ITU AI/ML in 5G Challenge: Applying Machine Learning in Communication Networks

A Real-time CQI Prediction Framework for Proactive Resource Scheduling in 5G Enabled Drones Using AI

Submitted by:

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Use-case Flow Diagram

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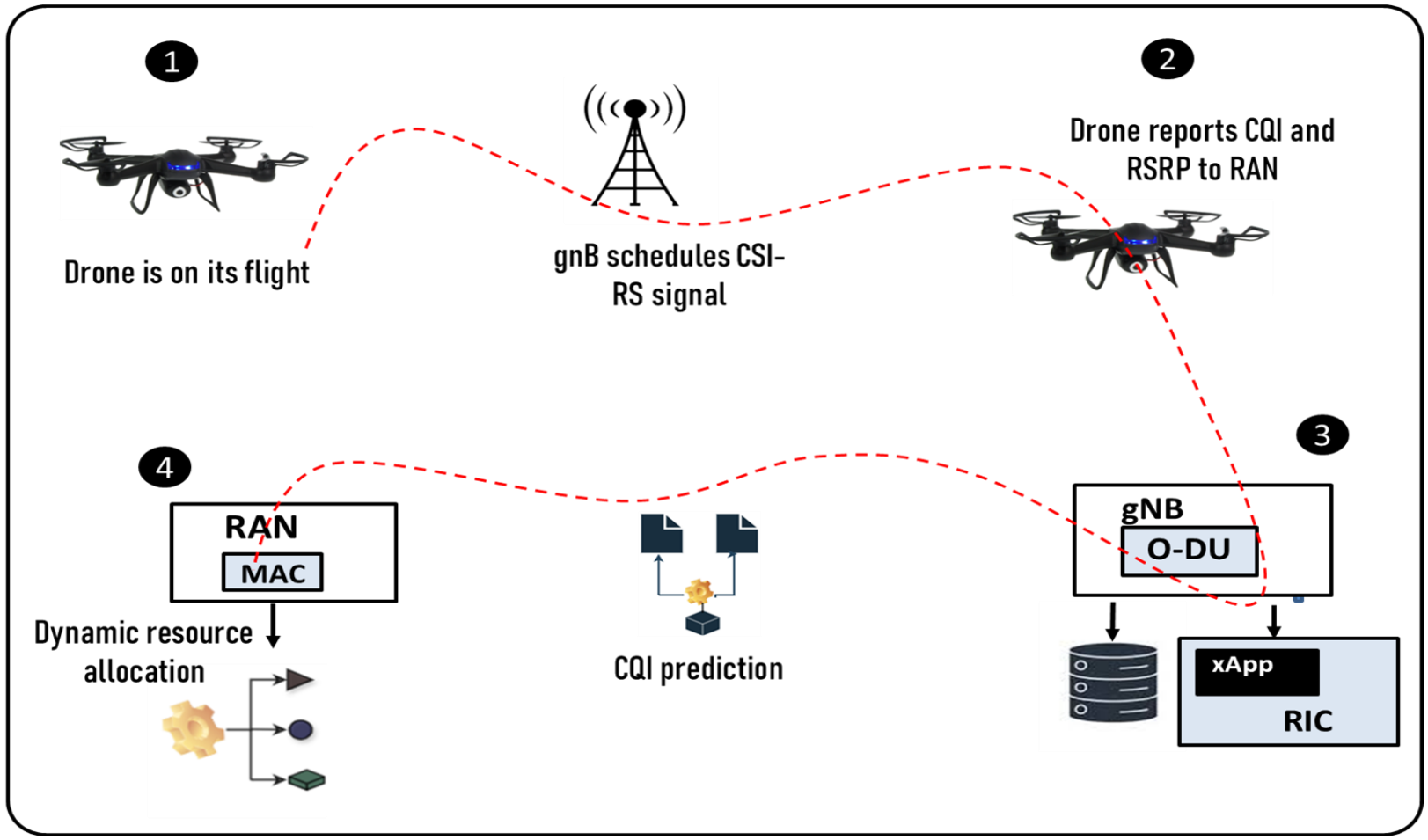

