# Energy-Efficient Wi-Fi

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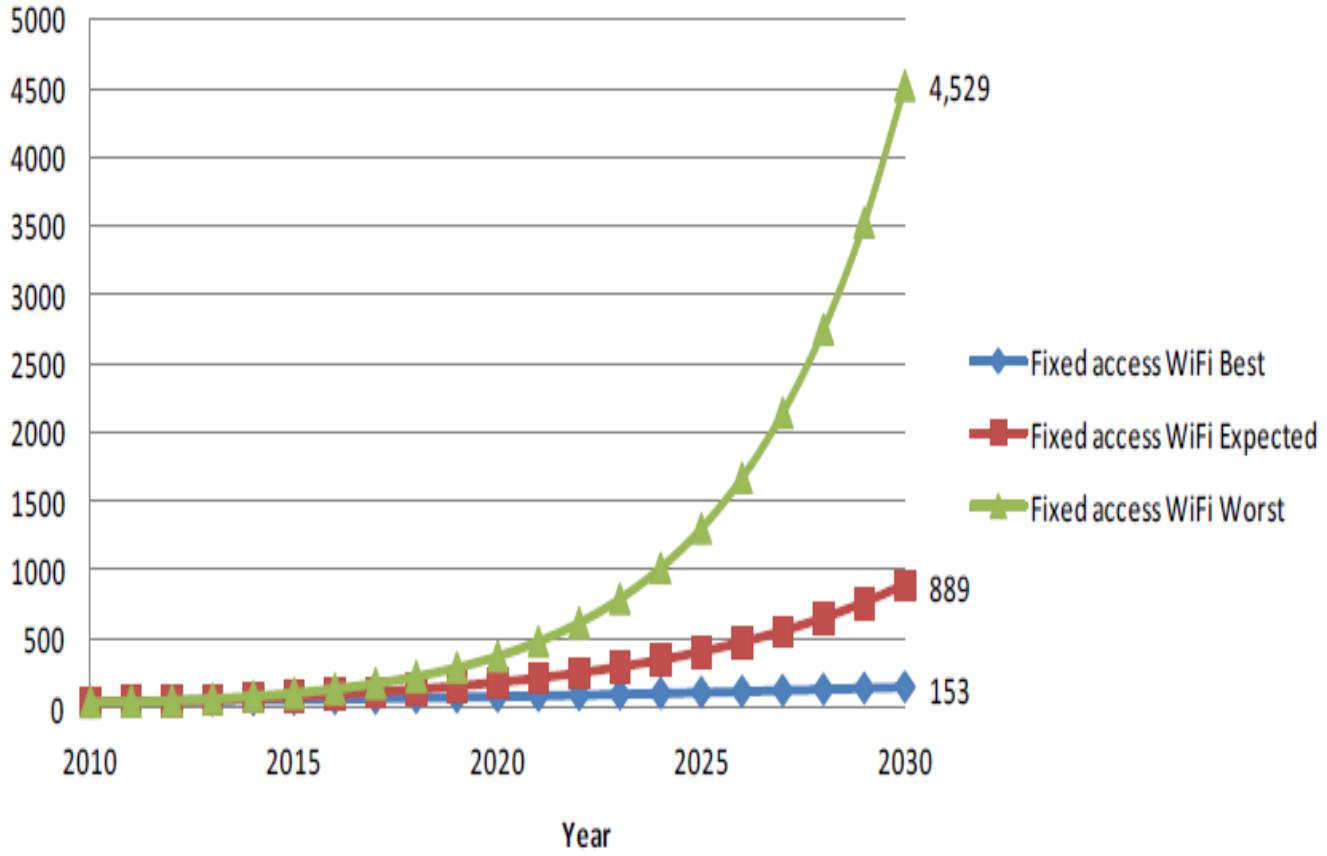
- The number of Wi-Fi access points will exceed 1.5 billion devices globally by 2023.

