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Bottleneck Management Using Consecutive Intervention Annulment in Deeply chocked G2G Networks

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ABSTRACT

The Internet of Things (loT) and particularly Gizmo-to-Gizmo (G2G) communications are considered as major enablers for future smart cities' initiatives. While offering a wide range of applications and services, supporting such devices constitutes, however, one of the most important challenges to be faced by Network Operators (NO). Indeed, the expected huge number of devices requesting to connect to the network at the same time may result in severe Bottleneck in the access network with a high risk of Bottleneck collapse. Although there has been exploitation of the physical layer technique enhance the capability of multi-trip system, link scheduling problems still exist. Link scheduling problem addressed with a cross layer design. Cross layer design is a process of solving Bottleneck and scheduling problems in wireless systems wherever nodes capable by way of the Consecutive Intervention Annulment (CIA) capability under Signal to Interference Noise Ratio (SINR) model. CIA an efficient advance to tolerate the multiple adjacent concurrent communication to coexist, enable multi-packet reception. Cross layer design placed among the physical layer and MAC layer. The technique of both layers can support the additional difficult cross layer design intended use of improve system process. The proposed system consists of distributed link scheduling for solving the interference occurring during communications. This scheduling is an effectual process used for managing the interference relationships and with the help of advanced physical layer technique using CIA to take out the interference moreover decode the data by receivers.

Keywords: MTC, Gizmo-to-Gizmo, smart cities, IoT, LTE-A, Random Access, ACB, Bottleneck, Cross Layer Design, Interference, Physical Layer Techniques, Scheduling

I. INTRODUCTION

The "Smart Cities" initiatives have been recently pointed out by many experts as an emerging market with enormous potential, which is expected to drive the digital economy forward in the coming years [1][2]. With the potential number of applications and services based on Gizmo-to-Gizmo (G2G) communications, it is expected that this technology will play a determining role in smart cities development [3] [4]. G2G communications are expected to grow more and more during the next coming years, reaching 10.5 billion connections by 2019 (up from 3.3 billion in 2014) [5]. Supporting efficiently such huge number of devices within current and future mobile networks (i.e. 50) is of a paramount concern for mobile network operators. Indeed, enabling a full automation of sensors and actuators comes with a cost of an increased number of devices requesting simultaneously the establishment of a connection with the access network (i.e. eNB). This may result in severe

Bottlenecks, between the different terminals attempting to access the network, with a high risk of Bottleneck collapse [6]. Figure 1 illustrates a typical mobile network architecture and highlights the different locations in which there are potential risks of Bottleneck. As it can be seen, the Random Access Network (RAN) is not the only part of the mobile network concerned by the Bottleneck. However, the RAN constitutes the most challenging part since the resources at the core network can be scaled easily, as shown in some recent contributions [7]. Indeed, the number of resources at the access (i.e. opportunities to connect) is very small compared to the potential number of G2G devices willing to connect. Moreover, the diversity of both G2G applications (including prioritized G2G) and traffic patterns makes the handling of G2G devices even more complex.

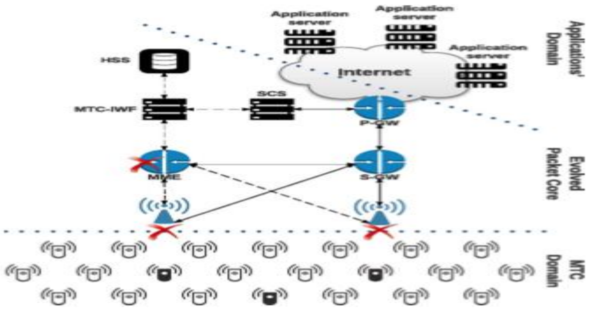


Figure 1. G2G Bottleneck Location

In this article, our main concern is to identify the risks existing in heavily chocked G2G network. Another important concern consists in highlighting some architectural lacks in the current 3GPP model.

To overcome the problem of 3GPP model we use CIA technique which can be applied to both G2G devices and other chocked networks. CIA is a technique that helps to promote the better communication and to result in increased throughput performance. During communication nodes are endowed with CIA in the context of cross layer design. Cross layer intend placed between the adjacent layers for instance physical layer and MAC layer for exploiting the dependencies between the layers and used to support the data services between the layers in the system because the physical layer is in charge for the reception of data and MAC layer is responsible for scheduling communications. Successive interference cancelation (CIA) is sophisticated physical layer technique gives a recipient the ability in the direction of decode two or extra concurrent data packets successively until the data obtained at a particular receiver. At each one step of decoding the receiver have to make certain that the signal presently enhanced meet the SINR requirement or else, no additional decode is achievable.

