Searching in Internet of Things using VCS

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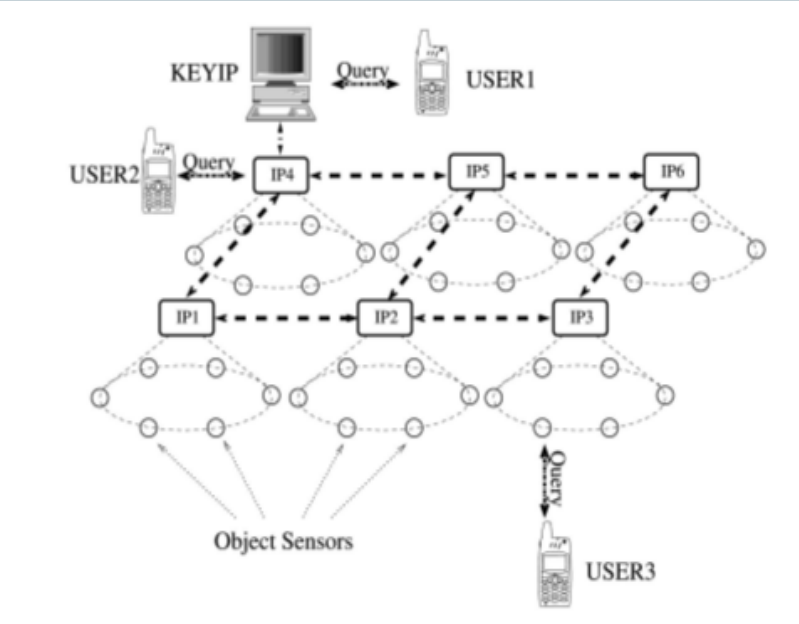
Introduction

- We will have hundreds of billion of RFID-tagged objects by 2015.
- The readings of these tags posses very short life-span.
- IoT is network of this *smarter* objects
- Search space is much larger than current Internet
- Due to high dynamic nature of nodes, existing approaches like crawling and indexing cannot be used.
- Use of Virtual Coordinate System (VCS) for finding optimal service provider.

Recent work – Snoogle

- An information retrieval system built on sensor networks
- Each real-world object is associated with sensor which carries textual description of object.
- Hierarchical structure consisting of *object sensors*, *Index Point (IP)* and *Key Index Points (KeyIP)*



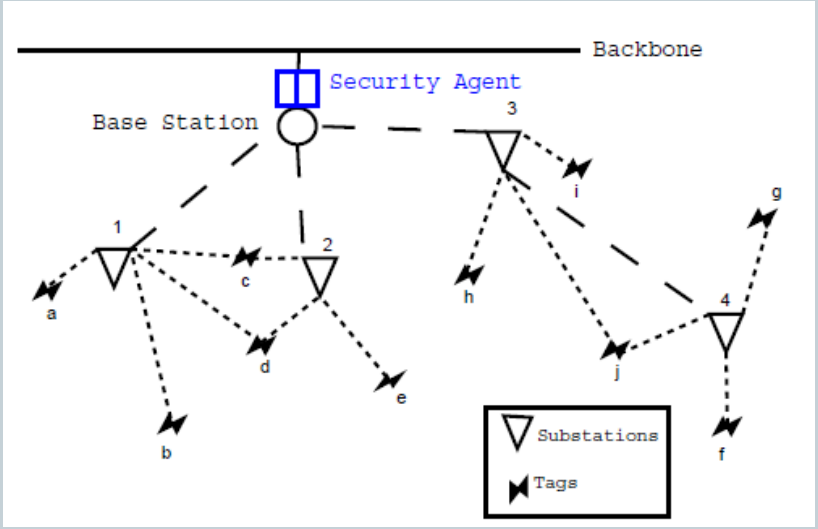
System Architecture

Recent work – Snoogle

- End user can query using a smart portable device like smart phone
- Searching is based on keywords, which will be compared with textual description of objects.
- Two kinds of queries
  - Local – specific to range of one IP
  - Global – query KeyIP and that will broadcast it to all IPs.
- Limitations – Supports search for static data only, for each change database at IP and KeyIP must be updated and use of Bloom filters generate approximate results.

Recent work - MAX

- Human-centric search engine
- Provides location that is natural to human instead of actual coordinates.
- Uses hierarchical structure in which objects in each level are easily movable than higher levels.



