Performance Analysis Multi-Radio Multi-Channel Wireless Mesh Network for Industrial Environments

Abdullah Salih BAYRAKTAR
Gebze Technical University, Computer Engineering
Kocaeli, Turkey
asbayraktar@gtu.edu.tr

Prof. Hasari ÇELEBİ
Gebze Technical University,Computer Engineering
Kocaeli, Turkey
hcelebi@gtu.edu.tr

Outline

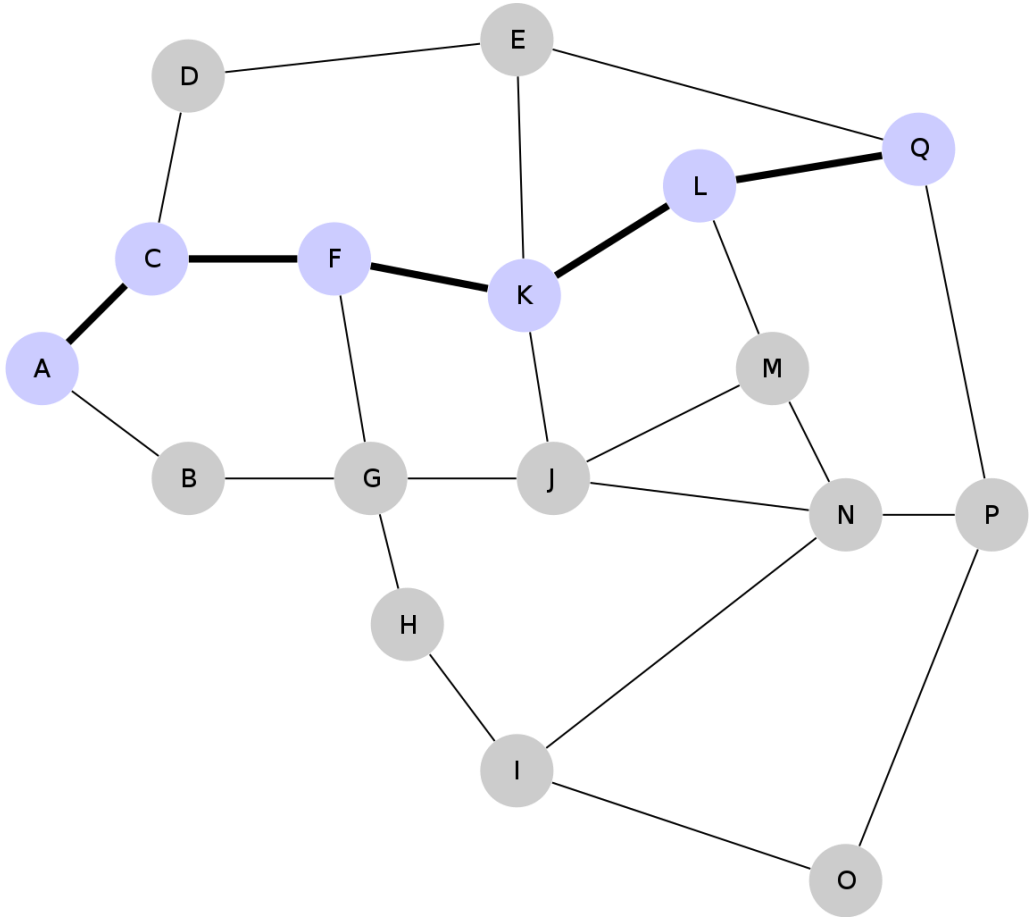
- Problem Statement
- Research Areas
- Proposed Solution
- Experimental Results
- Conclusions

Problem Statement

- Increasing usage of Wireless communications systems
- Need on Easy mesh, usage of it.
- Industrial 4.0, Industrial-IoT, IoT
- Challenge of cabling
- Need in defence industry.

