PROJECT -1

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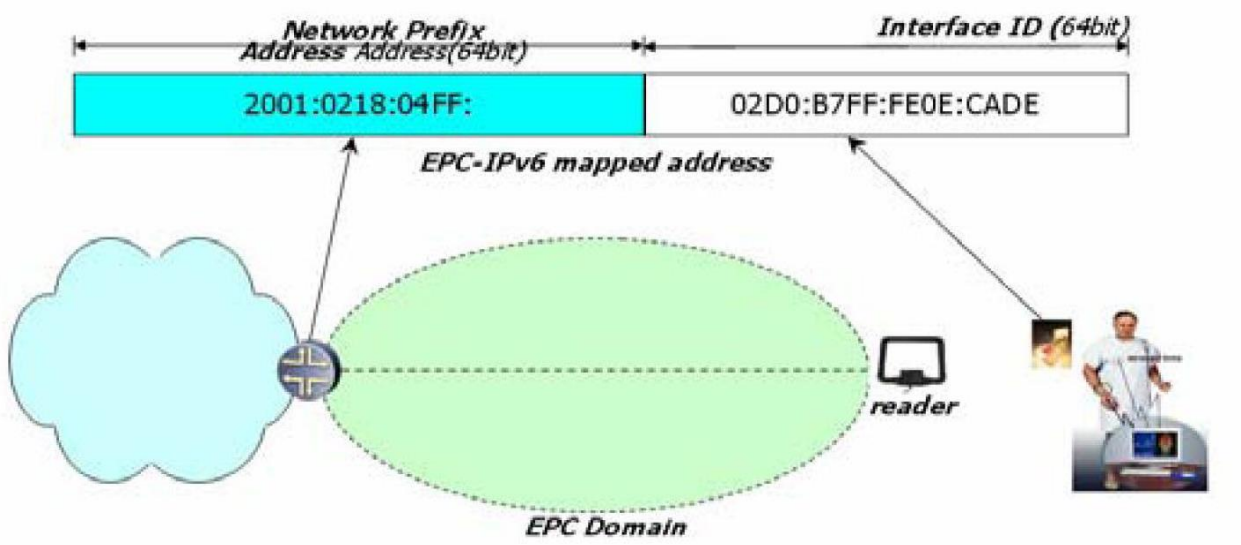
The Internet of Things: A survey

1. Section 5.2 of the paper describes about the issues of addressing the thing/ RFID in particular, which enables the RFID to communicate with the internet. In the paper two methodologies have been discussed.
   a. Use IPV6 mapped to the EPC address of the object.

   b. Use the RFID data in the IPV6 payload.

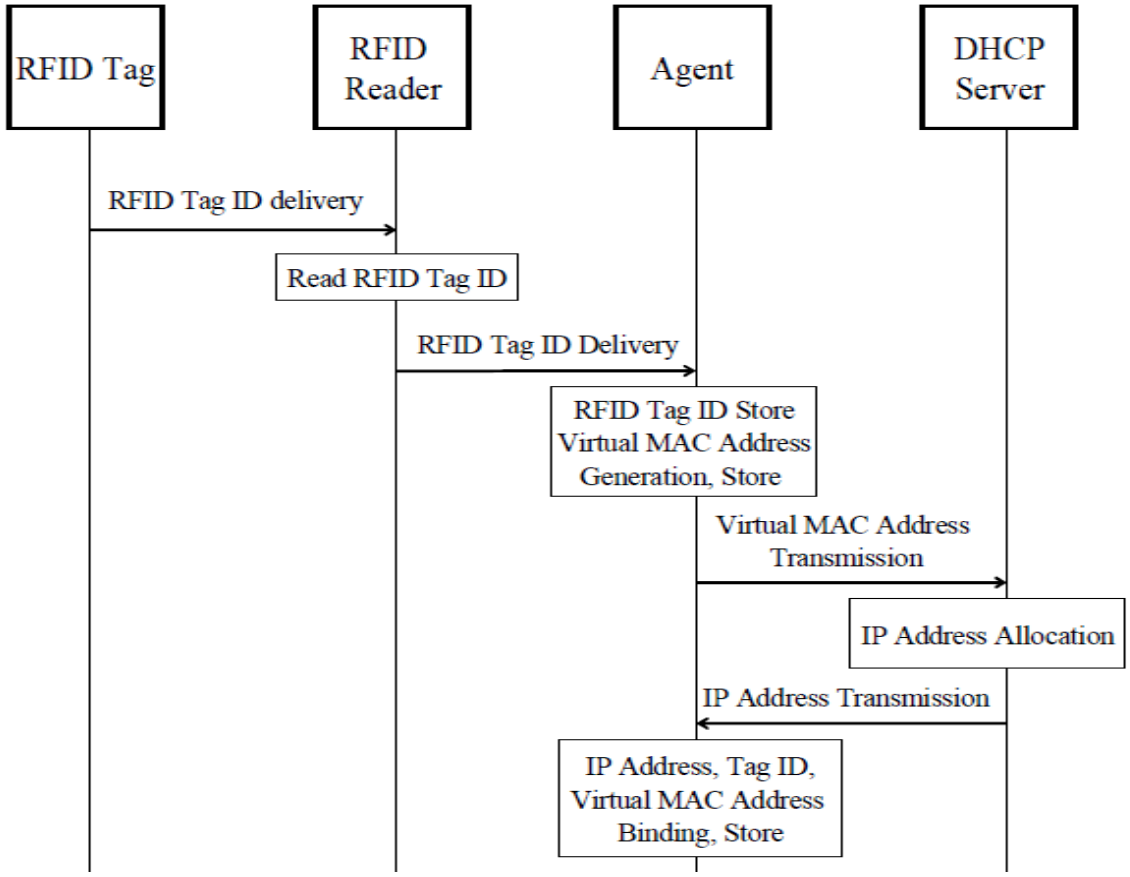
Differences:

