Socio-Physical Interaction Network (SPIN)

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Introduction

- Human beings are smart entities. Objects also become smart when they are capable of:
  - ➢ Identification
  - ➢ Computing
  - ➢ Communication
- Following types of relationships used to exist among smart entities:
  - ➢ Human – Human
    - ❖ Manifested in OSN
    - ❖ Data sharing (contacts, audio, video)
    - ❖ Activity scheduling
  - ➢ Object – Object
    - ❖ Manifested in IoT
- We introduce the concept of Socio-Physical Interaction Network (SPIN) which enables smart objects to establish social relationships with each other
- Figure 1 represents SPIN as combination of Social features among humans and IoT

Figure #1

Internet of Things **+** Social Network of Humans **=** Socio-Physical Interaction Network (SPIN)

- The aim of the proposed project:
  - ➢ To capture different types of social interactions among smart entities
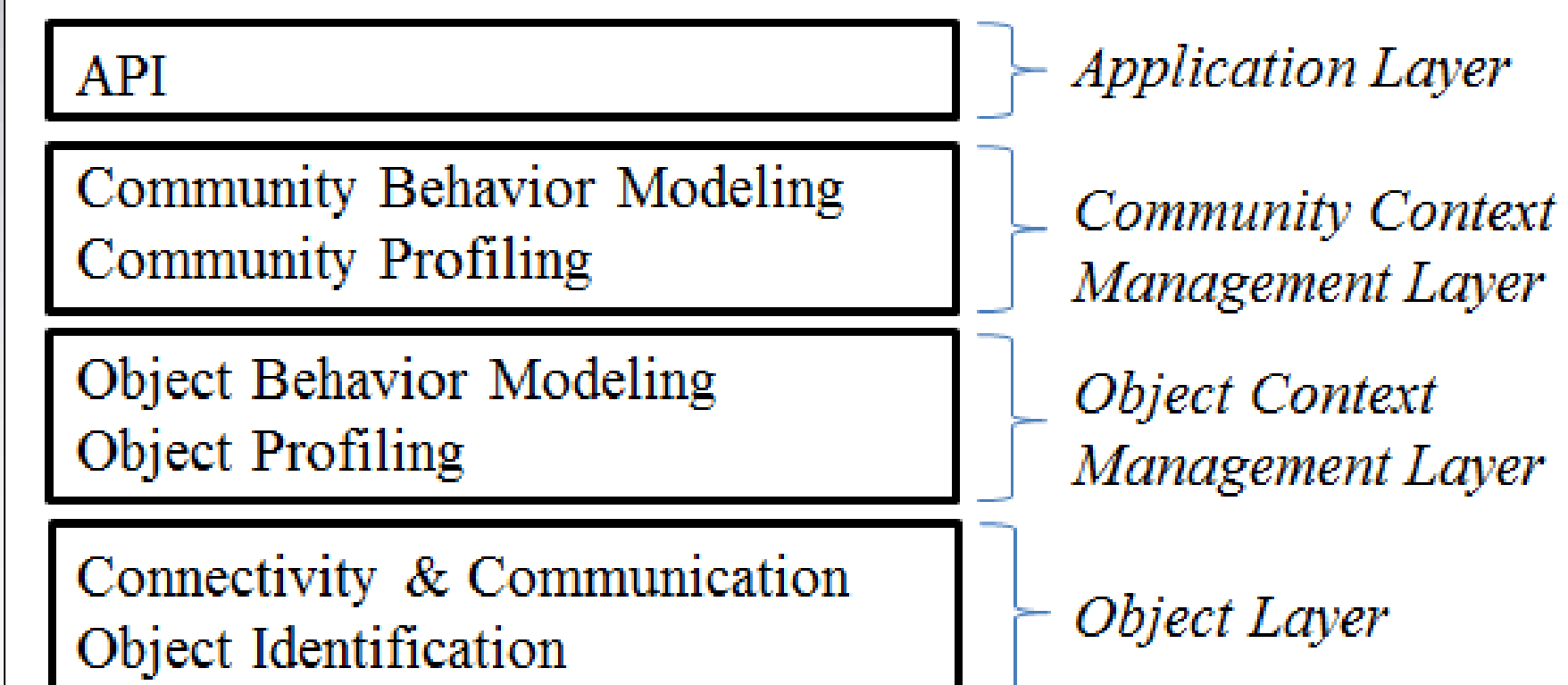 - ➢ To analyze the characteristics of the network of smart entities formed under SPIN architecture