CQI Vs. PRB Mapping (TDD)

- Guaranteed Rate (R) = 20 Mbps
- Band n78 (3.3 GHz)
- Total PRBs (nPRB) = 106
- Sub-carrier Spacing (SCS) = 30 kHz
- Bandwidth = $nPRB \times 12 \times SCS$ $(\approx 40\ MHz)$
- Required Guaranteed PRBs (gPRB) = $\frac{R}{SE \times 12 \times SCS}$
- SE – Spectral Efficiency

CQI mapping table [3GPP 38.214, Release 15]

CQI Index	Modulation	Code Rate x 1024	Efficiency	gPRB	gPRB (Round Off)
1	QPSK	78	0.1523	364.78	365
2	QPSK	193	0.377	147.36	148
3	QPSK	449	0.877	63.35	64
4	16 QAM	378	1.4766	37.62	38
5	16 QAM	490	1.9141	29.02	30
6	16 QAM	616	2.4063	23.09	24
7	64 QAM	466	2.7305	20.35	21
8	64 QAM	567	3.3223	16.72	17
9	64 QAM	666	3.9023	14.24	15
10	64 QAM	772	4.5234	12.28	13
11	64 QAM	873	5.1152	10.86	11
12	256 QAM	711	5.5547	10.00	11
13	256 QAM	797	6.2266	8.92	9
14	256 QAM	885	6.9141	8.04	9
15	256 QAM	948	7.4063	7.50	8

CQI Vs. PRB Mapping (FDD)

- Guaranteed Rate (R) = 20 Mbps
- Total PRBs (nPRB) = 25
- Band n66 (2.1 GHz and 1.7 GHz with 400 MHz offset)
- Sub-carrier Spacing (SCS) = 15 kHz
- Bandwidth = $nPRB \times 12 \times SCS$ $(\approx 5\ MHz)$
- Required Guaranteed PRBs (gPRB) = $\frac{R}{SE \times 12 \times SCS}$
- SE – Spectral Efficiency

CQI mapping table [3GPP 38.214, Release 15]