- First method tries to map the RFID tag with IPV6 address, by using the 128 bits IPV6 address field; where 64 bits of 128 bits are used for RFID tag identifier and other 64 bits is used to address the network interface gateway between RFID system and the internet, as shown.



EPC code for the RFID tags were of different bit size, 64, 96 and 256. The above mentioned method of mapping the RFID tag with the IPV6 address is with the EPC code of bit size 64. This method won't work for the EPC code of 96 bit. To solve this the agent method is used, where networking mechanism using address management agent so that networking using IP in RFID. Network mechanism using

address management agent receives RFID tag ID of various length and generates IP address. Also, the information of RFID tag ID and IP address is mapped and it stored in address management agent. By using the mapping information stored in the address management agent, RFID is able to make the networking using IP between RFID tags, as shown below.



- Other method discussed has the idea of encapsulating the entire RFID message in the IPV6 payload, thereby avoiding any mapping of the EPC code to the IPV6 and creating different ipv6 packet. Source and destination address are used, where source address specifies the address of the tag provided by the DHCP server in the core network and destination may be somewhere in internet.

Advantages:

- First method able to achieve the objective of providing the real time information about the object. EPC Information Server can trace objects location because it records the reader's information such as IP address whenever it was requested. But, there are many difficult to get real-time information the objects embedded with EPC code. Therefore, we have been required that mapping method between EPC code and network address to get real-time information. Since there can be EPC of different bit sizes, the mechanism discussed to support the different EPC code length helps to achieve extensibility. This is very advantageous for the tags/objects without the TCP/IP stack to be able to communicate with the internet.
- Second mechanism discussed which supports addressing the RFID, has advantage of faster global tracking. Better coverage of all-IP and beyond. Increased scalability, reliability and security.

Disadvantages:

- First methodology uses the concept of mapping the EPC code to the IPV6 address of the tag at the reader or at the agent in the reader, which will be a huge overhead to the reader in terms of the memory consumption to maintain the mapping of IP and EPC code of different tags in the network. Consider the case with thousands of tags the agent or reader with small memory will be over utilized. Since there is so much mapping and for each message communication reader has to do so much work of getting the proper tag to communicate, considering the passive reader; the battery life will deteriorate. Gateway needs to create new IPV6 packet, with the payload as message generated by the tag and source address as gateway ID plus the RFID tag. There is so much processing power consumed doing this heavy duty tasks.
- Second method discussed has the drawback in cost factor, changing the ipv6 to ipv4 and complying to ipv6 standards.