Application

- Smart applications:
  - ➢ Smart home, office, city
  - ➢ Healthcare for elderly and disabled
  - ➢ Security system for large public areas, like airports and shopping malls
  - ➢ Intelligent transportation system, etc.
- Searching and browsing:
  - ➢ Navigating from one object to others through their contextual links
  - ➢ Effective service discovery
- Mobile Social Networking (MoSoN):
  - ➢ MoSoN applications to cater to the social interaction needs of mobile users.
  - ➢ Formation of Mobile social communities on the basis of common interests
 - ➢ Scheduling of activities incorporating several smart users and objects

System Architecture

- We have introduced a four layer SPIN architecture as shown in Figure 2

Figure #2

API	— *Application Layer*
Community Behavior Modeling / Community Profiling	— *Community Context Management Layer*
Object Behavior Modeling / Object Profiling	— *Object Context Management Layer*
Connectivity & Communication / Object Identification	— *Object Layer*

- Figure 3 represents the typical organization of smart entities in SPIN architecture
  - ➢ Objects belonging to a person form *ownership community*
  - ➢ Sub-community among ownership community based on *stationary* and *non-stationary objects*
  - ➢ Resource-rich devices act as gateways between the communities
  - ➢ Intra-community communication through gateways
  - ➢ Objects in ownership community of a person interconnects with objects of friends and family community of the same person to form *social community*
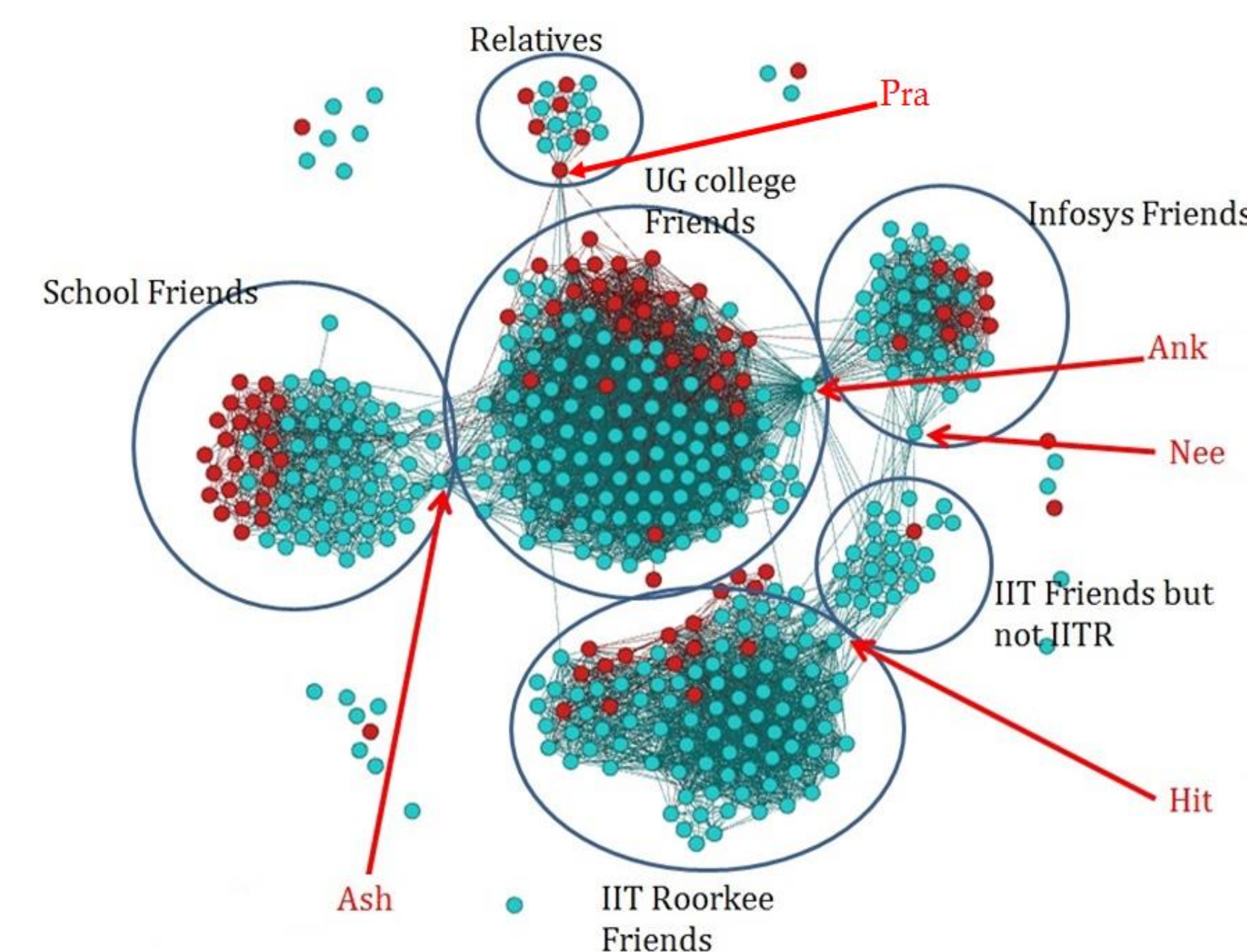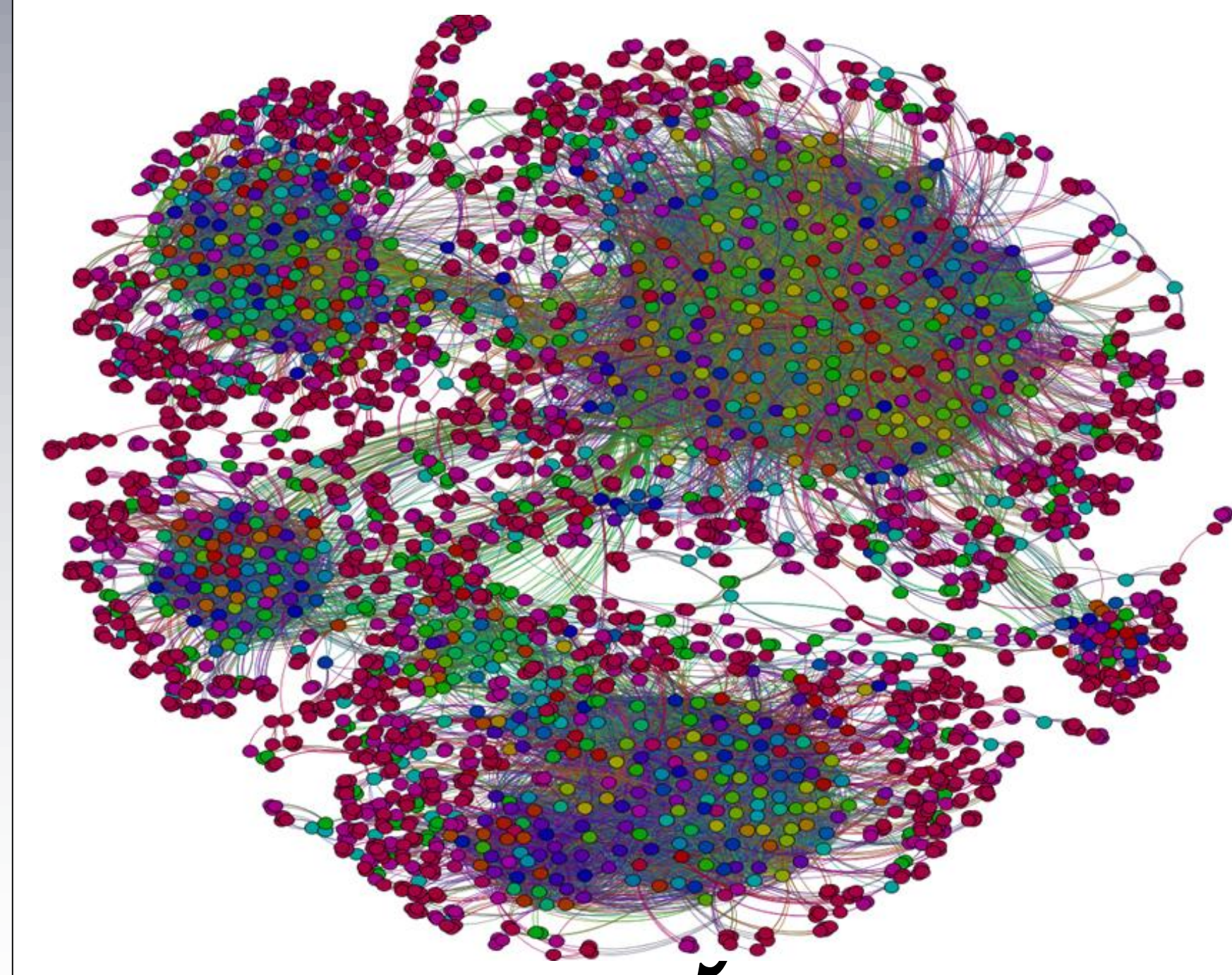
Figure #3
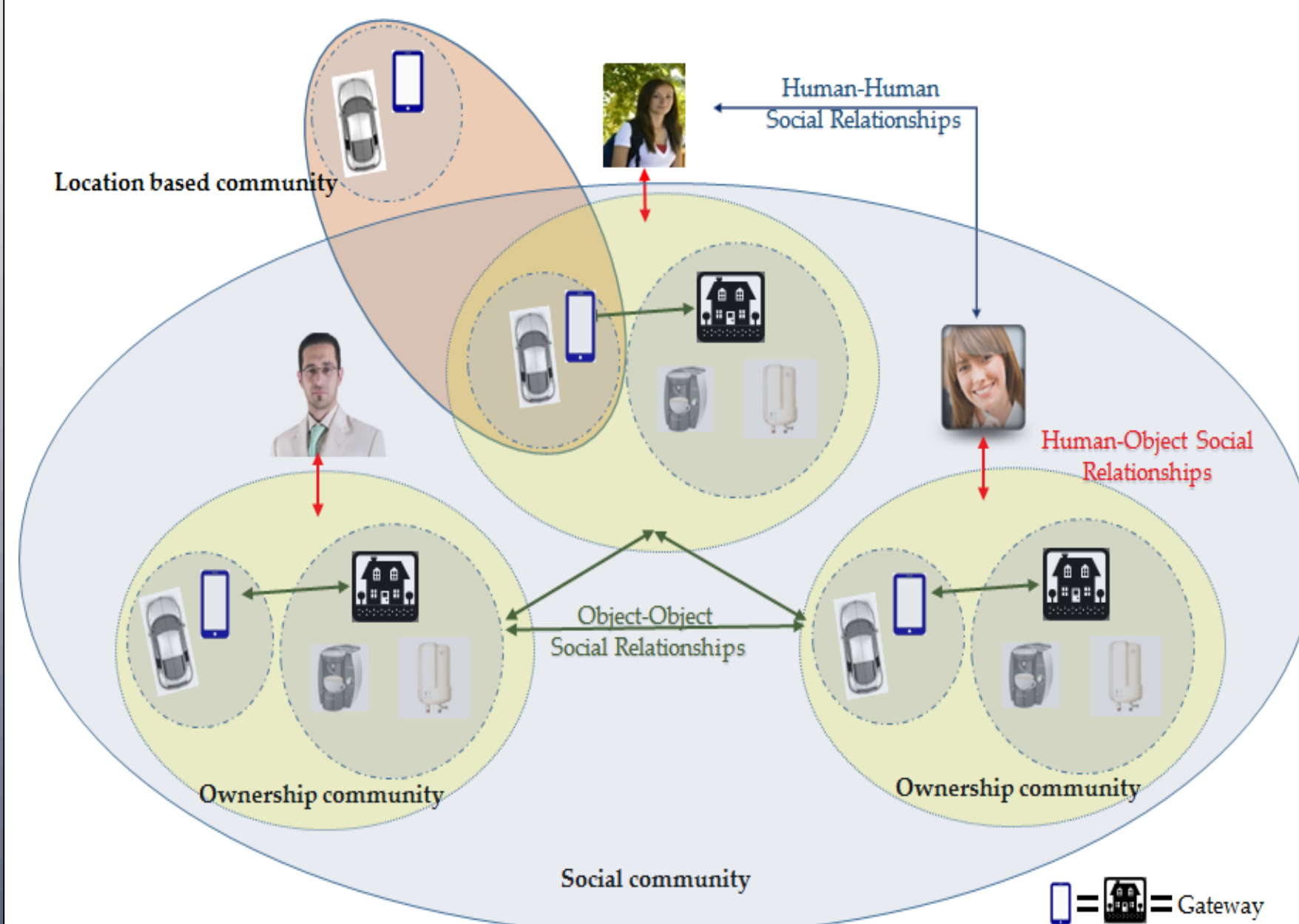
Dataset