Research Areas

- High bandwidth,
- Good coverage,
- Self-installation,
- Load balancing,
- Reasonable cost,
- Reliability
- Durability



Research Areas

- Single Radio Single Channel
- Single Radio Multi Channel
- Multi Radio Multi Channel

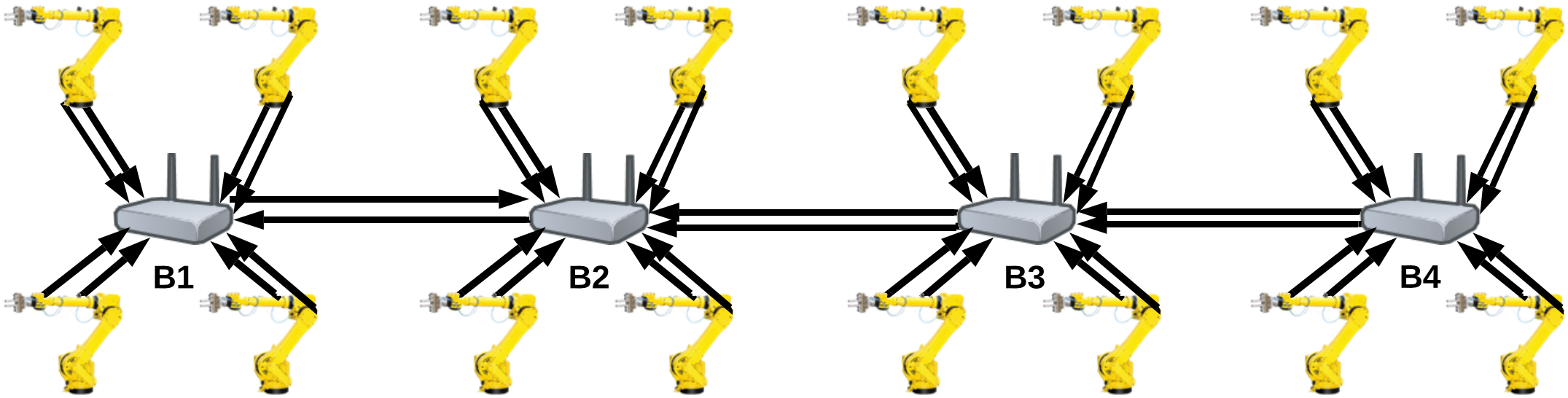
- Disrubuted
- Central
- Manuel

Research Areas

- In mesh networks, each node is expected to be able to connect to a large number of nodes simultaneously and support hopping data transmission.
- The 802.11g standard of the 802.11 (Wi-Fi) family widely used in high-bandwidth wireless networks is also one of the widely preferred media access protocols in mesh networking. 802.11g uses the algorithm of CSMA/CA (Carrier Sense Multiple Access/Collision Avoidance) for media access.

