Goal
Proving via demonstration that C-RAN more efficiently utilizes computing and communication resources (CPU, RAM, I/O, etc) than a traditional mobile network (RAN) through the concept of virtualization and dynamic allocation of resources [1]

Motivations and Objectives

Motivations
- Current cellular networks are ineffective in dealing with dynamic data demand (e.g., due to the so-called tidal effect [2])
- Ever increasing need for network bandwidth in order to (i) support multimedia traffic and (ii) give access to more and more users
- Reduced power consumption (“towards green comms”) and ease of upgradability to future wireless standards

Objectives
- Develop a testbed using Universal Software Radio Peripheral (USRP) boards in conjunction with OpenBTS to dynamically allocate resources based on traffic utilization
- Compare resource utilization with varying traffic loads between a conventional wireless cellular network architecture (Traditional RAN) and a C-RAN

Research Challenges

• Setting up a base station (BS) in a virtual environment (BS → VBS)
• Methods for generating realistic traffic (voice, data)
• Configuring SIM cards for use with OpenBTS
• Dynamically allocating necessary resources to Virtual Machines (VMs)
• Real-time profiling of the (computing and communication) resources used by the VMs

Acknowledgement
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Methodology

• Configuring GNURadio and the Ettus USRP Hardware Driver (UHD) to enable the USRPs to transmit/receive data
• Dynamically allocating resources to the VBSs through VMware Workstation
• Configuring OpenBTS on the VBSs to create a C-RAN
• Compare power consumption between Traditional and Cloud RAN

Results

Traditional RAN

<table>
<thead>
<tr>
<th>Power Usage</th>
<th>CPU Utilization</th>
<th>Resource Utilization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case 1: 78.75W</td>
<td>77.47%</td>
<td>1.23GB, 2 Threads</td>
</tr>
<tr>
<td>Case 2: 65.06W</td>
<td>10.13%</td>
<td>1.26GB, 2 Threads</td>
</tr>
</tbody>
</table>

C-RAN

<table>
<thead>
<tr>
<th>Power Usage</th>
<th>CPU Utilization</th>
<th>Resource Utilization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case 3: 82.31W</td>
<td>57.04%</td>
<td>1.13GB, 3 Threads</td>
</tr>
<tr>
<td>Case 4: 18.85%</td>
<td>1.12GB, 1 Thread</td>
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</tr>
</tbody>
</table>

In the Traditional RAN 143.81W is consumed, while only 82.31W is consumed in the C-RAN

Preliminary results show potential benefits of deploying a larger C-RAN

Future Work

• Upgrade testbed network from GSM to LTE by switching to OpenAirInterface
• Configure SIM cards to work with OpenAirInterface
• Upgrade VMware Workstation to VMware vSphere for dynamic memory and CPU utilization

References