II. BRIEF OVERVIEW OF THE 3GPP MODEL FOR HANDLING G2G DEVICES

Among different mechanisms introduced by the 3GPP, the ACB is certainly the most popular as it tackles the Bottleneck at its root (i.e. at the access network level). The ACB mechanism handles the problem of random access Bottleneck based on two barring parameters: (1) a barring factor acBarringFactor or p and (2) a barring time ac-Barring Time. Before establishing a connection with the network, the G2G devices, arriving at the state x1 with the average rate λ, check whether they are allowed or not to apply for radio resources. At this state, the devices receive the ACB factor p from the eNB and then start checking the ACB. Thus, the devices pass to the state x2 with the probability p, where they can try to be connected with the eNB by attempting the RA procedure.

Note that the ACB mechanism can be combined with other existing approaches to address more efficiently the access network overload.

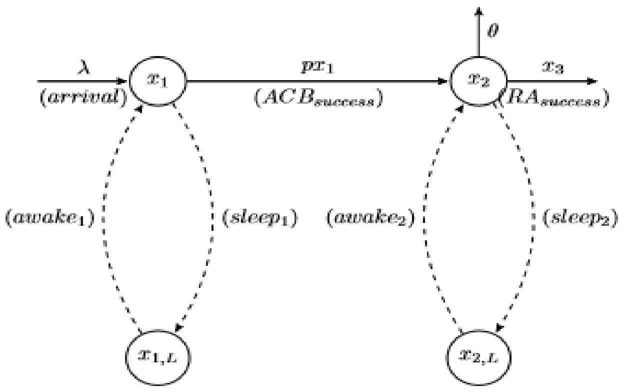


Figure 2. System Model

Otherwise, the devices go to a waiting state x1, L, in which they are blocked during a T barring time (computed based on ac-Barring Time) before retrying a new ACB check [14]. At the x2 state, the G2G devices choose randomly one of the available RACH preambles. If a preamble is chosen by only one device, the eNB indicates a successful preamble transmission 2. If a particular preamble is selected by at least two devices, a collision occurs. The collided devices go to a new waiting state labelled x2, L during a random back off time, which is calculated by each terminal. At the expiration of this latter, the different devices return to state x2 and retry the RA process as long as the maximum number of preamble re-transmissions denoted by Rmax is not reached [15]. Alternatively, the devices leave the system, with an average rate of θ, and may retry the access later on from the starting point. The whole G2G model described above, is illustrated in Fig. 2.

III. LACK OF 3GPP MODEL

Even if it was introduced to deal with the random access Bottleneck, the existing ACB schemes turn out to be ineffective in case of heavily chocked G2G networks. In fact, the ACB is efficient only when the number of devices in the states x1 and x2 is known precisely. However, in most of the overload situations, these numbers are not known accurately. Thus, even if a good network controller is applied to deduce the best blocking probability, its performance is closely related to the estimation of the number of devices in these states. For some types of G2G devices, like event-driven terminals, the devices' arrival can be at best bounded as the process of arrival is generally a mixture of diverse distributions (e.g. Poisson for credit machine in shops, Uniform for traffic lights and Beta for event driven applications). Worse, there is also no mean to know exactly the number of devices that passes the ACB check (i.e. devices passing at state x2), which makes the problem even more complicated. Indeed, even if a small ACB access probability is applied, to block more devices from attempting the access, the accumulated number of devices going to state x2, is far bigger from the limited number of available preambles during one RACH opportunity. Moreover, the number of back-logged devices at state x1 cannot decrease as there is no defined exit strategy in the 3GPP model.

IV. PROPOSED SYSTEM

Proposed system consists of Distributed Link Scheduling for managing the inference links during communication. Initially, nodes are constructed, and energy assigned to each and every node that is deploy in the system. Then find the source node and receiver node with localization process. Among the physical layer and MAC layer, the cross layer design is implemented. Cross layer design is generally used to develop the system performance. System formation achieved in the cross layer design; where nodes endowed with CIA capabilities under SINR interference model. The cross layer design used for supporting the data services between the layers and uses the functionalities of both physical and MAC layers for obtaining better performance between the protocol layers in the system. CIA is a very capable interference utilization technique due to its enable of several simultaneous communications. SINR calculated with noise power, data communication rate, and interference of other data. SINR threshold value must be maintain to hold up the successful transfer the link. If the SINR condition is not met, after that the acknowledged package cannot properly extract from the receiver node then again sender has to retransmit packets. Cross layer design with CIA constraints provides the security against packet loss by solving the link scheduling problems develops a distributed link scheduling algorithm. The decentralized approach uses Distributed Link Scheduling algorithm for activation of interference links. By this Distributed link scheduling ability to improve the throughput performance of a system is improved.

