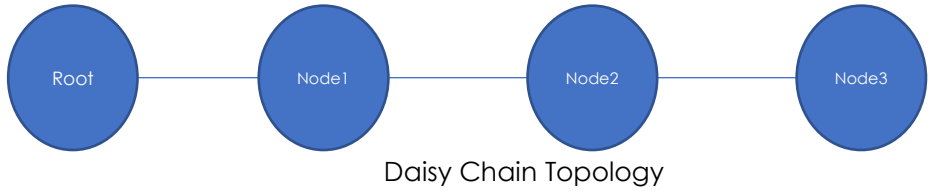
Stacked Chamber Configuration Example (Mesh + TR-398)



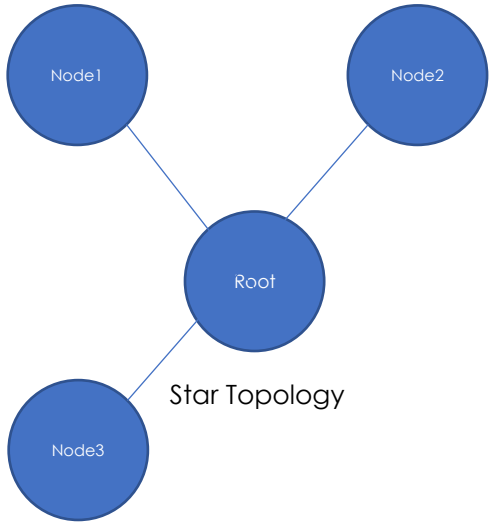
TR-398 + 3-Node Mesh Tested (Cabled)

Every Mesh system is different. In this example the APs are dual-band with 4 antennas on Root AP and 6 Antennas on Extenders

