To Hop Or Not To Hop

# Average 100m time and pulse on a marathon run!

Hop conditions:

* Store and forward: Correctly receive a packet before it can forward
* Cooperative relaying Techniques: Just send what you get! Sink will try to estimate the full package.

Distance

* Stationary target
* Moving target – when must it use a relay? “Frisbee Model”
  + Timeout after sending a package = using relay instead? (Chap 11)
  + One sink – One moving source
    - Central Organized
  + Two sink – one moving source?
    - Distributed Organization: In-Network Processing
    - Data-Centric Network
    - Time Synchronization
  + One sink – Two source/Sink – One moving Target
    - Central Organized
    - Time Synchronization
    - Localization
  + One sink – Four Source/Sink-One moving Target
    - Central Organized
    - Time Synchronization
    - Localization
    - Topology Control

Material

* Different material different power absorption of the signal amplitude
  + AIR
  + “Building”

Frequency

* Sampling Frequency
* Penetration frequency of material

Quality of data acceptance

* Store and forward
* Cooperative Relaying Techniques
* Aggregation: Do we need the entire signal or can we use average/min/max over some time?

SNR :

* Internal Noise
* External Noise

QoS:

* Bandwidth
* Delay
* Jitter
* Packet loss rate
* Robustness (Can we sell our idea as approved merchandise)

Lifetime considerations

* Time to first node death

Scalability

* One, two or many hop

Compression of data to give extra distance

* Correlation / temporal correlation
* Fidelity and accuracy in relation to estimations
  + Calculation powers?

Database and result considerations

* Central base database?
* Distributed database with mean values?

Time Synchronization: Chap 8

* Energy consumption of synchronisation algorithm
* Scalability
* Precision requirements
  + NTP: Network Time Protocol : Receiver synchronize to the senders’ clock
  + LTS: Lightweight time synchronization protocol : External “GPS maybe” reference time node
  + Diverse

Localization: Chap 9

* Physical position vs symbolic location
* Absolute vs relative coordinates

Topology Control: Chap 10

* Hierarchies and node restrictions

# Introduction

## Scenario introduction

|  |  |
| --- | --- |
| A marathon runner is racing a track shaped as shown in figure 1, while equipped with sensor node A. The sensor node is broadcasting a package every second tracking the runner’s pulse history. The level of details in the tracking package defines the number of marathons possible for the runner to run before a new battery is required. At one time the track was closed, resulting in the runner racing around the building of her workplace.  Protocol introduction “To hop or not to hop”  Node A will be broadcasting with a packet size of 128 Bytes. The base station will collect the data from node A when in range and save the data. The North station will, when in range and the base station is out of range, receive and relay the message to the base station. The same scenario will happen at the south station. Time Synchronization, Localization and Scalability will be considered regarding the protocol design. Each and combined scenarios will be evaluated in relation to signal strength relative to power consumption and data reliability. |  |

Figure 1: A marathon runner "node A" is racing around a track, while transmitting pulse information to the base station. In the red northern territory, node A transmits to the north station which relays the message to the base station. Likewise, at the southern station.

## Power consumption

### Source: Node A

Source node A will be transmitting at a periodic transmission rate. Different levels of power consumption will be determined by the chosen protocol, but, in any case, the power consumption will be considered, over a period of one second, constant. The less power consumption of node A will give longer individual lifetime and runtime for the runner, but low signal strength of node A might not give a lowest possible system power consumption. Depending on the needed quality of the received package, e.g. -3db, a cut of distance will be calculated and measured. Distance measuring will be limited by interference providing a need for a scalable transfer function estimate and an average over multiple measurements. Life time of node A will be considered when half of the battery capacity is used.

### Sink and Source: North and South Station

Idle time, receiving and transmitting power consumption will be calculated and measure. When out of range the “pole” stations will go to an idle state to save power. When in transmitting mode different measurements will be conducted depending on the chosen protocol. E.g. firm or no handshakes between pole station and base station will be measured leading to different possible distances between jumps.

## Sink: Base Station

The required detail of information needed to give a good user estimate will raise the question of acceptable package loss. Signal strength, package frequency, package loss vs reliability from both pole stations and source will determine the power consumption of the base station and the system. The base station will never be in idle state and it must be able to reach pole station resulting in the highest cost function of the system.

## Path Loss “Free Space Loss vs Engineering building space loss”

## Deep fading and ARQ

Fast Fading: Page 92 [Ref 1] “*For WSN with their small transmission ranges (leading to small RMS delay spread) and their comparably low symbol rates, it is reasonable to assume flat fading channels.”*