



Institute for the Wireless Internet of Things

at Northeastern University

Colosseum Batch Experiments

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Batch Mode

- Radio applications and scenarios are controlled automatically by Colosseum
- Containers need to be preconfigured to use the Radio API which will allow Colosseum to control the radio applications
- Containers **do not** have access to the teams' network storage folders
- Containers **are not** accessible by SSH (except for the nodes with node_type set to "bot")
- Batch jobs are inserted in a queue and run when resources are available

Batch Mode

Set-up through configurations files:

- Batch configuration file:
 - Tells Colosseum how to run the experiment
 - Must be saved to the network storage on the File Proxy at
/share/nas/teamname/batch/
- Modem configuration file(s):
 - Passes any additional parameters to the container
 - Parameters need to be handled by user code
 - Must be saved to the network storage on the File Proxy at
/share/nas/teamname/config/

Batch Configuration File

- Name of batch experiment

- Duration of batch experiment

- RF Scenario to run

- Traffic scenario to run

- Mapping of SRNs to nodes in the scenarios

```
1  {
2   "BatchName": "My Test Batch",
3   "Duration": 300,
4   "RFScenario": 6742,
5   "TrafficScenario": 1,
6   "NodeData": [
7     {
8       "RFNode_ID": 1,
9       "ImageName": "modem-image-v1",
10      "ModemConfig": "modem_config_file_1",
11      "isGateway": true,
12      "TrafficNode_ID": 1,
13      "node_type": "competitor"
14    },
15    {
16      "RFNode_ID": 2,
17      "ImageName": "modem-image-v1",
18      "ModemConfig": "modem_config_file_2",
19      "isGateway": false,
20      "TrafficNode_ID": 2,
21      "node_type": "competitor"
22    }
23  ]
24 }
```

Batch Configuration File, cont'd

Mapping of SRNs to nodes in the scenarios:

- **RFNode_ID**: Node in the RF scenario the SRN should be mapped to
- **ImageName**: Container image to load on the SRN
- **ModemConfig**: The location of the modem config file to load

```
1  {
2    "BatchName": "My Test Batch",
3    "Duration": 300,
4    "RFScenario": 6742,
5    "TrafficScenario": 1,
6    "NodeData": [
7      {
8        "RFNode_ID": 1,
9        "ImageName": "modem-image-v1",
10       "ModemConfig": "modem_config_file_1",
11       "isGateway": true,
12       "TrafficNode_ID": 1,
13       "node_type": "competitor"
14     },
15     {
16       "RFNode_ID": 2,
17       "ImageName": "modem-image-v1",
18       "ModemConfig": "modem_config_file_2",
19       "isGateway": false,
20       "TrafficNode_ID": 2,
21       "node_type": "competitor"
22     }
23   ]
24 }
```

Batch Configuration File, cont'd

Mapping of SRNs to nodes in the scenarios:

- **isGateway**: Determines if the collaboration gateway is connected to the node
- **TrafficNode_ID**: Node in the traffic scenario this SRN should be mapped to

```
1  {
2    "BatchName": "My Test Batch",
3    "Duration": 300,
4    "RFScenario": 6742,
5    "TrafficScenario": 1,
6    "NodeData": [
7      {
8        "RFNode_ID": 1,
9        "ImageName": "modem-image-v1",
10       "ModemConfig": "modem_config_file_1",
11       "isGateway": true,
12       "TrafficNode_ID": 1,
13       "node_type": "competitor"
14     },
15     {
16       "RFNode_ID": 2,
17       "ImageName": "modem-image-v1",
18       "ModemConfig": "modem_config_file_2",
19       "isGateway": false,
20       "TrafficNode_ID": 2,
21       "node_type": "competitor"
22     }
23   ]
24 }
```

Batch Configuration File, cont'd

Mapping of SRNs to nodes in the scenarios:

- **node_type**: The type of this node
 - **competitor**: used for standard batch jobs
 - **bot**: allows users to SSH into the node during a batch job, e.g., for debugging purposes.

```
1   {
2     "BatchName": "My Test Batch",
3     "Duration": 300,
4     "RFScenario": 6742,
5     "TrafficScenario": 1,
6     "NodeData": [
7       {
8         "RFNode_ID": 1,
9         "ImageName": "modem-image-v1",
10        "ModemConfig": "modem_config_file_1",
11        "isGateway": true,
12        "TrafficNode_ID": 1,
13        "node_type": "competitor"
14      },
15      {
16        "RFNode_ID": 2,
17        "ImageName": "modem-image-v1",
18        "ModemConfig": "modem_config_file_2",
19        "isGateway": false,
20        "TrafficNode_ID": 2,
21        "node_type": "competitor"
22      }
23    ]
24  }
```

Batch Job Workflow

After users queue batch jobs and start executing:

- Containers are loaded on the SRNs
- The colosseum.ini file is copied into the container → contains info in the batch job
- If specified, the radio configuration is pre-loaded into the container

Batch Job Workflow, cont'd

- Startup user scripts are executed (e.g., **upstart** of sysvinit scripts)
- After boot, the SRN controller periodically calls the **status.sh** Radio API script to check that the status of each container is **READY**
- 5 minutes after container boot, the SRN controller calls the **start.sh** Radio API script regardless of whether or not the container radio is in the **READY** state

Batch Job Workflow, cont'd

- Once `start.sh` has been called, RF and traffic scenarios start.
- The radios are now able to communicate through MCHEM.
- The containers needs to ensure that the `status.sh` script now returns **ACTIVE**

Batch Job Workflow, cont'd

- When the scenario is completed, the **stop.sh** Radio API script is called
- The containers begin preparing for teardown
- Users may use this time to copy files to the **/logs** directory (saved on the NAS after the batch job ends)
- The container needs to ensure that the **status.sh** script now returns **STOPPING**