CQI Index	Modulation	Code Rate x 1024	Efficiency	gPRB	gPRB (Round Off)
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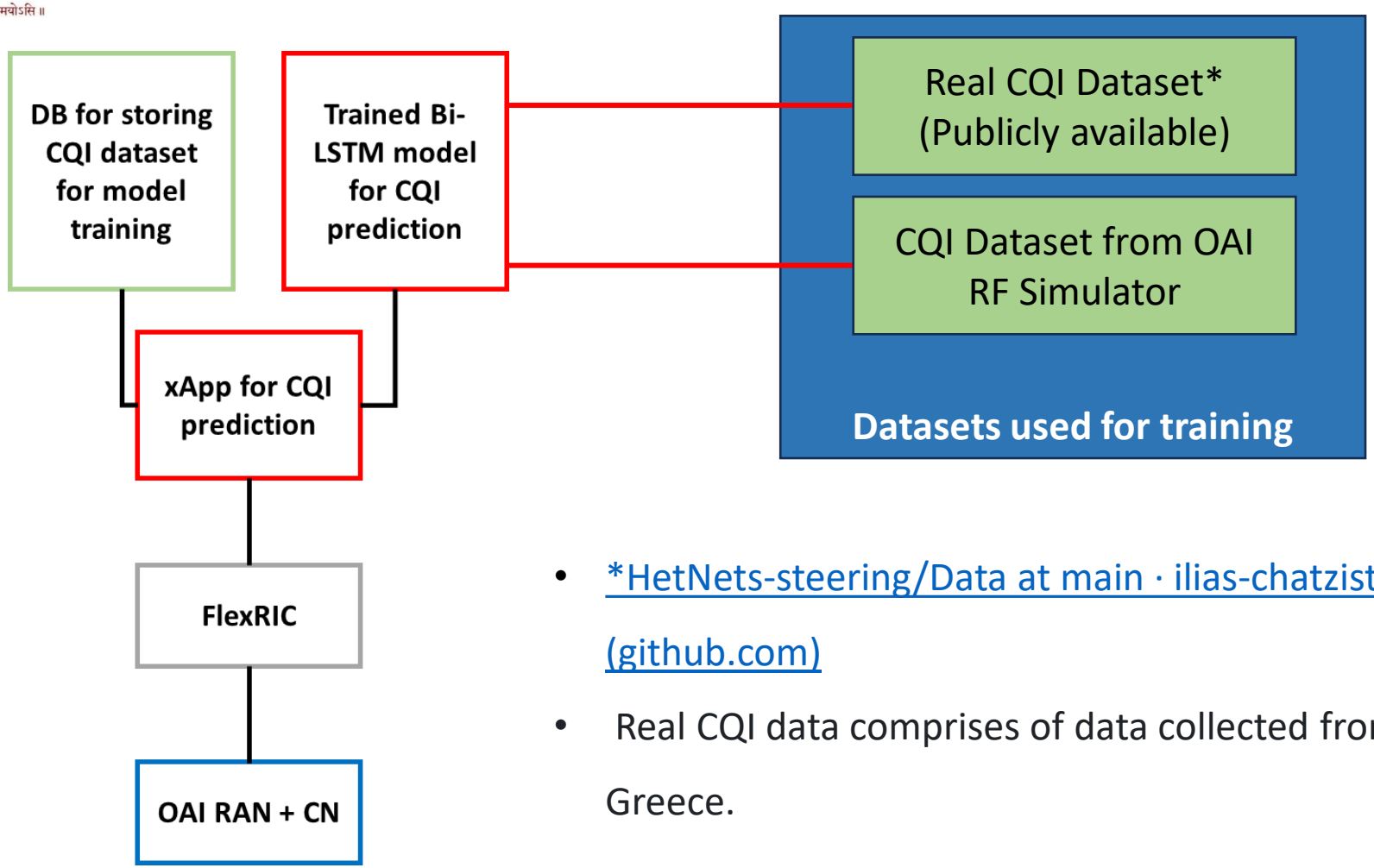
Model Training



- *HetNets-steering/Data at main · ilias-chatzistefanidis/HetNets-steering (github.com)
- Real CQI data comprises of data collected from 73 real cars in a route in city Volos, Greece.

Demonstration Flow

Setup OAI 5G Network CN, gNB, UE, FlexRIC

Run the xApp

Load the trained model from previous step

Receive the MAC indication message with CQI data in xApp

xApp predicts the CQI for the next frame using the trained model in the previous step

Compute the guaranteed PRBs required to meet the data rate constraints in the xApp

```
Frame Level Predictions [Frame Number, Actual CQI, Predicted CQI, Guaranteed PRBs]
[0085,15,15,08],   [0086,15,15,08],   [0087,15,15,08],   [0088,15,15,08],   [0089,
[0094,06,06,24],   [0095,06,06,24],   [0096,06,06,24],   [0097,13,06,24],   [0098,
```