- Using the Stanford Large Network Dataset Collection we have generated the kind of network that will be formed among smart entities under the SPIN architecture
- 1115 preliminary social graphs taken from Facebook, Google Plus, and Twitter
- Graph shown in Figure 4 is example of one such preliminary graph. It represents author's Facebook graph and consist of 426 nodes and 6795 edges
- Nodes represents the humans and edges represents the friendship between them
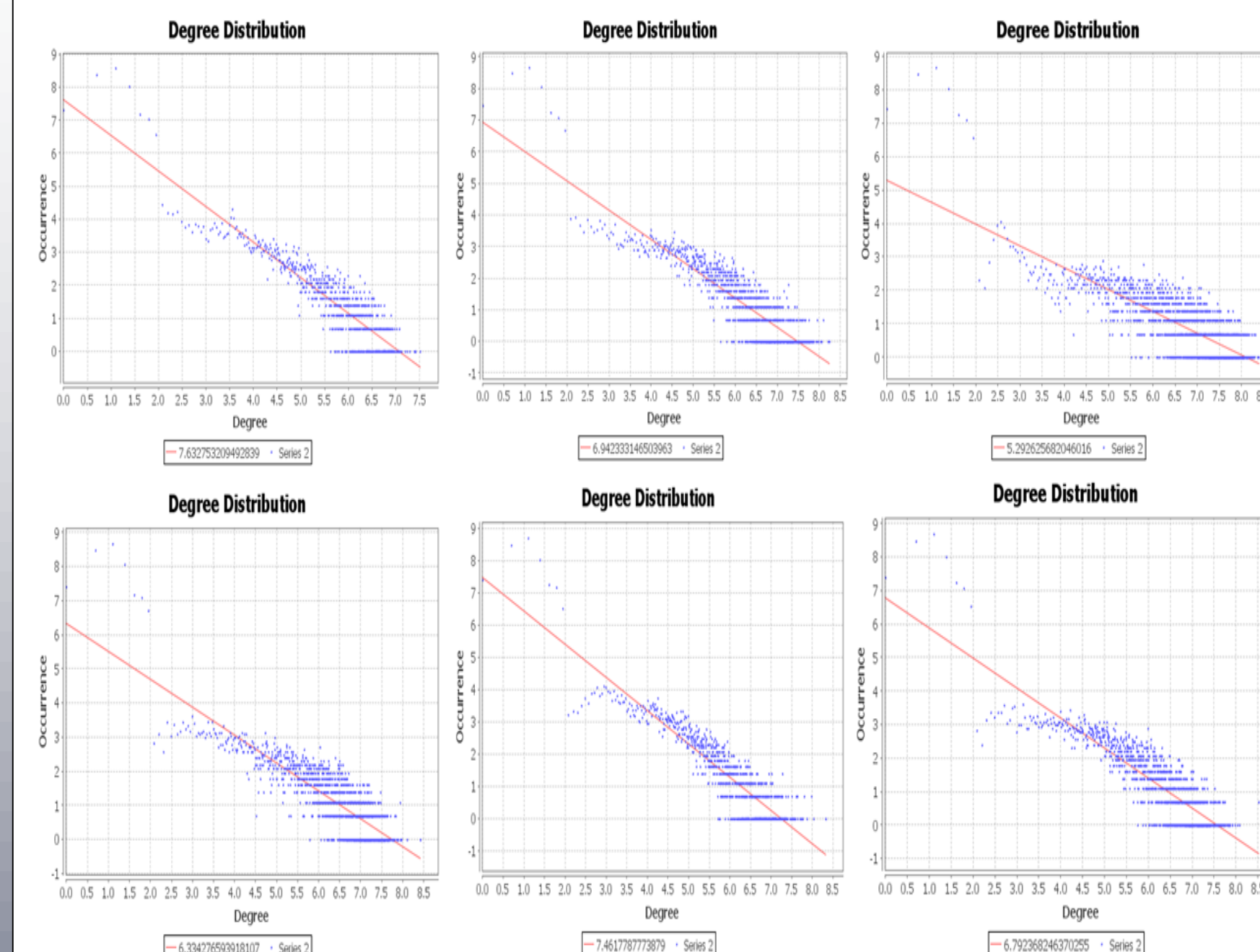
Figure #4

- Using our preliminary dataset we have generated 3345 object graphs
- Figure 5 shows one such object graph consisting of 3240 nodes and 32284 edges
- Nodes represents the objects that belong to a person and edges represents the social relationship between objects
- We have generated three types of object graphs:
  - a) **Regular Object Graphs:** Object graphs representing the case where every human has 9 objects divided into two sets: *stationary* and *non-stationary objects*
  - b) **One-Third Randomized Graphs:** In these graphs one third of the randomly chosen nodes from the regular object graphs have been deleted
  - c) **Half Randomized Graphs:** In these graphs half of the randomly chosen nodes from the regular object graphs have been deleted

Figure #5

- Figure 6 represents the degree distribution of 6 randomly picked graphs out of 2230 degree distribution graphs we plotted on Log-Log scale
- The patterns resemble the degree distribution patterns of scale free networks

Figure #6

Acknowledgement