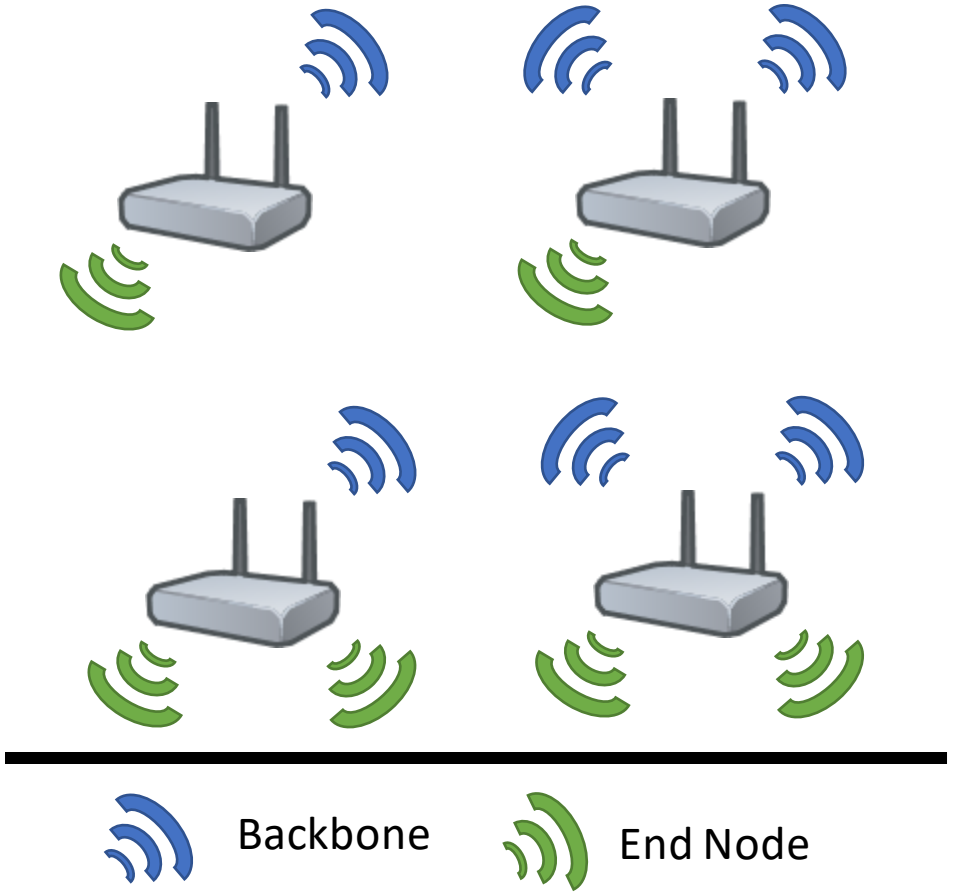
Proposed Solution

- In this study, communication scenario (e.g. robot welding) of collaborative running robot sets on production lines is considered.

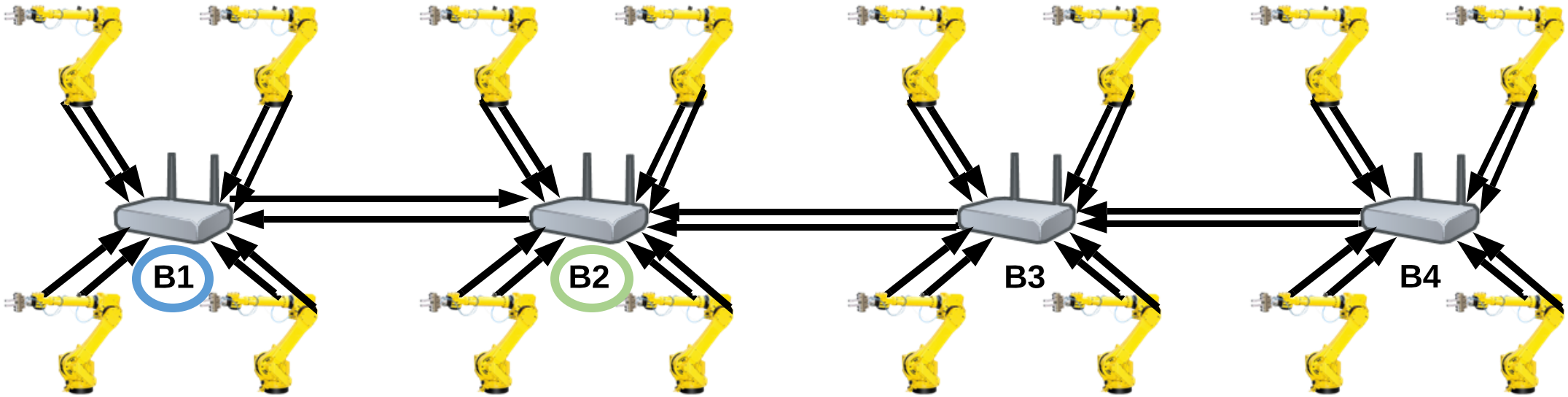


Proposed Solution

- Single radio (SingleRadio_1):
- Dual radios (MultiRadio_2_1e1b):
- Three radios (MultiRadio_3_1e2b):
- Three radios (MultiRadio_3_2e1b):
- Four radios (MultiRadio_4_2e2b):



Proposed Solution for Data Analysis Center(DAC)



Proposed Solution

- Each senario are run in variety of trafic taht genereted from all the other node expected DAC. The Packet interval table is shown.