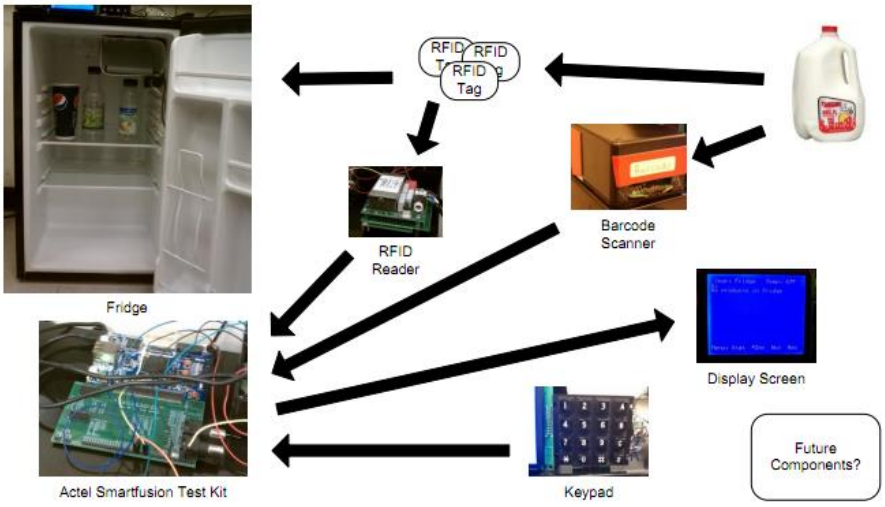
2. The web squared mentioned in the paper, specifies the extended version of the current Web over the internet, which aimed at providing the better user experience and add smartness by taking into the account of the user contextual information. Issues to be considered to support the IoT data over the web are,

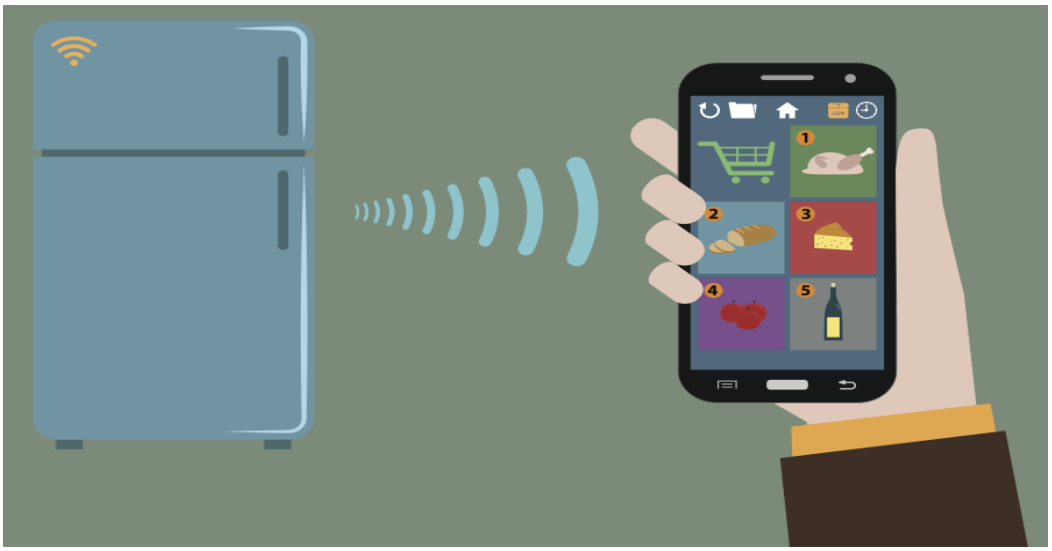
   - Need to develop a better way to address and identify the object/thing in the global context. Need to address the issue of providing the mobility.
   - To provide better user experience the communication protocol should be real time and induce less latency. With the TCP and reliable communication features, user context sensing and acting on the data will hinder better user experience.
   - Since yet there is no standard designed to specify the characteristics (format of messages sent/receive) of the object, it's difficult to converge all the smart objects in the network.
   - Since any device can enter the network and start communicating with the existing devices/things. Authentication to use the network resources and avoid man in the middle are serious issues to investigate and research.
   - Since the current encryption methods and algorithms are designed for the devices and web with good amount of memory and performance capabilities, but in the IoT scenario the devices are constrained of memory and processing power, so new technologies have to be designed and implemented to support password encryption and protecting data.
   - Since the user data is being present in the internet like the user's medical data (heartbeat data, or any medical condition), users location data and many more data collected by the sensors and applications may be collected and may be misused without the user's knowledge. There are no current technologies to control such diffusion of data.
   - The issue like digital forgetting need to be introduced to remove the data about the user from the storage, which are of no use anymore.