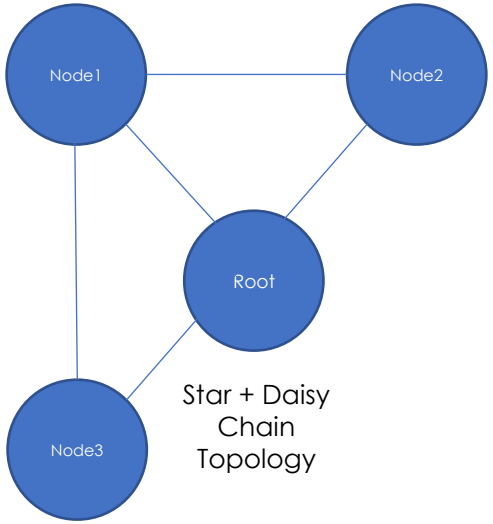
Root + 3 Satellites Topology Examples



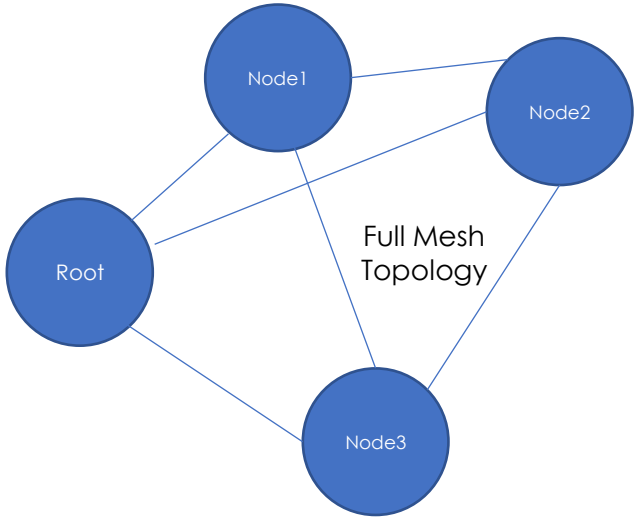
Daisy Chain Topology



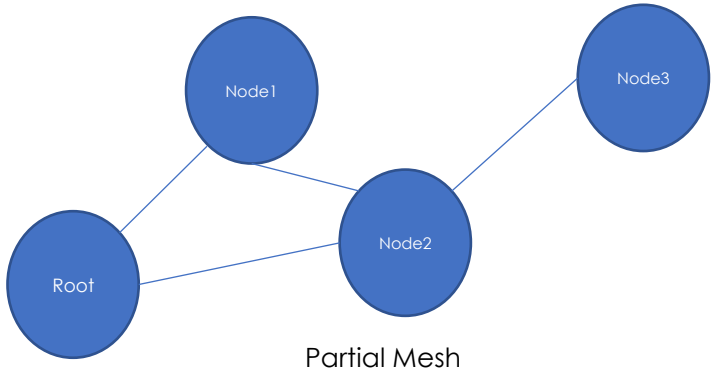
Star Topology



Star + Daisy Chain Topology



Full Mesh Topology



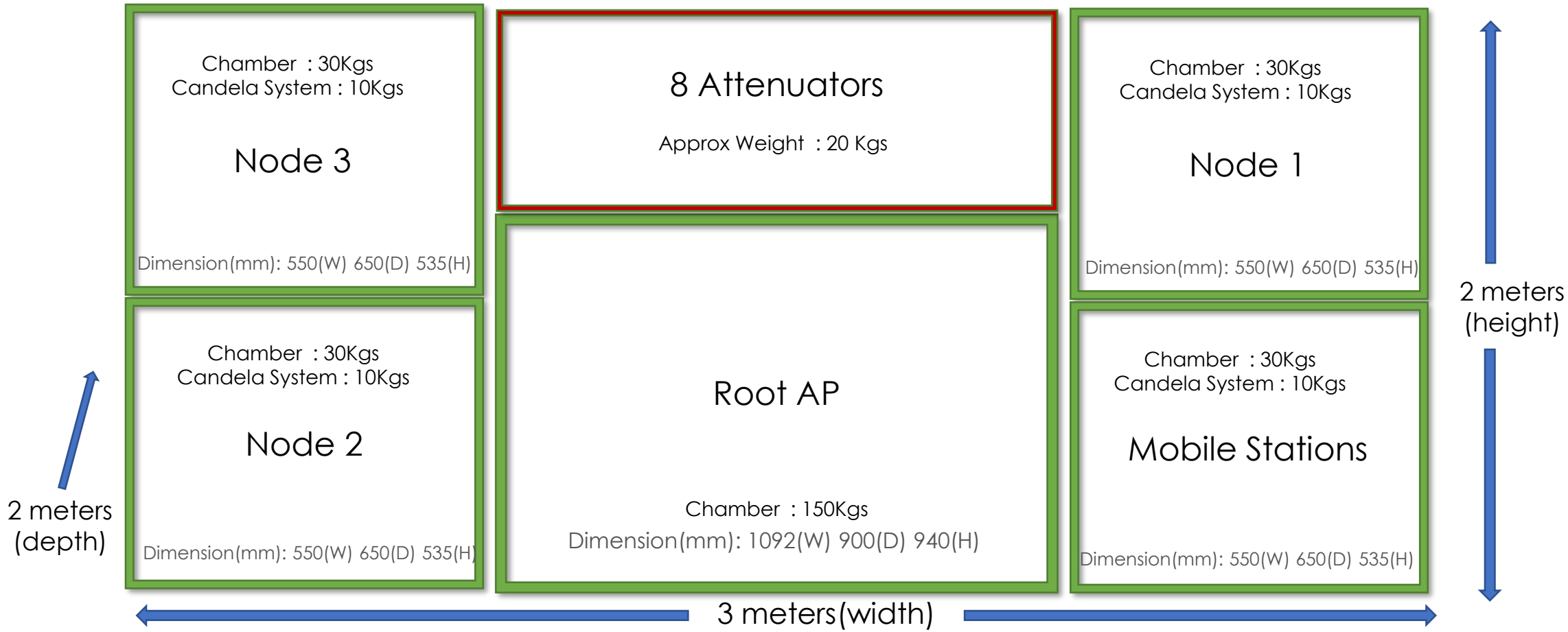
Partial Mesh Topology

TR-398 + Star Topology Tested (Root AP + 3-Nodes)

