IEEE IoT
IoT Scenario & Use Cases: City Tagging

Description

City tagging allows a person or a service provider to tag places using a virtual place marker to describe a particular feature of places and link to descriptions available via the Internet. Tags can be public or private. Private tags are visible to a closed user group and sometimes they can be viewed only if the user is paying for a service or a single tag. Tags can be organized to outline a trail within a city – one where place markers are easily accessed and followed by users' with access to smartphones or other mobile devices. Examples of the usage of the basic service are:

- *Users of the service can follow a route that takes the customers to visit places tagged by content providers.*
- *Movies can include tags identifying the shooting locations within a city. Books can be augmented with tags and information related to places of relevance. Social media and social network information can be tagged and geolocalized.*
- *The tourism industry can tag particular areas of cities providing suggestions, as well as more information about places to visit. A single tourist can tag places that he deems important for his visit and then share them with friends or other users.*
- *Tourist guides (e.g., the Michelin Guide) can tag places, and on request, subscribers can be steered towards a chosen restaurant or place to visit, perhaps with reservation assistance being provided.*
- *Tags can also have a social value. For example, friends can share their suggestions regarding interesting things or people with like interests can tag bars, clubs and other entertainment places.*

Applicability Areas: Entertainment, Tourism, Education

A service based on city tagging falls in the Smart City category. Examples of how city tagging can be used include tourism, whereby visitors to a city can follow tags left from earlier visitors, or content providers, in order to gain insight and reviews on available attractions and events. Another application can be used for individual entertainment purposes. For example, a group of friends can leave clues leading to a final prize in a customized treasure hunt game. Educational applications are also possible, such as a city administration tagging all the relevant buildings pertaining to a unique historical period in order to create a virtual tour, or travel guides can tag suggested restaurants and other places of interest, effectively certifying the site for visitors. Finally, city tagging can be a tool for users to tag the places visited in a city as a point of reference for further exploration and research once they return home. This service could represent the basic functions for a Location Tagging Platform to be used to create different services based on location tags. For example: http://geo2tag.org/index.php/Geo2tag:Open_Source_LBS_Platform or https://www.openhub.net/p/geopress or https://code.google.com/p/hood/).

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The Participants

- The **User** utilizes the functionalities made available through the tags. Users can be passive or can add value to tags by updating information (e.g., recommendations). Users can become Tag Owners by creating new tags, or extending existing ones, that can be integrated in the storyboard for a closed user group.
- The **Tag Owner** is in charge of creating a tag and associating it to a directory of tags for subsequent user searches. In effect, this creates storyboards by associating different tags that pertain to different places according to a logical link. It also allows other actors to extend the information content of tags, with such things as advertisements, games and prizes, and with greater communication capabilities creates the possibility of offering services related to the physical location that a tag references.
- The **Content Provider** can be considered as being somewhat of a meta-provider. It represents different stakeholders that can add valuable content to the tags. The Content Provider could be a City Administration that provides touristic, traffic, and historical information about different places and things. It could also be an advertiser seeking to provide local advertisement to tourist or people interested in a specific part of a city. Or, it could be a group of users (a social network) willing to share their knowledge and their suggestions and recommendations about specific spots in a city.
- The **Help Desk** provides further functions and services triggered and related to a specific Tag. It could be the Help Desk of the Tag Owner for helping in technical problem or the specific Tag Content, or it could pertain to the Content Provider that is able to extend the value of the information provided within the context of the tag.

A representation of a City Tagging Service is provided in Figure 1.

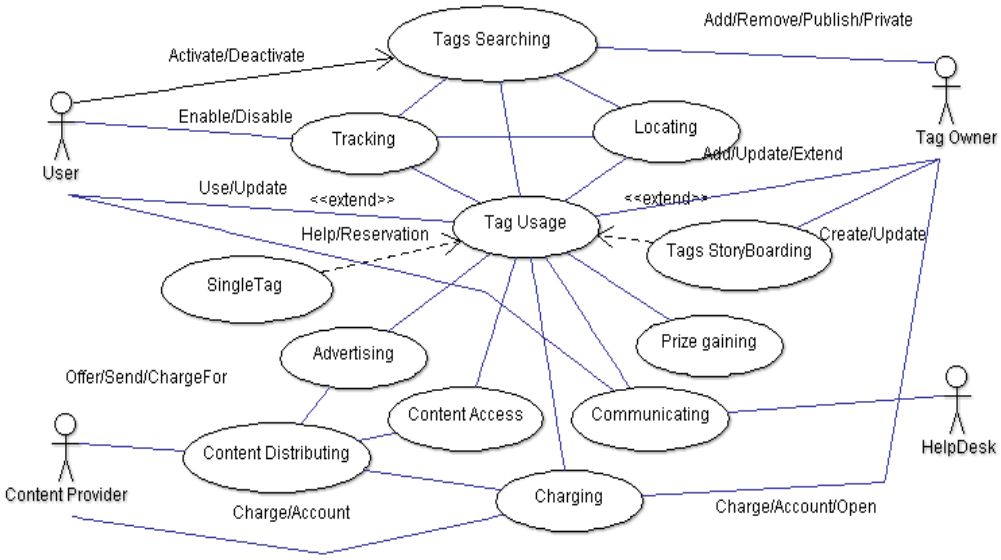

Figure 1: City Tagging Service

Another interesting functionality is the ability of the system to "promote" interesting tags to users who have activated the service and approved this option. Tags with content determined to be of potential interest are then "advertised" to users' on their personal mobile device.

