

Energy Aware Scheduling and Queue Management for Next Generation Wi-Fi Routers

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Outline

- Introduction
- Multi Band Router Architecture
- Energy Aware Algorithm
- Results
- Conclusion







Multiband

Energy

Conclusion

Current Multi Band (802.11n generation)



The benefit of using multi-band router is less interference, higher capacity and better reliability.



Current Multi-Band Queuing System



Multiband



Multi-shared-band Router (Suggested)



Multiband









Current Multi-band and Multi-shared-band Routers

- Energy consumption is high
 - \$27 per year for a router even for stand by (Ecotricity)



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Decreasing energy consumption of multi-band routers.

Multiband



Current Solution for Energy Awareness

- Channel selection based on power consumption by considering QoS.
 - 2.45-2.55 GHz: 5 dB



band

Energy

Resul

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5.65-5.75 GHz: 10 dB

- User has Antenna Selection in MIMO
 - Good for transferring data but not for stand by.
- Using small packets



Proposed: Energy Aware Scheduling Algorithm and Queue Management (e-ASA)



- Follows sleep and wake-up procedure of bands
- Depends on incoming traffic rates and QoS

Energy

Conclusion



e-ASA Based Multi-shared-band **Queuing System**





e-ASA Based Multi-shared-band Scheduling





Energy Modeling

- Energy modelling for only downloading
- Depends on idle or busyness of bands

Energy consumption during idle time

Band is idle

$$E_a = T * (\alpha * \rho_a + \beta * (1 - \rho_a))$$

Simulation time

Energy consumption during data transfer time

$$E = E_a + E_b + E_c$$

Total energy consumption

Band is busy

Energy



Simulation Environments



Used Bands	<u> </u>	2.4
Length of Q_s	≜	15
Length of Q_a , Q_b and Q_c	≜	50
Bandwidth size on each bands	≜	20
Modulations	<u> </u>	QI
Channel Quality Index (CQI)	≜	3,
Transmission Time Interval	<u> </u>	1n
Threshold for one band	≜	0.8
Threshold for two bands	<u> </u>	0.9
α and β	≜	10

- 4GHz, 3.6GHz, 5GHz
- 0 packets
-) packets
- MHz
- PSK, 16QAM, and 64QAM
- 5, 7, and 11
- ns
- 8
-)
- and 3, respectively



Results



- Discrete event simulation by following M/M/3/N.
- 100 realizations for different number of users with increasing data traffic.
- We compare
 - Single (Single band router),
 - Current (Current multi band router),
 - Shared (Multi-shared-band router)
 - Shared (e-ASA) (Multi-shared-band with energy aware scheduling algorithm)

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Energy

Result

Conclusi

Objective



Result Conclusion

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Band Usage



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Summary of Results



Improving throughput rate of multi-band up to 20%

Multi-shared-band with e-ASA



Up to 60% energy can be saved by using e-ASA.



Conclusion





Thank You



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