3. One of the applications of RFID can be used in the smart refrigerator, wherein each items in the refrigerator have a RFID associated with it when it purchased from the shop. And RFID data can be read by reader in the refrigerator and information about the items can be then streamed to server to analyze and draw some action out of it. Use case to achieve is items will have an expiry date associated with it, which is entered for that item during the manufacture or packing. Reader can make a note of all the items in the refrigerator by sensing every time a new item is placed or the item is taken

out of the refrigerator. It can then send those data to server to make analysis about the type of item and their expiry date, how stale the food will be in next one day, what's the condition of the food now, what all recipes can be prepared from the items in the fridge. If user wants to make a make a recipe user can just ask the refrigerator reader about the list of items in the refrigerator so that reader can intimate back about what all to buy. To add some more smartness, it is possible the user can just intimate the reader or an agent in refrigerator just like, "Get all the ingredients for Italian lasagna". Refrigerator agent can get the cuisine details and match with the items in the refrigerator, and it can order online if something is missing. By the time the user comes home all the ingredients will be arrived in home.

Flow Diagram:





Use case of Ordering Shopping lists

The Smart Refrigerator

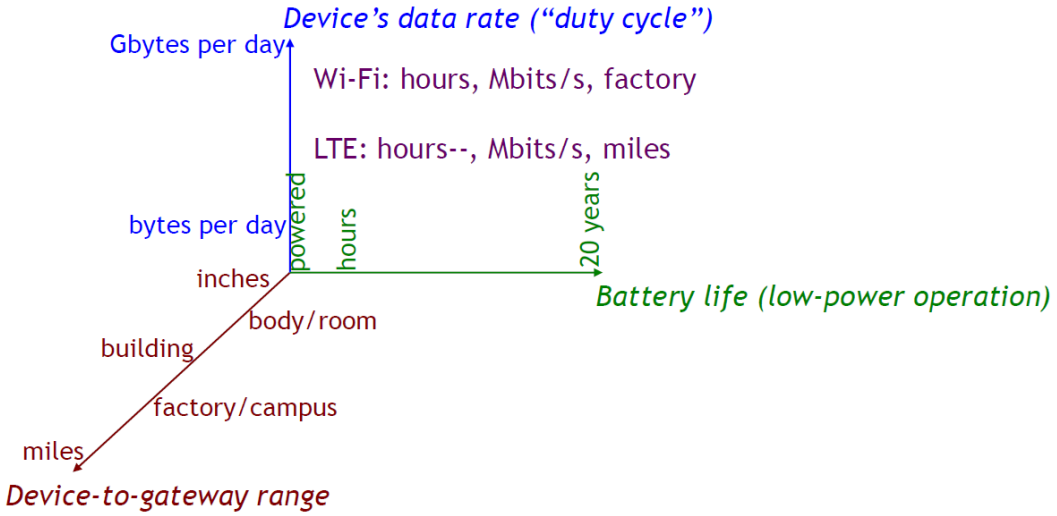
4.

- The vision statements mentioned in the section 2 of the paper, describes the different versions of the IoT vision like ITU vision, Things oriented vision, Internet oriented, semantic oriented and other, all these vision are keyed and linked by the RFID which as the author suggests as the *"forefront of the technologies driving the vision".* The visions proposed considers only th physical generic and the virtual objects which wants to connect to internet through RFID as the only means.
  Author could have consider other visions of how the IoT as a technology approaches to connect the living objects like dog, a Croc in lake tanganyika. There could have been more paradigms to connect such living animals and want to get more data out of those. The use case to solve these connecting animals somethings may be like when did the dog in the house had last meal, is the dog's stomach doing good ??.

- Another description or explanation about the RFID in the paper could have been more as part of enabling technologies. RFID could give data to reader about what the tag information like what the tag attached to, when its created. Since the author considers the RFID as the key enabling technology for IoT, author could have explained about how the RFID can do real time sensing of different context about the thing, human. Like in the above example about the dog, RFID attached to dog can give information about which dog is it attached to, also may be using the EPC code and IPV6 mapping suggested in the paper can tell about the dog whereabouts and location. But author could have explained about **how** to get information about dog's heartbeat etc using sensor networks.

- Author considers SOA architecture to give overview of abstracting the object functionality for appplication developer in IoT and also gives comparision for the RFID, WSN and RSN. Author could have also considered the key network design space challenges involved in the IoT. As shown[1], below what are the technologies need to be used to support different application involving high data rate, for small battery powered, or long battery powered with few bytes of data.

IOT NETWORK DESIGN SPACE



References:

1. https://www.csail.mit.edu/