A set of basic high-level functionalities of city tagging is represented in Figure 1. The Tag Owner can create a new tag, or update an existing one, and link either tags he owns or tags in the public domain. In doing so, the tag owner creates a storyboard, which is a set of pointers to associated tags that "tell a story" based on the user's location. The value of the storyboard could be quite interesting. For example, a book editor could sell a city guidebook, as well as access to a storyboard that provides a "virtual rendition" to readers as they walk through the city. What's more, Tourist guidebooks clearly benefit by using associated tags, as they can provide up-to-date information that a printed book cannot.

Tags can be further extended with content and information such as advertising, coupons and special offers. The possibility to communicate, either by messaging or phone calls, with a help desk or with the tag owner opens the door for greater information exchange and added services, such as restaurant bookings.

Access to tags could also require a fee, which could be applied at the level of a single Tag or at the level of the aggregated storyboard.

City Tagging Service Business Model

The business model that underlies a city tagging service is based on infrastructure providers being able to properly map users throughout a city. To achieve this, infrastructure providers could use the location capabilities offered by smart phones, but it could also use sensors and short-range communication to better identify the location of the users (e.g., QR codes or RFiD). In addition, a simple system of identifiers in clubs, bars, and restaurants could precisely identify the right tag and the related users. For instance, a tag could represent a table reserved in restaurant that was suggested by a specific tag associated to the tourist guide. The infrastructure provider is an enabler, it has to provide a few functions related to the location management, dynamic management of tags, the ability to provide content on demand to users and possibly a messaging system that supports the communication between users and tags, as well as between users themselves.

Another important aspect of the business model is tag owners being able to build their own set of tags that can be linked together to form a storyboard to "sell" to users. The tags and their aggregation are open to a sort of "mashup" operated by users providing updated information or by specialized companies and administrations that make specific content available. This creates a valuable set of relationships between users, tag owners and content providers. Additionally, the open nature of the service and the related business model makes it well suited to the actual dynamics of social networks, possibly triggering a "network effect" where a group of users creates tags that are exchanged, improved and further associated across social networks.

In Figure 2, a possible value chain of the Service is represented.

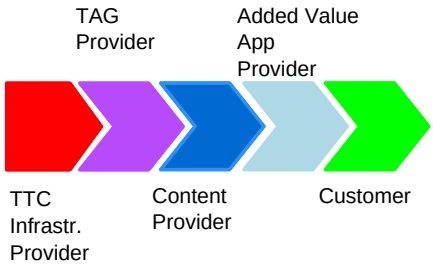

Figure 2: The City Tagging Service Value Chain

IoT Architecture Requirements

A fundamental aspect of a city tagging service is achieving contextual awareness from the infrastructure. This capability is of paramount importance in order to determine the location of the user, the availability of meaningful tags for specific users, determining billing based upon either users or locations, and the ability of the user terminal to support the tag and the related functionalities and associated services. Advertising as it relates to tags is fundamentally tied to personalization, thereby requiring specific knowledge of users and the ability to determine the context in which users are operating. Users will typically be on the move, sometimes quickly, so that the city-tagging infrastructure must react rapidly, and location and tracking capabilities are central to address this. In addition, the ability to dynamically integrate content and policies from several providers is another essential feature of the service. The context manager and the session controller have to keep pace with the availability of local resources within short notification times. The system has to be intelligent in pre-allocating resources and finding alternatives when resources suddenly become unavailable.

Autonomic and self-organization behavior is another particularly useful capability. The importance of contextual awareness is graphically represented in Figure 3, which clearly shows the central role of the context object. Contextual awareness and personalization of services directly pinpoint fundamental issues that could impact IoT architectures. This includes the management of identities and the ever increasing user and object identifiers, as well as the dynamic association of those identifiers within the active service.

It should be noted that the concept of virtual objects, and composite virtual objects, could help the service to have a clear decomposition and layering of functions. At the lower level, the service infrastructure deals with specialized, heterogeneous, and sometime proprietary, sensors and resources. By virtualizing some objects, a more homogeneous and uniform framework can be defined. In effect, it simplifies the usage and programmability of the set of functions available. The session and the context objects seem to be two examples of composite virtual objects because they can integrate functionalities of different virtual objects, providing simplified logic and a more effective set of methods and functionalities for controlling service provisioning.

