Review of Peer Selection Process in Device-to-Device Communication

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***Abstract*— The needs for emerging different communication technologies in the current and future network become necessary to achieve the development goals. So, the enhancement of any technology will reflect on the whole system. However, the improvement in the peering selection process will enhance the D2D communication performance that will reflect on the overall network performance and move forward to implement more technologies in the network. This paper aims to provide a review of the peering selection process and explain the main factors that could enhance performance. Also, it explains the importance of making the selection by considering the social relationship between users. The procedure of peering selection should be accurate and prevent privacy leakage that can be achieved if the peering selection considers the right factors in terms of social relationship and connection status.**

Keywords—Device-to-Device, Peer Selection, Fifth Generation Wireless Network

I. INTRODUCTION

The last several years have witnessed an unforeseen evolution in mobile broadband traffic and users' desire for high speed data access. According to Cisco visual networking index, smartphone traffic will be higher than that of PC by 2022, where smartphone traffic will be 44% while the PC traffic will be 19% of IP traffic. Also, wireless and mobile devices will use 71% of IP traffic. Recent report published by Cisco declared that mobile data traffic will increase sevenfold between 2017 and 2022 reaching to 77.5 exabytes per month and 3% of all Internet video traffic will be due to video surveillance by 2022. The global mobile devices will expand from 8.6 billion in 2017 to 12.3 billion by 2022. Over 422 million of devices will be capable of achieving 5G. Globally, the average 5G Nexus will generate 21 GB of traffic per month by 2022 [1].

Such a massive desire of the users for mobile data has been the primary motivation behind seeking alternative cellular architectures. These can bring about paradigm shifts in the utilisation of limited available frequency resources in an efficient manner. Moreover, it is believed that introducing D2D communication into the heterogeneous multitier cellular networks will significantly promote the performance of recent 4G cellular technologies in terms of system capacity, coverage, peak rates, throughput, latency and user experience [2].

Compared to other conventional communication techniques, D2D communication is a very efficient method for communication due to its short wavelength, high bandwidth and limited coverage. Therefore, a set of D2D pairs can establish multi-hop routes or form a cluster, which may autonomously operate with zero minimal or total operators'control. Due to the massive number of users and different types of application, the enabling of D2D communication needs to consider the relationship between users [3].

Thus, users need to check the relationship with their destination before establishing connection. The relationship between both peers should be built on trust to protect each other. So, applying the social-aware factors will enhance the privacy of users and establish a connection with trusted users and avoid the connection with untrusted users [4]. However, the success of applying D2D communication in the future depends on the trust situation because if trust is not considered, it will fail the D2D applications [5].

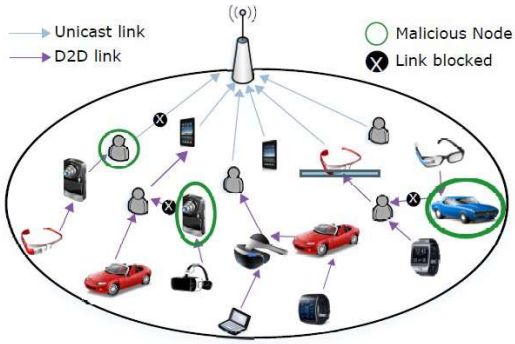

Fig. 1. Node Selection [6]

In Fig. 1, it is showing the general case of D2D architecture and different type of devices connected and some of these links not allowed or blocked based on the connection conditions or social relationship [6]. Some researches depend on the information from the social network for improving the D2D performance. Social information can define the common relationship between different users, which helps to improve peering selection through available users [7], [8]. Therefore, an appropriate social-aware peer selection scheme can be fused into the communication system to address these challenges [9]. The selection of peers is also challenging in terms of reliability since communicating with the wrong peers in the trusted relationship may affect data integrity and cause privacy leakage [7]. The performance of D2D communication can

be improved if the peer is selected in an appropriate way based on the condition of communication and social-aware status. Consequently, in a case of inappropriate selection of peer, the connection may drop or become unstable [10]. The cooperation between users is essential to have an efficient D2D communication system; however, most users do not provide data to unknown users due to privacy issues. At this point, it is essential to define the relationship type to clarify the user status whether trusted (close friend, friend, a friend of friends), or not trusted (strangers/malicious) [10], [11].

In addition, further performance comparison indicated that the social dynamic peer selection scheme does not only maximise connection performance, but also guarantee high privacy protection. An advanced peering and mode selection techniques to establish a reliable D2D connection should be designed concerning users' demands and social-aware status in such a way that they can select the best peers and optimum mode of communication among available modes [8], [12].