- Wi-Fi networks can consume 4529 Tera Watt-hour (TWh) energy worldwide by 2030 [1].

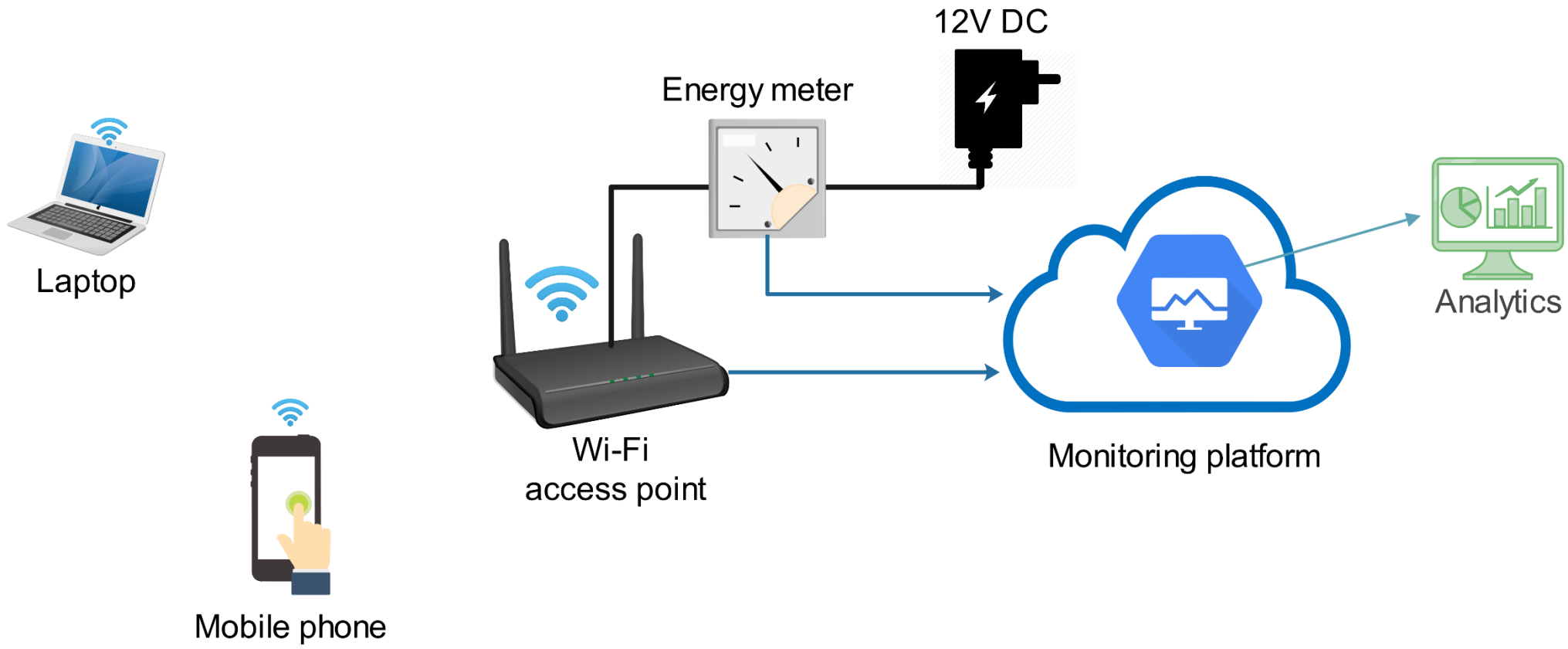



[1] Andrae, Anders & Edler, Tomas. (2015). Supplement: On Global Electricity Usage of Communication Technology: Trends to 2030.