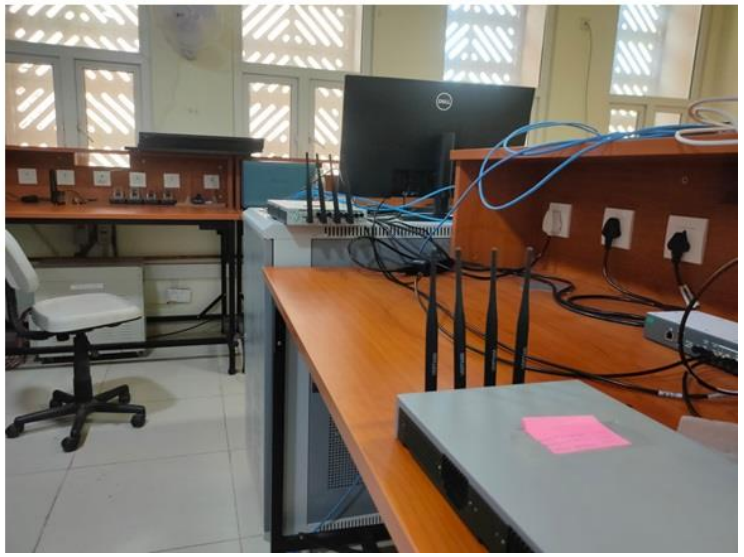
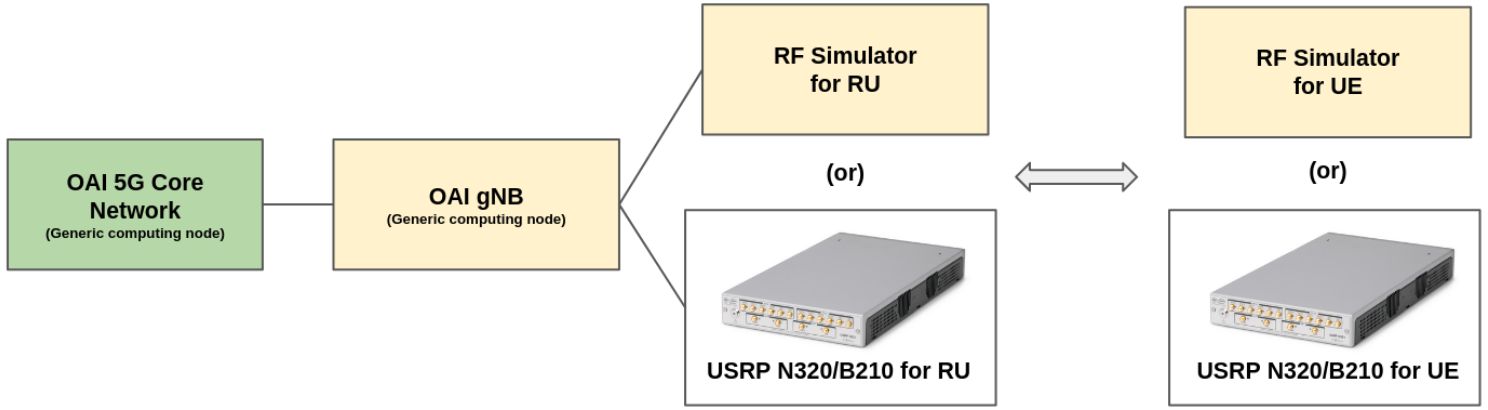
xApp logs

xApp sends RC control message to gNB with guaranteed PRBs

gNB scheduler allocates the guaranteed PRBs to the UE communicated by xApp

OAI gNB logs showing frame number and guaranteed PRBs for the UE

```
Frame Number: 959, Guaranteed PRBs: 11
Frame Number: 960, Guaranteed PRBs: 11
Frame Number: 961, Guaranteed PRBs: 11
Frame Number: 962, Guaranteed PRBs: 15
Frame Number: 963, Guaranteed PRBs: 15
Frame Number: 964, Guaranteed PRBs: 15
Frame Number: 965, Guaranteed PRBs: 15
Frame Number: 966, Guaranteed PRBs: 15
Frame Number: 967, Guaranteed PRBs: 15
Frame Number: 968, Guaranteed PRBs: 15
Frame Number: 969, Guaranteed PRBs: 15
Frame Number: 970, Guaranteed PRBs: 17
Frame Number: 971, Guaranteed PRBs: 17
Frame Number: 972, Guaranteed PRBs: 17
Frame Number: 973, Guaranteed PRBs: 17
Frame Number: 974, Guaranteed PRBs: 17
Frame Number: 975, Guaranteed PRBs: 17
Frame Number: 976, Guaranteed PRBs: 17
Frame Number: 977, Guaranteed PRBs: 17
Frame Number: 978, Guaranteed PRBs: 11
Frame Number: 979, Guaranteed PRBs: 11
Frame Number: 980, Guaranteed PRBs: 11
Frame Number: 981, Guaranteed PRBs: 11
Frame Number: 982, Guaranteed PRBs: 11
Frame Number: 983, Guaranteed PRBs: 11
```

Thank You!!!

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