Batch Job Workflow, cont'd

- When experiment has ended, the radio container needs to ensure that the `status.sh` script now returns **FINISHED**
- Two minutes after `stop.sh` is called, the container deallocates, regardless of whether or not the container radio is in the **FINISHED** state

Batch Mode Timeline Example

Batch mode timeline example of 600 seconds:

- Minute 00:00 - 13:00 → batch job starts
 - The USRP is flashed
 - Containers are allocated/instantiated
 - Initial startup scripts are called
- Minute 13:00 → check containers for readiness
 - Did all the containers `status.sh` report a **READY** state?
 - Did the RF subsystem report **READY?** (Colosseum internal readiness check)
 - Did the traffic subsystem report **READY?** (Colosseum internal readiness check)

Batch Mode Timeline Example, cont'd

- Minute 13:00 - 16:00 → scenario preparation
 - 3 minutes for Colosseum scenario preparation
- Minute 16:00 → scenario starts
 - All containers call to `start.sh`
- Minute 16:00 - 26:00 → user experiment runs

Batch Mode Timeline Example, cont'd

- Minute 26:00 → scenario stops
 - All containers call to `stop.sh`
- Minute 26:00 - 28:00 → container teardown
 - 2 minutes for user radio application cleanup (e.g., copying any data to the `/logs` directory)

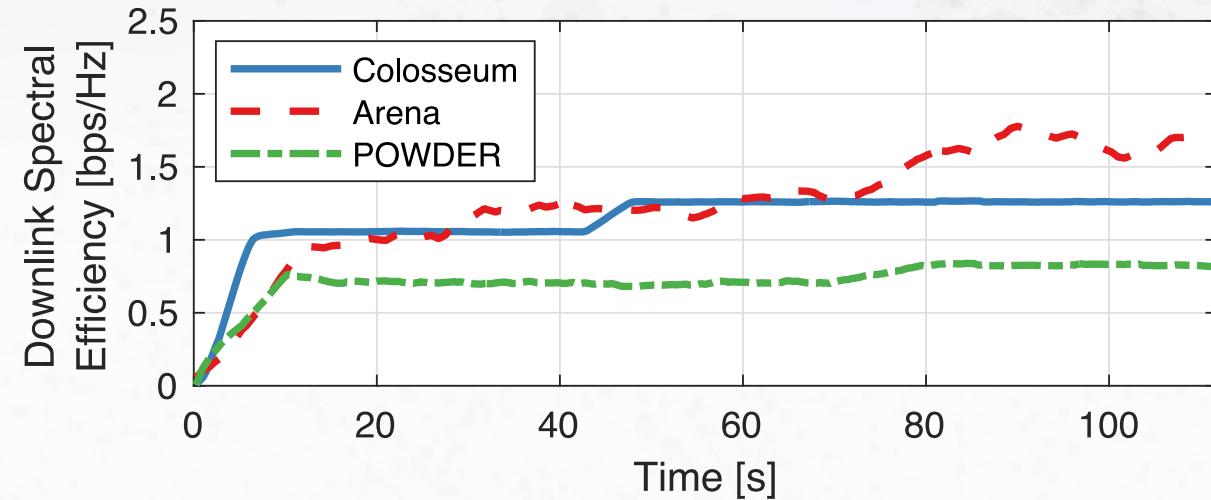
More info on batch mode jobs:

- <https://tinyurl.com/5y4cens8>

Validation Pipeline Example

Port containers to different testbeds

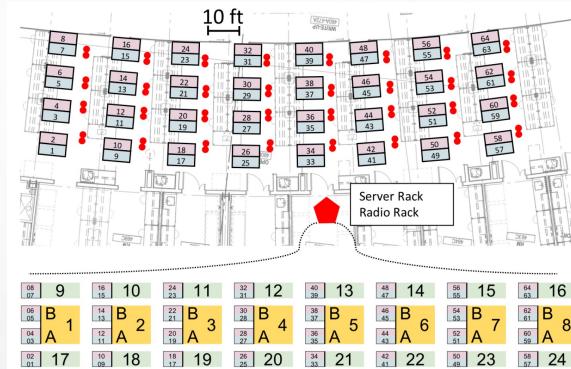
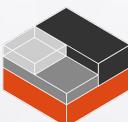
- Prototype on Colosseum
- Validate in real environment
- Test large-scale capabilities on city-scale platforms



Test at-a-scale
on emulated
scenarios



Validate in
real wireless
environment



Test large-
scale
capabilities



Platforms for Advanced
Wireless Research

Ad: Open 5G Forum: Fall 2021

November 17-18, 2021 (virtual)

- A virtual event sponsored by the ACM SIGMOBILE on *open* and *open-source software* for the *5G ecosystem (RAN edition)*

More info:

- <https://open5g.info/open-5g-forum/>

Program

#	Wednesday 11/17	Thursday 11/18
10:00	Open 5G Forum Keynote Oguz Sunay	OAI Tutorial Raymond Knopp, Shweta Srivastava
:15		
:30		
:45	A tutorial on O-RAN and Open RAN Rajarajan Sivaraj	
11:00		
:15		
:30	srsRAN Tutorial Paul Sutton, Northeastern WiOT Team	Open 5G Forum Short Talks Rittwik Jana, Matti Hiltunen, Melike Erol-Kantarci, more to be announced
:45		
12:00		
:15		
:30		
:45		
13:00	Open RAN in Colosseum Northeastern WiOT Team	Open 5G Forum Panel
:15		
:30		



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Thank You! (Questions?)



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