# What Factors Affects Energy?

- Transmit power
- Hardware characteristics
- Operating system energy management capability
- Wireless communication parameters e.g. SNR, traffic pattern

# Effect of SNR on energy consumption

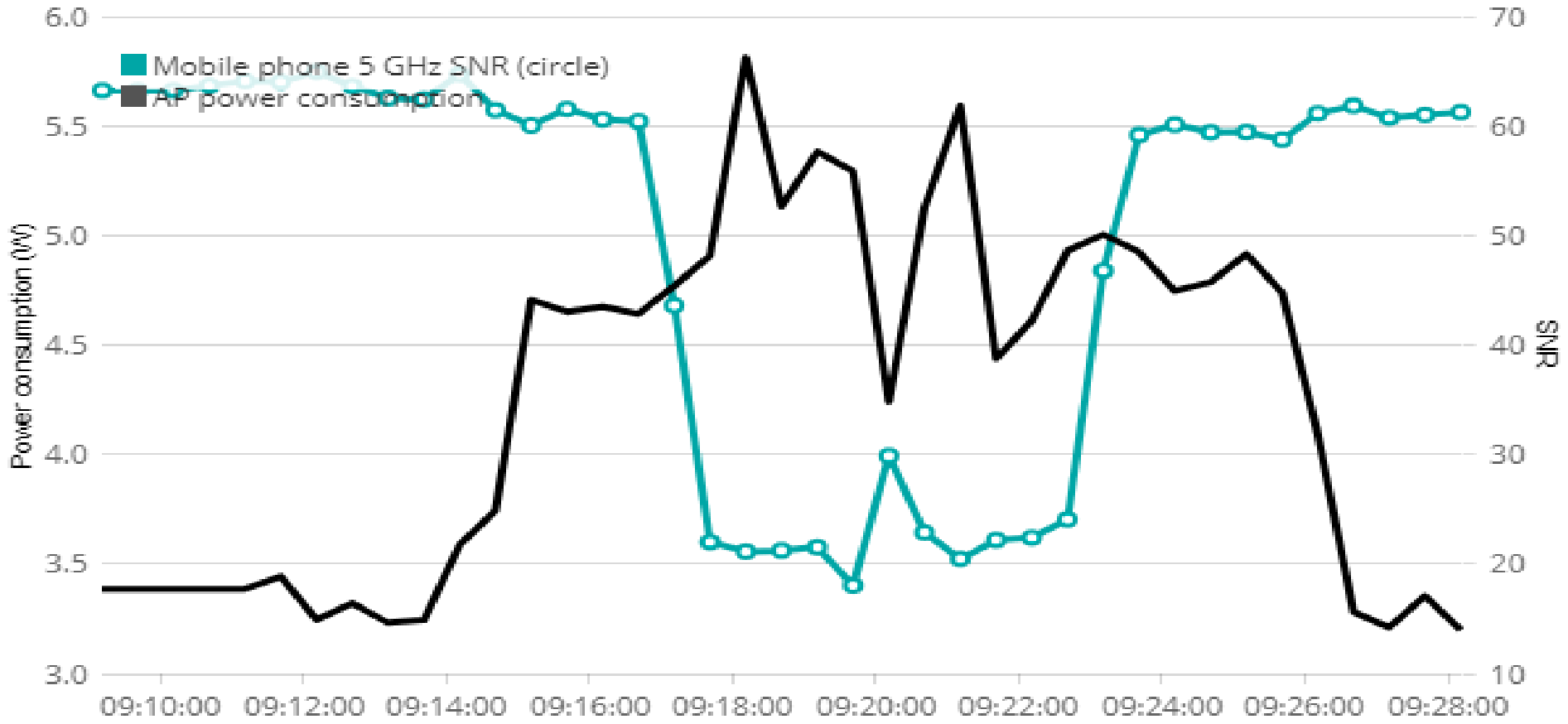


# Measuring energy consumption of access points

- Dynamic transmit power control (TPC)
  - Mikrotik RBD52
  - Mikrotik RB921
  - Mikrotik RBwAPG
- Static transmit power control
  - AirTies 4920
  - Zyxel B50B