Scenario No	Packet Interval (ms)	Expected Packet Count
1	1000	80
2	500	160
3	100	800
4	50	1600
5	10	8000
6	5	16000
7	1	80000
8	0,5	160000
9	0,3	266656

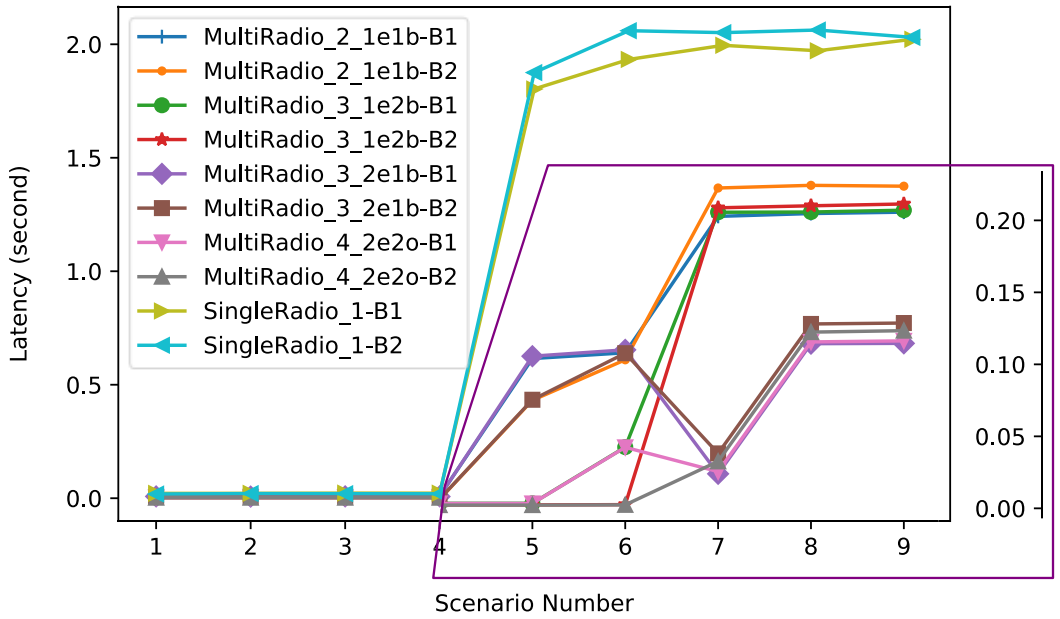
Exprimental Results

- Performance tests and topological improvements have been made for the topology to meet transmission requirements by using mesh networks of sensors and image data from robots.

- The effect of the number of radios such as single, double, triple, quadruple and the location of the Data Analysis Center (DAC), the node the data will be transmitted, on bandwidth and end-to-end packet latency were examined.

