

2.6 Results and Analysis

For the FCB dataset, Qwen3-8B was queried with the same data as sample 968, under a constrained output format, yielding the results shown as follows.

```
▼ 968
prompt "Current RSSI of each sector × sub-band (1-second average, unit: dBm) A_a: 328.5 A_b: 281.9 A_c: 226.6 A_d: 280.3 A_e: 222.6 A_f: 28.9 B_a: 29
1.3 B_b: 163.6 B_c: 256.4 B_d: 290.2 B_e: 233.4 B_f: 12.7 C_a: 370.9 C_b: 287.6 C_c: 214.9 C_d: 17.7 C_e: 271.5 C_f: 8.6 D_a: 304.0 D_b: 276.7 D_c: 227.3
D_d: 0.3 D_e: 10.1 D_f: 19.3 Please provide the MHz allocation for 5G NR-U / Wi-Fi 6 (with a preference for the most cost-effective options)."
```

```
completion [{"A": {"NR-U": 36.6, "WiFi6": 63.4}, "B": {"NR-U": 41.6, "WiFi6": 58.4}, "C": {"NR-U": 48.3, "WiFi6": 51.7}, "D": {"NR-U": 60.0, "WiFi6": 40.0}}]
```

```
root@autodl-container-09dd4b98a3-53fe9bb9: /autodl-tmp# python test.py
Loading checkpoint shards: 100% | 2/2 [00:13<00:00, 6.53s/it]
[{"A": {"NR-U": 35.0, "WiFi6": 65.0}, "B": {"NR-U": 40.7, "WiFi6": 59.3}, "C": {"NR-U": 44.3, "WiFi6": 55.7}, "D": {"NR-U": 60.0, "WiFi6": 40.0}}]
root@autodl-container-09dd4b98a3-53fe9bb9: /autodl-tmp#
```

Summary error (NR-U) MAE (mean absolute error): 1.6 MHz RMSE: 2.201 MHz
Maximum absolute error: 4.0 MHz (sector C) Signed mean bias: +1.625 MHz, the comparison result slightly favours allocating more NR-U overall. The same input as the 928-data instance was submitted to DeepSeek-R1-Distill-Llama-8B.

```
▼ 928
prompt "Current RSSI of each sector × sub-band (1-second average, unit: dBm) A_a: 311.0 A_b: 267.8 A_c: 226.3 A_d: 285.4 A_e: 43.8 A_f: 14.3 B_a: 31
4.7 B_b: 181.7 B_c: 267.6 B_d: 294.5 B_e: 281.2 B_f: 11.2 C_a: 361.9 C_b: 288.0 C_c: 226.1 C_d: 209.3 C_e: 304.5 C_f: 7.7 D_a: 278.8 D_b: 274.2 D_c: 199.8
D_d: 0.3 D_e: 10.9 D_f: 60.3 Please provide the MHz allocation for 5G NR-U / Wi-Fi 6 (with a preference for the most cost-effective options)."
```

```
completion [{"A": {"NR-U": 48.3, "WiFi6": 51.7}, "B": {"NR-U": 36.6, "WiFi6": 63.4}, "C": {"NR-U": 31.6, "WiFi6": 68.4}, "D": {"NR-U": 60.0, "WiFi6": 40.0}}]
```

```
root@autodl-container-09dd4b98a3-53fe9bb9: /autodl-tmp# python test.py
Loading checkpoint shards: 100% | 2/2 [00:12<00:00, 6.31s/it]
[{"A": {"NR-U": 45.9, "WiFi6": 54.1}, "B": {"NR-U": 37.0, "WiFi6": 63.0}, "C": {"NR-U": 35.0, "WiFi6": 65.0}, "D": {"NR-U": 60.0, "WiFi6": 40.0}}]
root@autodl-container-09dd4b98a3-53fe9bb9: /autodl-tmp#
```

Summary error (NR-U) MAE (mean absolute error): 1.55 MHz RMSE: 2.090 MHz
Maximum absolute error: 3.40 MHz (sector C) Signed mean bias: -0.35 MHz, the allocates slightly less to NR-U overall.