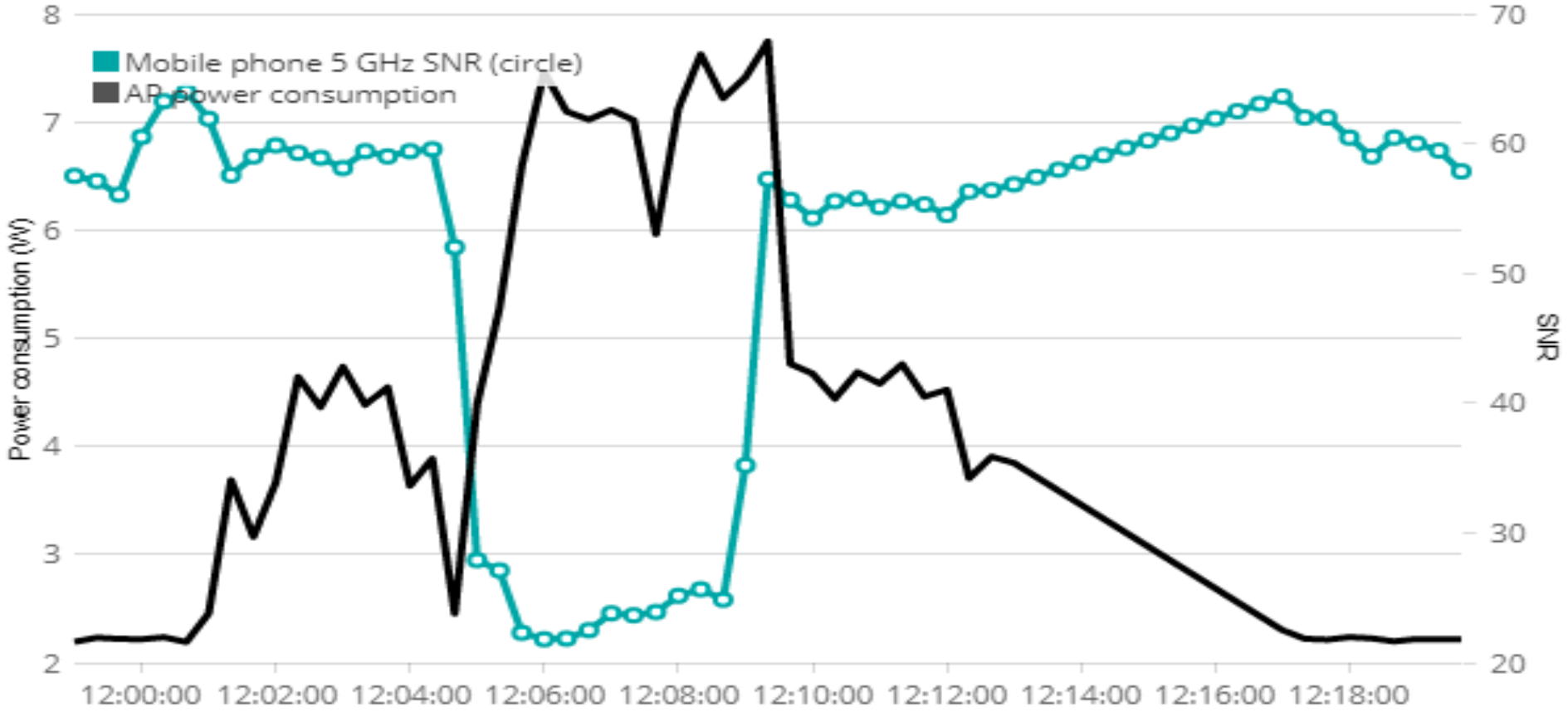
# Energy vs SNR

Mikrotik RBD52G



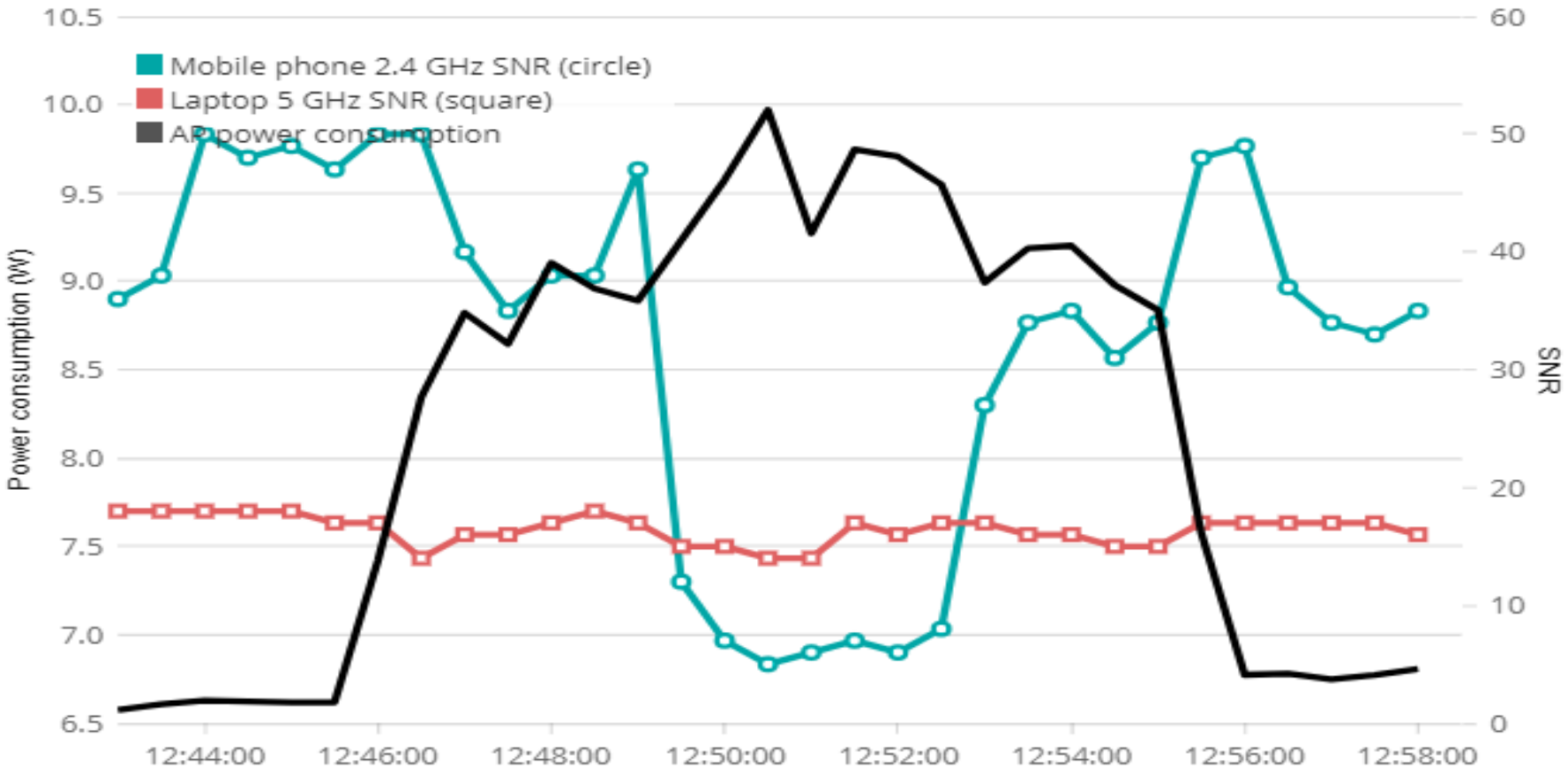
# Energy vs SNR

Mikrotik RB921



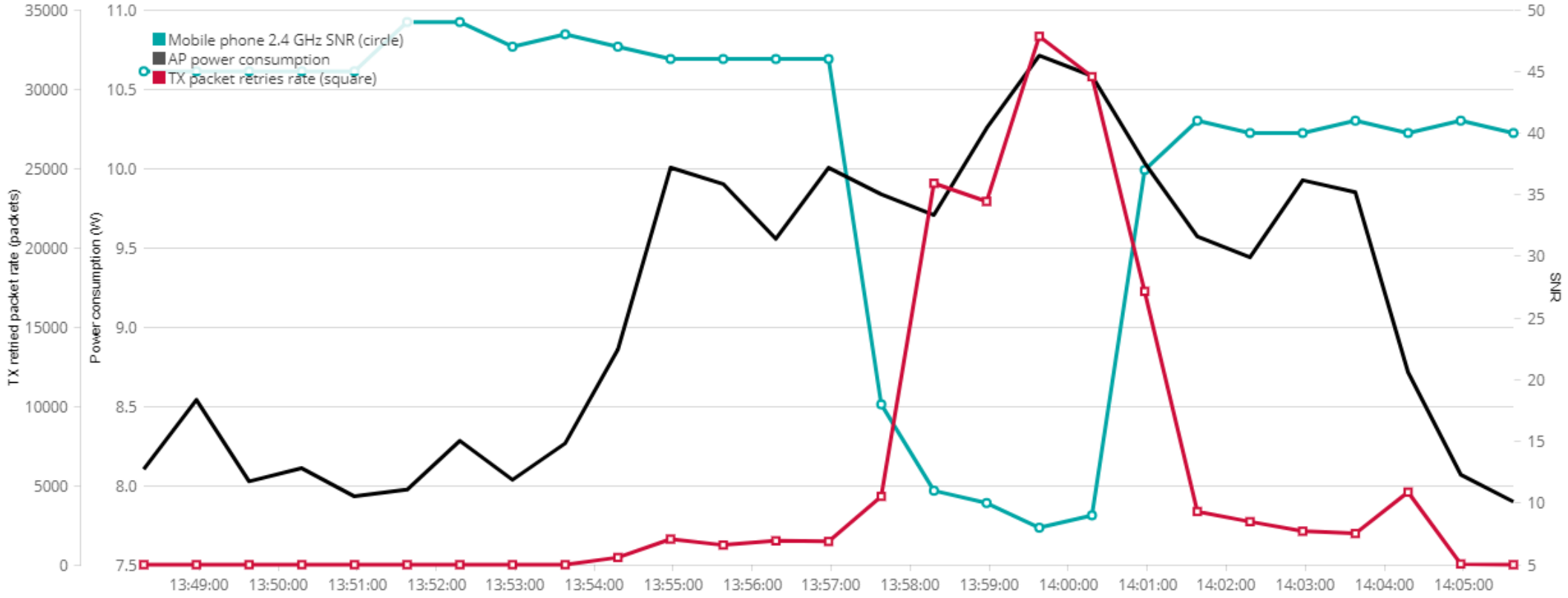
# Energy vs SNR

AirTies 4920



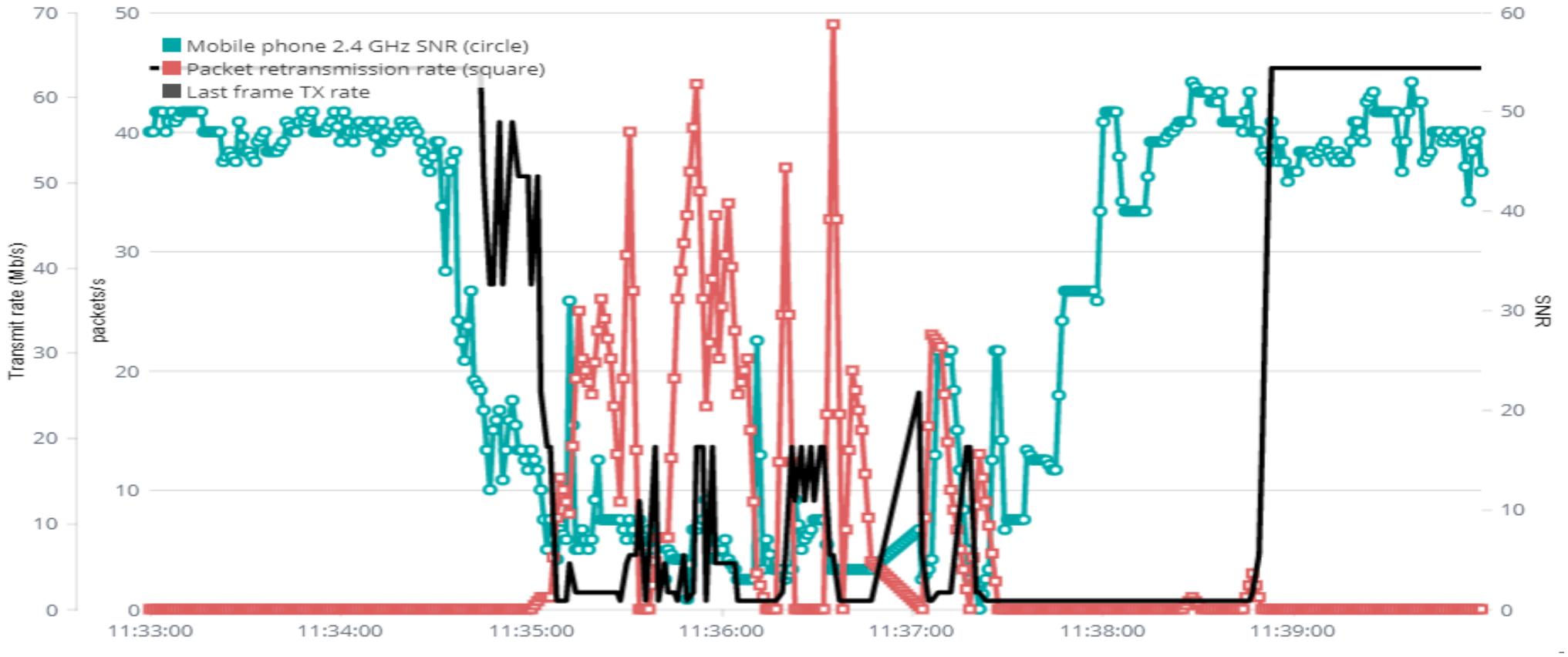
# Energy vs SNR

Zyxel B50B



# SNR vs re-transmission and TX rate

AirTies 4920