Total Testbed Approximate Weight : 400 Kgs

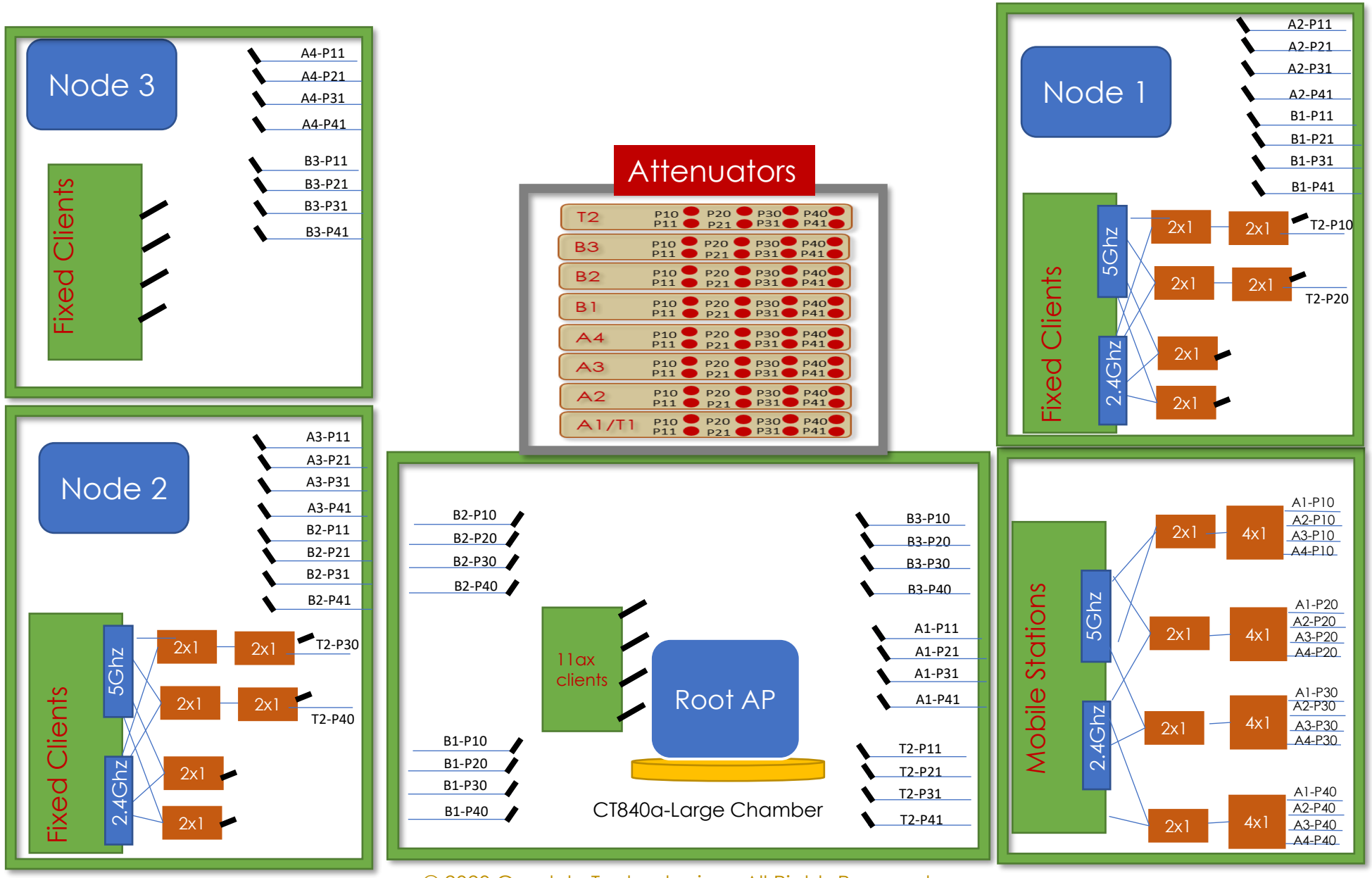
Approx space required : 3 meters (width) x 2 meters (depth) x 2 meters (height)

No special power requirements. Candela units draw power similar to Desktop PCs and chambers draw power for small fans



TR-398 + Star Topology Tested (Root AP + 3-Nodes)

TR-398 + Star Topology Tested (Root AP + 3-Nodes) - OTA



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