For the AOA Dataset. Qwen3-8B selected the second item in the Dataset.

```
▼ 0
from "user"
value "Advanced technical optimization - edge computing: Stadium deployment with 64 antenna elements, 8-layer MIMO. Current beamforming gain: 9.6dB, interference level: -8.8
dBm. AoA resolution: 2.9°, tracking accuracy: 97.0%. System efficiency: 84.5%, target: 89.2%. Technical challenge: optimize edge computing for 60,000-user stadium with 400MHz
spectrum. Require advanced spectrum allocation considering edge computing implementation."
```

```
▼ 1
from "assistant"
value "Technology-optimized allocation: 5G NR-U: 300MHz (75.0%), Wi-Fi 6: 100MHz (25.0%). Technical strategy: balanced allocation for edge computing implementation. Impleme
ntation: 64-element array with 2.9° AoA resolution, 8-layer MIMO processing, 9.6dB beamforming gain. Performance targets: 89.2% system efficiency, 97.0% tracking accuracy. Ex
pected benefits: 42% performance improvement, 15% efficiency gain through advanced edge computing integration."
```

```
</think>
Technology-optimized allocation: 5G NR-U: 290MHz (72.5%), Wi-Fi 6: 110MHz (27.5%). Technical strategy: bal
anced allocation for edge computing implementation. Implementation: 64-element array with 2.9° AoA resolut
ion, 8-layer MIMO processing, 9.6dB beamforming gain. Performance targets: 89.2% system efficiency, 97.0%
tracking accuracy. Expected benefits: 38% performance improvement, 26% efficiency gain through advanced ed
ge computing integration. Technical realization: 64-element array optimized for stadium deployment
```

DeepSeek-R1-Distill-Llama-8B selected the 61st item in the Data.

```

▼ 0
from "user"
value "Stadium network analysis - post-match period, clear weather: 7,960 active users detected through AoA measurements. Current spectrum allocation: 5G NR-U 189MHz, Wi-Fi 6 211MHz. Signal quality: excellent (SNR: 24.0dB). Channel utilization: 38.0% (low load). AoA analysis shows 8 dominant directions with 13.9° spread, spatial diversity index: 5.4. Weather impact: clear conditions affecting propagation. Optimize 400MHz total spectrum for maximum efficiency and cost reduction."

▼ 1
from "assistant"
value "Optimized allocation: 5G NR-U: 230MHz (57.5%), Wi-Fi 6: 170MHz (42.5%). Analysis factors: post-match user patterns, clear weather impact, excellent signal conditions. AoA-guided optimization: 8-direction beamforming, spatial diversity factor 5.4. Expected improvements: 22% throughput increase, 5% operational cost reduction. Implementation: Dynamic spectrum management with real-time AoA tracking for 60,000-person stadium optimization."

```

```

[LoRA OUTPUT]
Optimized allocation: 5G NR-U: 230MHz (57.5%), Wi-Fi 6: 170MHz (42.5%). Analysis factors: post-match user patterns, clear weather impact, excellent signal conditions. AoA-guided optimization: 8-direction beamforming, spatial diversity factor 5.4. Expected improvements: 25% throughput increase, 5% operational cost reduction. Implementation: Dynamic spectrum management with real-time AoA tracking fo...

```

After training on the two datasets, both Qwen3-8B and DeepSeek-R1-Distill-Llama-8B showed very high accuracy in ad-hoc spot checks, with negligible errors. Because spot checks are inherently stochastic, a systematic evaluation was conducted: the LoRA-fine-tuned models were re-run on the entire FCB dataset (2,002 samples) and on the first 2,000 samples of the AOA dataset to generate predictions. For each model, outputs from the base (pre-fine-tuning) version and the LoRA-tuned version were compared, and per-sample results were exported to separate .csv files