V. SYSTEM DESIGN

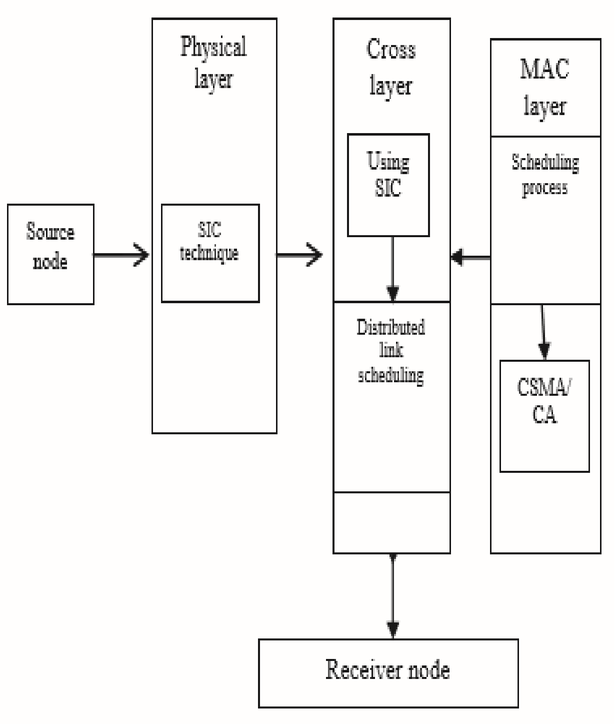


Figure 3. Block Diagram

The following diagram typically explains the wireless multi-hop system where packets are transmitted from the source node to receiver node throughout the layers. Cross layer placed between the physical and MAC layer for improving the Source system performance and uses the functionalities of both layers. Physical layer consists CIA techniques endowed with each node, and MAC layer is responsible for scheduling the communications. Manage the interference links between source nodes to receiver node using distributed link scheduling in a distributed manner and avoid data collision with CSMA/CA. When a packet arrives at receiver node checks data with CIA under SINR model. By this scheduling process, throughput performance of system increases.

VI. SYSTEM IMPLEMENTATION

A. System Formation

A group of nodes is deployed in a system and forms different type of system topologies. Set command is used to create the nodes. Location of the nodes programming with X and Y coordinates, the relation between nodes is determined by the choice of the participating nodes involved, not by an based on random choice. In system energy of each node is created and Assign IP addresses and MAC addresses and then use System Animator (NAM) tool to provide a visual interpretation of system topologies to present throughput, some packets on each link.

B. Localization Process

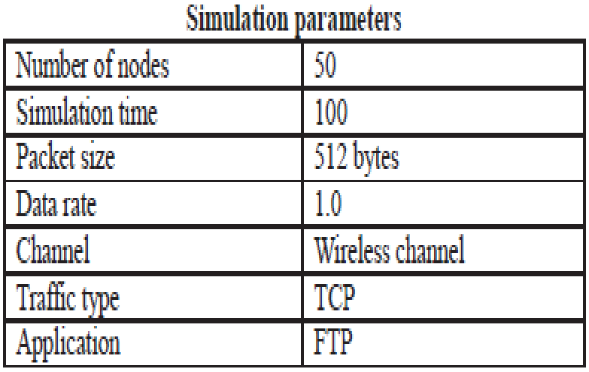
The goal of localization process is to determine the accurate position of nodes with the help of localization algorithm. By this process can quickly identify the source node and receiver node in the system. With these process can able to divide the system into regions such as interference area and non-interference area.

C. Cross layer Design With CIA

Initially, nodes are deployed in a system with IP address, MAC process. After the formation of a system have to identify the location of the nodes using localization algorithm because the nodes will be a static or dynamic process and after identification of sender and receiver node transmit the data packet through a link. When transferring the data there may be interference will occur so with the help of physical layer technique can able to control the interference in a system then data will send to a receiver without any disturbance. CIA method is a physical layer technique give a receiver the capability to make out two or more simultaneous data packets consecutively until data obtained at a particular receiver. Then distributed scheduling algorithm is used for problems occurring during communication in cross layer for reducing the data collision then finally analysis the result.

