An Adaptive Reliability Transport Protocol for the Internet of Things

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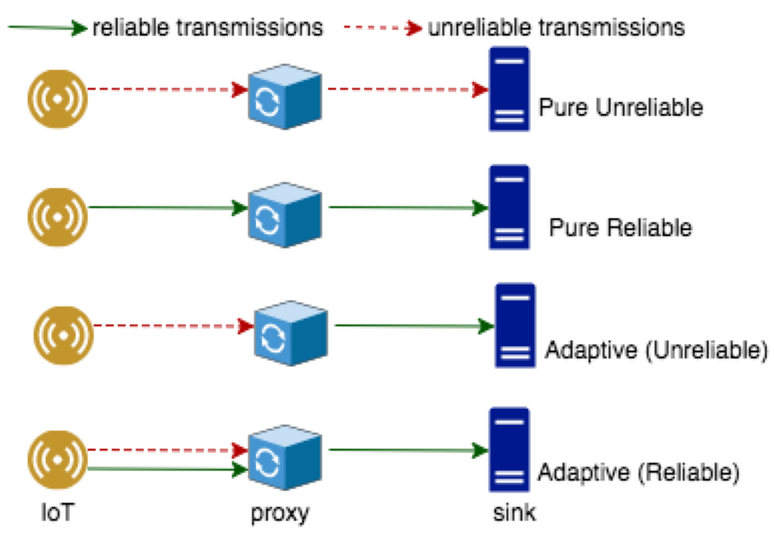
The Problem

- Billions of IoT devices in use by 2022 in various application areas.
- Constrained devices are limited in memory, bandwidth and power.
- Typically use batteries which may be expensive and hard to replace.
- Need to maximize device lifetime while ensuring data quality.
- IoT protocols:
  - Utilize full reliability with TCP e.g., MQTT or no reliability with UDP e.g., CoAP
  - Have custom reliability at IoT application
- Depending on the IoT application, reliability requirements may vary over time

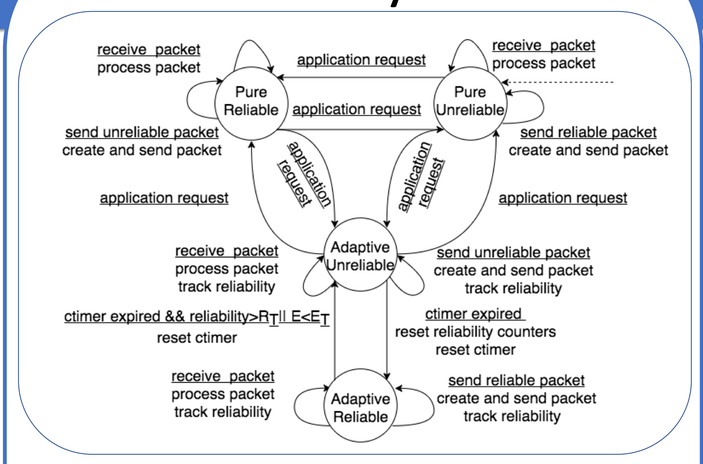
Objective and Methodology

- Design an Adaptive Reliability Transport (ART) protocol to allow an IoT application to dynamically request variable levels of reliability.



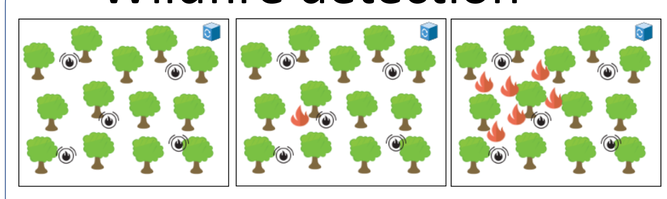
Adaptive reliable mode:
if Energy>E_T; use reliable transmission
else use unreliable transmission

Summary FSM

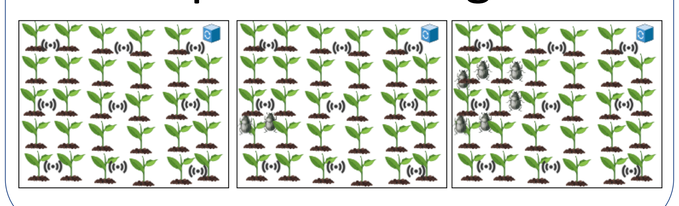


Applications

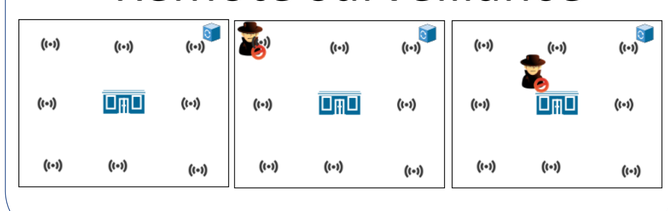
Wildfire detection



Crop monitoring



Remote surveillance



0% 50% 100%

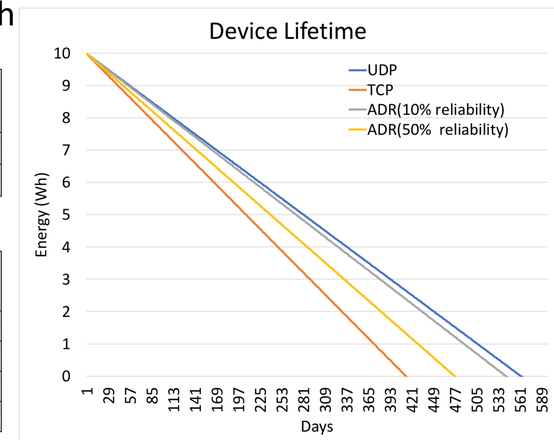
% reliability

Preliminary Results

- Distance between IoT device and proxy=200ft
- Measured energy to send 10,000 packets with TCP and UDP with RP3, Wi-Fi AP and iperf3 as an estimate for ART energy cost
- Lifetime increase is with respect to TCP
- Initial energy=10Wh

Protocol	Transmission Energy (Wh)
UDP	0.0178
TCP	0.0242

Protocol	Lifetime (days)	%Lifetime increase
UDP	560	35.92
TCP	412	0
ARP(10%)	542	31.55
ARP(50%)	475	15.29



Conclusion and Future Work

- An adaptive reliability protocol can provide energy savings that extend device lifetime.
- Energy savings depend on the reliability level
- 50% reliability increases lifetime by 15.29% while 10% reliability increases lifetime by 31.55% which is close to lifetime using UDP
- IoT applications request required reliability
- Application requirements should be taken into account when determining the required reliability level

- Future Work:
  - Complete protocol development in NS3
  - Compare performance of IoT protocol CoAP with and without ART