System Architecture

Recent work – MAX

- For privacy concerns tags can be made – *public* which can be searched by anyone or *private* which can be searched by owner.
- Uses pull based mechanism for query resolution.
- Query will be broadcasted to all substations by base-station which further will be broadcasted to every tag by substation.
- Limitations – each query has to be sent to each and every tag which makes this inappropriate for global networks.

Major Challenges

- Architecture Design – current techniques like crawling, indexing, storing does not work.
- Search in Locality – unlike web search here user is interested in some physical object
- Scalability – as RFID tagged objects increases the system must be scalable.
- Real-time – one of the most important requirements of IoT
- Privacy and Security – as data is extremely private and tools like firewall are not useful as insiders and outsiders cannot be separated in pervasive environment.

Proposed Technique

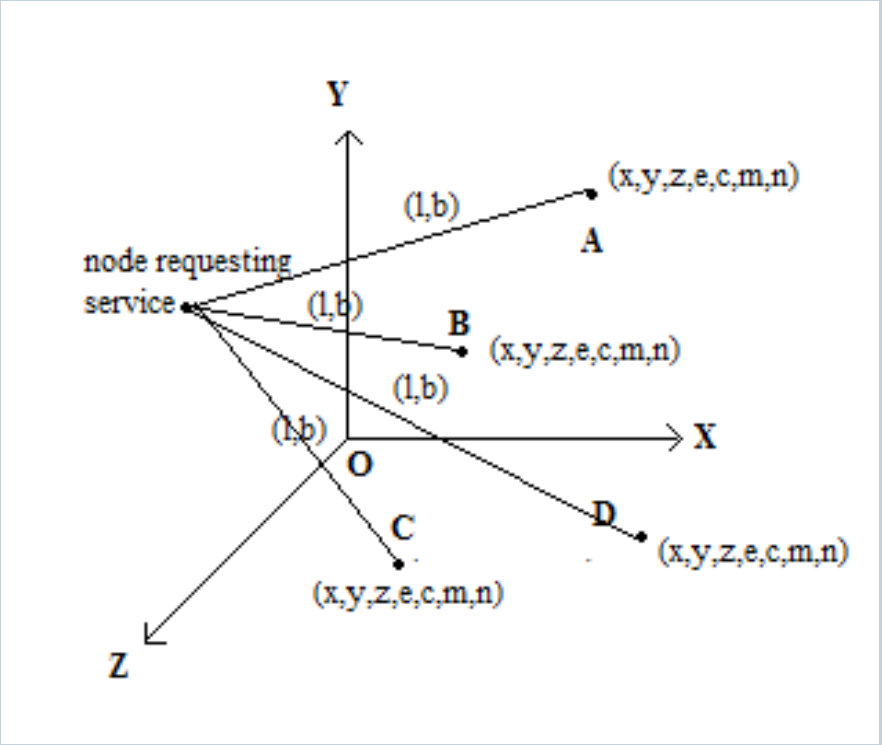
- We propose a novel approach for Service Discovery
- We are using VCS (Virtual Coordinate System) which is used in Peer-to-Peer networks for finding nearest node providing service.
- Basically we assign each node several attributes like memory, energy, computation power etc.
- After having this all features the node requesting service does some processing and provides list of nodes ranked according to user's preference.

Node Parameters

- Shortest distance
- Energy level
- Communication cost
- Computation cost
- Memory
- Node status
- Bandwidth
- Latency

System Architecture

- Each node has seven parameters and each link consists of two parameters.
- System does not have any mediators which makes system scalable.
- User can assign weights to different parameters to indicate priority.
- Our system uses pull based approach to maintain up-to-date data.



System Architecture

Calculations

- Least Distance : Euclidian Distance using x,y,z parameters
- Energy Level : Specified by node
- Communication Cost : Calculated based on distance and transmission capacities
- Computation Cost : In terms of approximate time it will take to complete the task
- Memory : Specified by node
- Node Status : Specified by node
- Bandwidth and Latency: Unlike wired link bandwidth and latency are not constant. To measure them periodically *hello* packets can be used.

Calculations

- After getting all this parameter we are using weighted-mean to find optimal service provider
- The weights to each parameter is decided by the user and if user has not specified any priorities then each one is given same priority.
- And finally a ranked list according to users preference is provided.

Conclusions

- We have proposed Virtual Coordinate Systems based searching technique which finds the optimal service provider in IoT.
- The inclusion of parameters like energy and communication cost makes this system more suitable for WSN.
- And our system used pull based approach which makes it scalable to larger networks.

Key References

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