II. IMPACT OF PEER SELECTION ON D2D COMMUNICATION PERFORMANCE

The implementing of D2D communication is an important aspect of the 5G network that the future systems will hopefully overcome most of the limitations of the current technologies as long as they are fully controlled. On the other hand, the need to decrease the amount of data to be exchanged between BSs can be added as another advantage [13], [14]. Hence, the challenge is not only in adopting D2D communication system, but also in providing a stable connection based on the conditions concerning social factors. Thus, trust between peers is imperative for an efficient D2D communication and to make it worth to be applied and merged with other technologies [6].

Recently, the application of social factors in modern technologies has become universal due to the need of finding new ways to improve performance and satisfy the users. Peering selection process is based on selecting the peer to establish the D2D connection at a particular area, which is a challenging task due to the huge number of users [15], [16], [17]. The long period required in the selection process for the best device will cause high power consumption, which reflects on the battery drain speed. Furthermore, delay in obtaining the optimum D2D-pair is considered the main issue especially for delay-sensitive applications [18].

When D2D connection is selected as a communication mode, the challenge is on how to select the best peer among the available peers due to the massive number of peers and hesitation on privacy limit. Also, most of peering selection studies considered only peer communication attributes (such as distance and delay attributes) in peering selection decision while ignoring relationship status that will affect the connection quality and user's privacy.

III. PEER SELECTION PROCESS

As the peering selection is part of the D2D communication, this part should synchronise with the other techniques of the D2D communication system. Peer discovery is mandatory for two potential devices so that a connection can be established for D2D communication on the direct link. However, the interested peering parties have to listen only to detect the discovery signal. The discovery signal can be designed as a sequence and messages, which include at least the target identity. In this case, both the proximity and identity discovery will occur at the device side. In some cases, multiple requests of the discovery signal are required due to the high demands for resources and high multiplexing factor.

This paper focuses only on the peering selection process and shows the impact of social relationships factor in this procedure as follows:

- **Prior Steps of Peer Selection**

The steps of linking between peer discovery and peer selection can be explained as follow [19]:

i. In the discovery phase, each device searches for a potential peer within its radio proximity for D2D communication. It evaluates the identity of the discovered peer to determine its credibility for D2D communication. This phase involves a number of messages, which are exchanged between devices and BS in which information about their respective link qualities are communicated. Then, the communication procedure is established whereby the new D2D pairs can initiate actual communication.

ii. The communication phase involves channel estimation, mode selection, resource allocation, power control, actual information transmission and reception. When the mode selection chooses to communicate using a D2D link, the peer has to select its suitable peer to establish the link using a procedure called peering selection [7], [8], [20].

- **Selection Based on Social-Aware Status**

An efficient peering selection is important due to the massive increase of users and connected devices to the network. Social information can be considered in selection decision, which can play a role in protecting privacy if the selection considers the trust relationship between users. Also, the selection process might be enhanced by adopting social factors [3], [21]. To make the adoption of the social-aware factors applicable, the selection must be fast and able to design it in a way that can improve the selection and minimise processing time [22]. So, the enhancement on performance and privacy drive can be used in multi-attribute decision modelling to find the best peer and establish the D2D connection, while the communication and social attributes can be used to rank the peers and select the best one [21].

In [23] the social-trust-aided D2D communication was proposed by considering the social trust to improve the D2D communication and the clustering coefficient in graph theory was employed to check the social-link possibility. Using social trust among users with secure transmission may obtain the ideal bound of potential performance.

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the social trust to improve the D2D communication and the clustering coefficient in graph theory was employed to check the social-link possibility. Using social trust among users with secure transmission may obtain the ideal bound of potential performance.

Nevertheless, these approaches were based only on social relationship to apply the D2D communication system. Social relationships cannot guarantee that the D2D connection can meet the stability and performance level required to establish the connection. The continuous mobility of the device reflects negatively on the performance of the D2D connection if the connection conditions are not considered [17].

Also, in [24], the connection was established based on trusted relationships between peers by evaluating the users based on social actions for peers. They built the evaluation process to check the peers based on these scales, which are close to real value. This way, the connection between peers guaranteed the trusted relationship between peers before establishing the connection, but it regretted the connection conditions that may cause losing the connection or degradation of the services.

So, to have an efficient peering selection method, it is necessary to consider different parameters related to the connection conditions based on the two main aspects. Firstly, there are parameters of the status of the link between peers like delay and throughput. Secondly, there are factors which are related to the social relationship between the peers and how to make the peer selection based on the type of the relationship or block this peer if the relationship does not match the requirement or may harsh the link.

IV. CONCLUSION

This paper has discussed the main points of peering selection in the D2D communication system, which can help in improving the performance of the D2D communication system. The peering selection support users to meet their demands for diverse types of applications by serving them in any expected situation and anywhere for various types of applications. So, the improvement of the peering selection procedures is very important and needs to consider different factors to make sure that always the peer will choose an optimum peer to establish the connection.

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