18-750 Project 2

CONTENT CENTRIC WIRELESS NETWORKS

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Networks have traditionally been used to retrieve and transmit information in various forms. But the way this information is retrieved has very little to do with the content being based on a host-to-host communication model which relies on IP addresses. With the growing popularity of IoT and sensor networks, the networks as we know today fall short in their ability to handle the scale and relating the content to its location.

The primary motivation of this project is to develop an intuitive scheme of content centric networks to bridge the gap between the content and how it is addressed. While the project can be generalised to all kinds of networks, the broadcast nature of wireless networks allows for flexible and realistic scenarios with sensor devices. The prospect of Content Centric Networks for growing data communication needs in IoT and sensor networks make a compelling case for working on this problem.

Design

The proposed project will involve formulating a location based hierarchical addressing scheme to retrieve content from sensors in a wireless network. While most of the intelligence will remain with the switches, the overall design can be broken up into the following components:

Intra Network

a) Sensor Nodes

The sensor nodes are generally responsible for providing data of a fixed type with varying attributes. For example, a temperature sensor will always report temperature but it could have different attributes like unit - Celcius or Farenheit, precision - current or hourly average. The node will advertise itself with a unique ID based on its MAC address, its position and the type of information it reports. Each sensor can advertise several attributes.

b) Switches

Switches will be the central point of contact for sensors. They will listen for node advertisements and add them to the routing table using their unique ID while maintaining attribute filters for each node.

c) Clients

Clients are nodes with the type: Host. Their primary purpose is to retrieve content from the sensor nodes.

Every node's address is a combination of its unique ID and key-value attribute pairs. The switches will maintain the routing table information through a periodic heartbeat.

Inter Network

FIB construction / Routing

Each switch will have a hierarchical address based on its location in the chain. For example, a Switch on the 9th Floor of Gates will be addressed as Pittsburgh/15213/CMU/Gates/9F while the one at 9F West would be Pittsburgh/15213/CMU/Gates/9F/West. The switches will advertise this information to the other switches to construct a FIB and routing will take place using Bellman Ford routing algorithm.

To retrieve temperature in Celsius from sensors in the West side of the floor the request would be addressed to Pittsburgh/15213/CMU/Gates/9F/West with Type: Temperature and Unit: Celsius. If the router at Pittsburgh/15213/CMU/Gates/9F/West successfully matches the type and filter in its routing table, the request would be made to the resultant nodes and response sent back to the client.

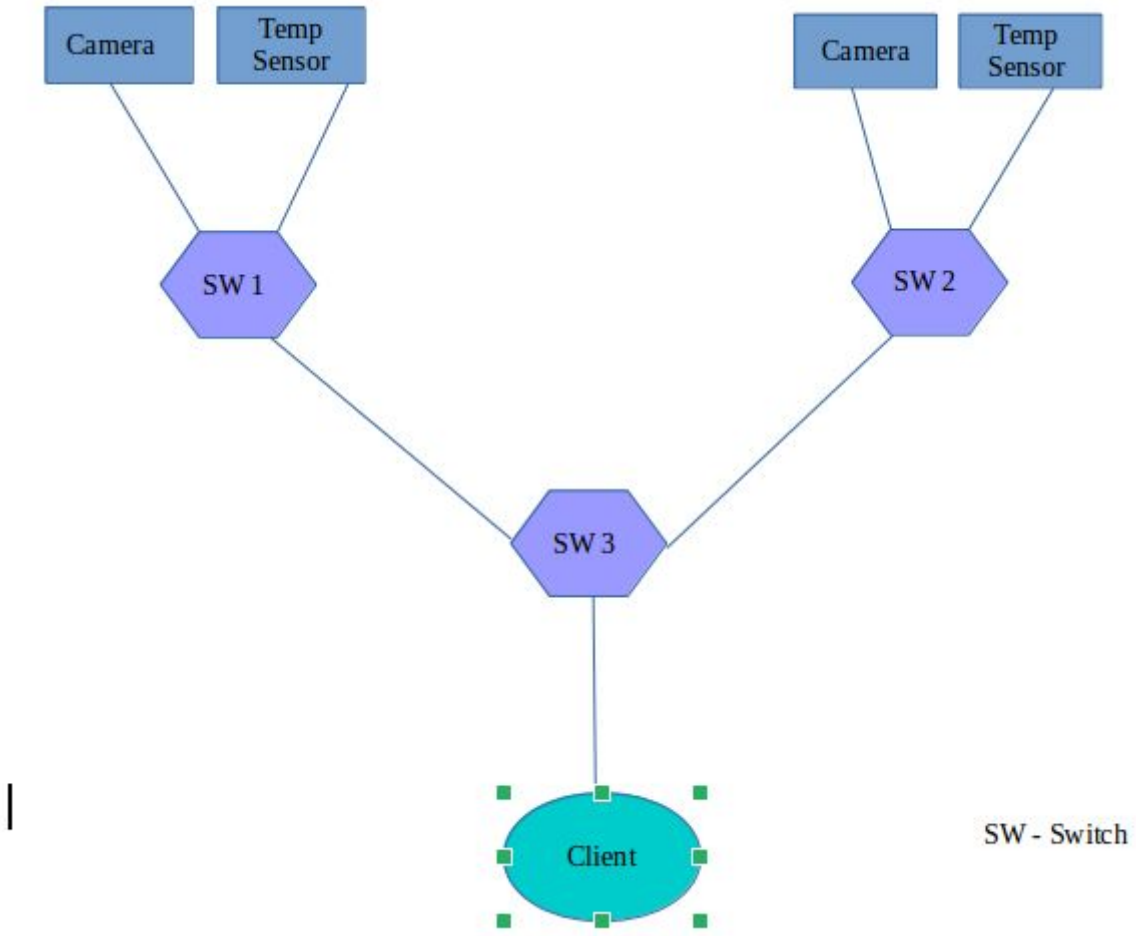
Additional considerations

- Fallback Route/Method
  Routers could cache frequent requests to the sensors and present the results in case of network disruptions.

- Security
  Joining the network based on a shared key.

- FIB compression
  Using Bloom Filters instead of Prefix Matches

Topology



Requirements:

Software
Click Modular Router

Hardware
Raspberry Pi – (7)