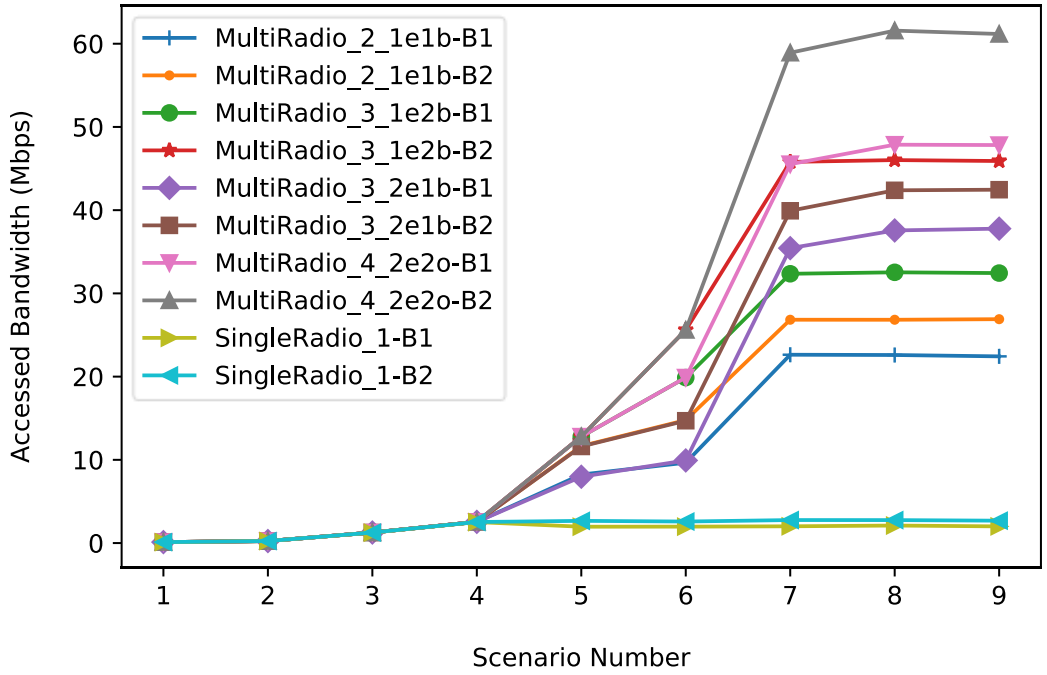
Exprimental Results

- As shown in Figure (SingleRadio_1-B1, -B2), major latency of approximately 2 seconds was observed between scenarios 5 and 9.



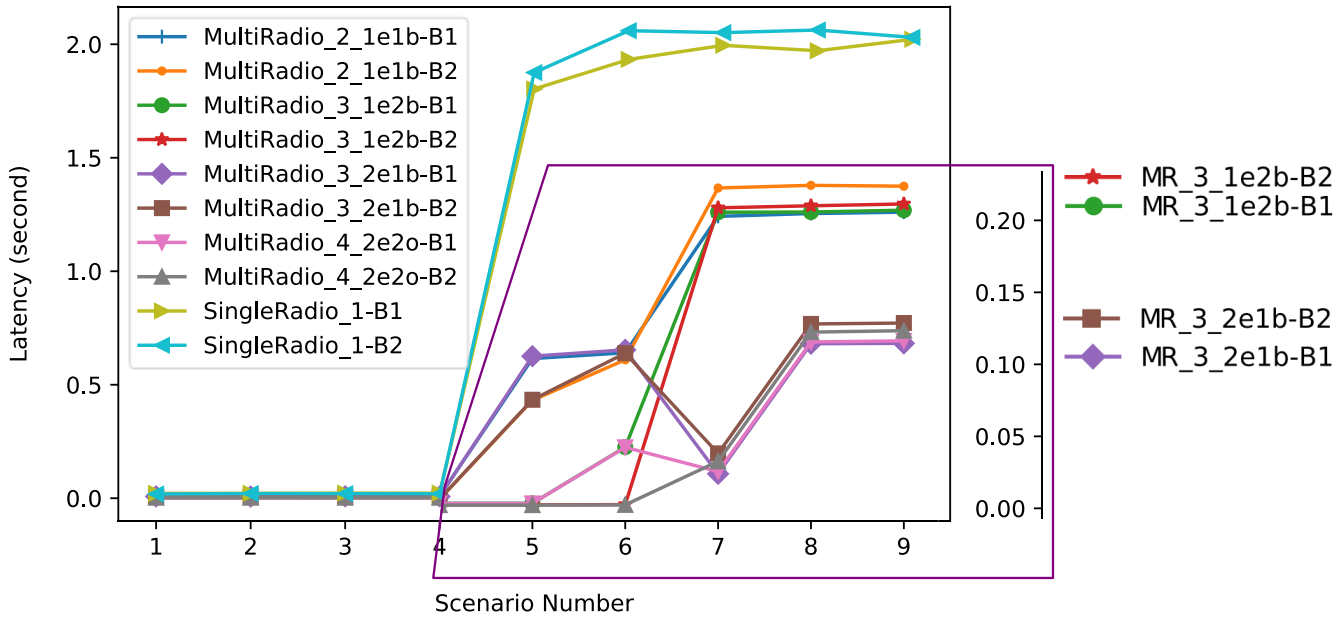
Exprimental Results

- When Figure is examined, it has been seen that increasing the number of radios is improving the accessible bandwidth. The MultiRadio_4_2e2b has the highest performance.



