"AN OVERVIEW OF DEVICE-TO-DEVICE COMMUNICATIONS TECHNOLOGY COMPONENTS IN METIS" PAPER SUMMARY

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Proximal communications interested in use cases that are machine type communications, national security and public safety situations and vehicle-to-vehicle and intelligent transportation systems. Device-to-device (D2D) is not a new research area, but industrial standardization has getting wide area. Recent D2D researches are focuses on full-duplex communications, multiple-input multiple-output systems (MIMO) and advancements of user equipment (UE) capabilities.

In order to obtain advantage from proximity and reuse gain both D2D with the help of the network and physical layer network coding (PLNC) can be used, however they make difference for hop gain. If distance between two in touch device is enough, necessary time slots can be decreased by using uplink and downlink. In addition, by using bidirectional D2D communication reuse gain can be provided. Both D2D and PLNC can be used together in order to make communication between user equipments more reliable, but in this case reuse gain advantage is lost. In METIS, superpositional orthogonality is used in order to allow direct communication between devices. By using this approach spectrum usage is improved. So, devices gathers signal which are high-quality, and it is easy for devices to decode the signals. Orthogonal device acts as both transmitter and receiver. This approach has three main advantage: adding more devices without needed extra spectrum, easy decode of the signals, and better control in the cell.

There are 5 main approach for the mode selection in communication which uses both D2D and network coding scheme. First one is cellular mode which is traditional communication between user equipments. Second one is base station managed 2-TS and 3-TS PLNC. Third mode is D2D communication, and in this mode resource management is handled by base station. Fourt mode is combination of the PLNC and D2D communication by using 3 TS. Last mode is D2D communication by using superposition property.

Although multi-hop connections are designed for NSPS, it is clear that internet services can also benefit. Range expansion and multi-hop proximity can be used with this communication.

The range expansion is designed to communicate using another device in range, as a bridge. For this D2D communication mode selection, RB allocation power control is required.

Another important issue in this communication is that users are not willing to cooperate. Users often aim to maximize their prosperity. Because cooperation will consume energy and processing power. Therefore, incentives are required.

A suggestion for incentives is the reputation of those who share. But this will create an extra difficulty. The other incentive is virtual money. Everyone will earn virtual money for the network sharing. Then, it will be able to spend virtual coins for using network sharing

again. Last incentives can be provided by operators. Because they will need to invest less in the infrastructure.

If transmission and reception can be performed at the same frequency at the same time, then theoric efficiency is doubled according to conventional frequency-division (FDD) or time-division (TDD) methods. This cannot be done in conventional devices, because the devices are receiving their own signals. Recently, the way of doing this has been opened. There are 3 steps to avoid receiving your own signal. First, separate antennas should be used for transmission and reception. The second is analog demand cancelation and the third is digital demand cancelation.

So far, the issue of receiving its own signal was solved at the low transmission level, such as Wi-Fi. As a result, the full duplex radios for D2D are enough.

In the presence of infrastructure-relay-assisted system that supports D2D communication, devices such as cell phones can potentially benefit from multiple antennas. When it comes to D2D communication, MIMO enabled systems that have network coding can be better than normal relay systems that do not support MIMO. The D2D enabled systems can also increase spectral efficiency using spatial domain.

In the previous section it has been discussed that UEs can provide a virtual infrastructure that can help with cell edge performance in Multiple Hop D2D relating. Even though UE relays can be complex they can still be reliable and flexible. MIMO usage in relay networks can help heavily in performance in Multiple Hop D2D relaying because MIMO can always be relied on when it comes to spectral efficiency and link reachability. It worth mentioning that taking advantage MIMO without CSI requirement in Multi Hop D2D can be done with STC. Since there isn't any need for CSI and when STC is used, a result of increased efficiency in UE mobility can be seen.

Coverage extension by D2D can be extended where multiple D2D UEs can direct signal to BS, by using this method signal-to-noise ratio gets better. This technique can also be known as MIMO. This technique is also very useful in crowded places like shopping malls.

Due to needing of people accessing the services on public transports or cars, simply vehicular user equipment (VUE) reliable connection is getting important subject. The biggest problem is Vehicular Penetration Loss (VPL), which reduces quality of signal. The promising solution for this problem that using cooperative beamforming to enhance the uplink of vehicular user equipment. For this solution public transports are so good because users are very active inside of this vehicle and most of the users static in this vehicle.

Three test-beds demonstrated. First one is about impact of interference cancellation (IC) in direct network. In result, LTE segmentation does not prop interface cancellation functionality. The second test is addition to first one with mode selection. The result is the chosen interference cancellation setups can double the system capacity. Third one is about Heterogeneous Network(HetNet).The average of the signal received is calculated.

D2D communication improved from analyzing proximity, reuse and hop gain to national security and public safety and intelligent transportation system. Specifically, cooperative D2D communications extends the coverage by using Vehicular User Equipment. This usage also needs new algorithms and protocols.