# Results:

| Access point | Presented experiment | The energy consumption during idle mode (Watts) | The energy consumption rise during high SNR | The energy consumption rise during low SNR | Transmit throughput with high SNR (MBps) | Transmit throughput with low SNR (MBps) |
|---|---|---|---|---|---|---|
| Mikrotik RBD52 | One client was connected to 5GHz network | 3.2 | 45% | 80% | 3 | 1.1 |
| Mikrotik RBwAPG | One client was connected to 2.4 GHz network | 2.9 | 35% | 80% | 2.6 | 0.8 |
| Mikrotik RB921 | One client was connected to 5GHz network | 2.2 | 125% | 260% | 3 | 0.6 |
| AirTies 4920 | Two clients were connected to 2.4 GHz and 5GHz networks respectively | 6.5 | 35% | 45% | 3 | 1 |
| Zyxel B50B | Two clients were connected to 2.4 GHz and 5GHz networks respectively | 8 | 25% | 55% | 5 | 1.2 |

# Summary

- Clients in low SNR increase energy consumption of APs with dynamic TPC up to 135%.
- Clients in low SNR increase energy consumption of APs with static TPC up to 30% (because of re-transmissions)
- Excessive energy consumption of APs can reduce battery life cycle by 30%.

- Clients' SNR affects efficiency (energy and throughput) of Wi-Fi networks


Q&A