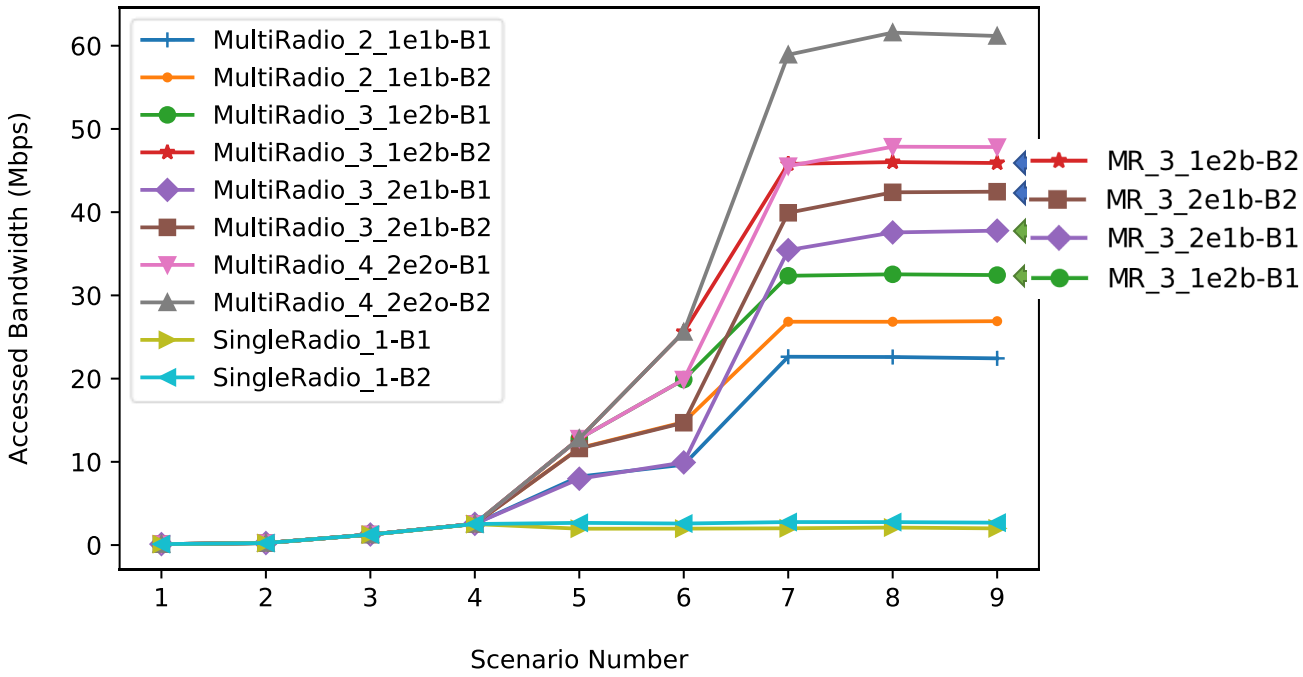
Exprimental Results

- When the latency graph in Figure is examined, it is observed that the saturation latency of four and three (2e1b) radio simulations are clustered around 0.12 seconds, and the saturation latency of two and three (1e2b) radio simulations are clustered around 0.22 sec. An increase in the number of radios reduces the latency. In addition, when three radio architectures are specifically evaluated, it appears that latency improvements can be made by improving channel assignment methods.



Exprimental Results

- For all network architectures in Figure, moving DAC to the center of the network (B2) has visibly increased the bandwidth. In addition, when the three radio network graphics in Figure 2 are examined, it has been observed that the accessible bandwidth of 2e1b-B2 is more than that of 1e2b-B2. However, the accessible bandwidth of 2e1b-B1 is less than that of 1e2b-B1. In addition, when three radio architectures are specifically evaluated, it appears that improvements can be made by improving channel assignment methods.



Conclusions

- The simulation results show that, the increase in the number of radios and the proximity of the data analysis node to the center greatly increased the data transmission performance. In addition, it has been noted that the method of channel assignment has positively or negatively affected the accessible bandwidth.

Perspective

- Efficient and distributed channel assignment algorithm for MRMC.

References

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Thank you for your time and attention

Questions ?

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