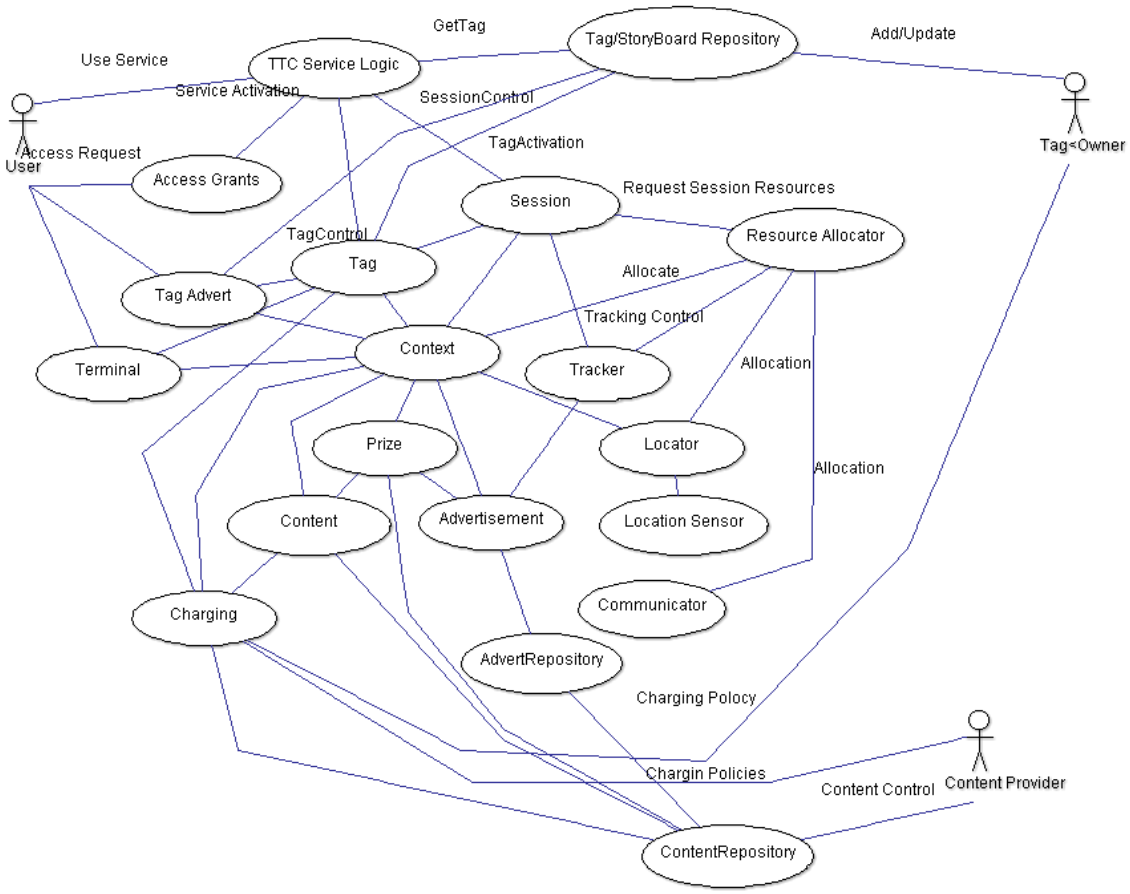

Figure 3: A quasi object model for city tagging service

The rapid and dynamic search of location related tags is another important aspect. Because traditional mechanisms for access to information (e.g., relational databases) do not fit well in this context, one possible requirement for IoT architecture is to provide fast access to information scattered in several places, as the Tag Repository likely will not be centralized. Techniques like nosql (and namely hadoop) could provide a better solution to meet this service requirement. Such an approach could even be improved if distributed search is integrated with cognitive capabilities that can retrieve information without having to process it in a more centralized manner.

Two other aspects are extremely important: the mechanisms to effectively pass messaging between different objects in the infrastructure and the role and involvement of the terminals in the service context. With respect to the first issue, a client server model for this service is a viable solution, but a PubSub, or even a tuple space solution for the communication of objects and things, seem to better fit the needs of the entire infrastructure. These mechanisms could be made more robust by introducing intelligent functions to determine what information should be passed to what existing object. Cognitive capabilities could be enforced in order to help the messaging between entities. The second issue is quite important because terminals will be more and more an integral part of the service infrastructure and there is a stringent need to understand how to integrate them as resources, as well as virtual objects within an open IoT infrastructure.

Other interesting functionalities from an architectural perspective are related to bidding and negotiation of resources. This issue seems to be a recurrent one in several use cases. It probably means that there is a great need for a uniform set of mechanisms for describing, negotiating and allocating physical objects. Since physical objects will show a great diversity, the negotiation of virtual objects could be a means to simplify and unify these important architectural mechanisms.

A summary of the findings include.

- Service level functions to be supported by an IoT infrastructure
    - Localization of virtual tags and association with places or other objects
    - Discovery of services/objects depending on users identities
    - Security/privacy aspects
    - Interoperability of various formats and information tagging
    - Advertising of objects/tags
- Basic functions to be supported by lower layers
    - Communication infrastructure for sending events or suggestions to users.
    - Ability to determine where a person moving in geographical environments or within buildings
    - Contract and openness of virtual objects depending on the contract between users and service providers
- An indication of the functions/requirements for city tagging
    - Mobility of objects and associated VOs.
    - Dynamic aggregation of a meaningful set of tags and possible allocation of resources.

- Interoperability of objects pertaining to different administrative domains
- Self-management with no user intervention
- Integration of terminals