D. Distributed Link Scheduling

Link scheduling is a process of determining the links for communication at a given time slots based on current traffic. During the process of scheduling, there will be some interference occurring between the neighbourhoods nodes. For solving such interference problems, in existing system GMS method is used in a centralized manner. Even in these, some utility maximization problem occurs, so GMS was developed with a decentralized approach. The main drawback of solving the interference problem is its limited region. So a distributed link scheduling algorithm is proposed with interference localization technique along with timeslots. In systems, simultaneous communications by immediate neighbourhood in the order of the receiver of a exacting link may create major increasing resistance. For these communications, a neighbourhood of each section is determined such that the interference outside the area has only a insignificant impact on its receiver node. This interference localization technique is used to localize interferences for maintaining the scheduling feasibility. With the help of this method, the scheduling process is done with CSMA/CA for avoiding the data collision with time back off the counter. In this process check links may or may not be clear. If the link is not clear then, the node has to wait for some time but if back off counter is zero then process set again and continued. By this distributed link scheduling process the system performance increases and at receiver node checks data with CIA constraints.



Simulation parameters

Number of nodes	50
Simulation time	100
Packet size	512 bytes
Data rate	1.0
Channel	Wireless channel
Traffic type	TCP
Application	FTP

TABLE 1: simulation parameters

E. ALGORITHM

Initialization: Find Na (Li) and Nb (Li) for every Implicit connection Li. Decision schedule selection m

Implicit connection Li chooses an arbitrary back-off time consistently within [1, Wt], also starts back-off.

Implicit connection li., stop the back-off timer while one of the accompanying two circumstances is legitimate: (1) Li hear an TARGET message as of Implicit connection KJ, and connection Li and K are clashing connections, or (2) other Implicit connections in V (l) send TARGET messages.

After li completes the back-off, send TARGET message to declare expectation to incorporated into choice timetable.

If "conflict" among the TARGET messages, Li will not be incorporated in m (t) in this manage slot.

Set-up of communication state

Any connection Li in m be able to alter its communication state if both of the accompanying circumstances are fulfilled:

ɏK ϵ N (l), if Implicit connection KJ dynamic past data slot, Li and K can coexist conventional SINR restraint.

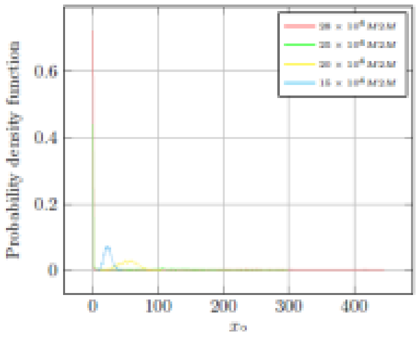
No Implicit connection in N(l) is dynamic in past information
opening.

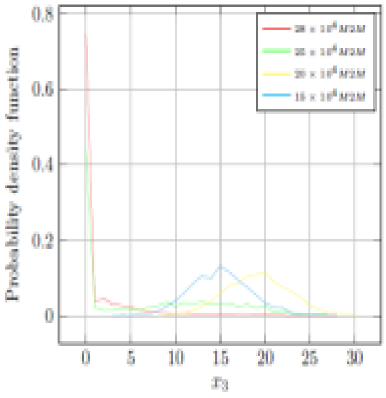
On the off chance that the above conditions are substantial, Li will alter its state as takes after: let I(t) with creation probability P Li, and Zi(t) = 0 with likelihood li =1-Pli.

On the off chance that either condition is not fulfilled,
then Zi(t) = Zi(t-1). information communication
If Zi(t) = I,l will transmitting utilizing setup I data slot.
If Zi(t) = 0, l will not transmit data.

First initialize the node links which is going to perform the communication. The links are scheduled using the back off timer. After finishing, it sends an alert message.

After the scheduling process, the communication state is set up for the nodes according to the constraints. Then the data communication is done.





VII. CONCLUSION

We addressed the problem of heavily crowded G2G network in which there is a high risk of G2G terminals' harmonization. Indeed, as identified in this paper, these networks present resources under-utilization problems and may result in a congestion collapse. We demonstrated that even when applying an efficient ACB mechanism, harmonization cannot be really avoided, which may lead to poor network performances. In fact, in case of heavily congested networks, the increased number of G2G terminals (i.e. increased number of RA attempts) goes along with a significant reduction of the number of successful RA and resources' under-utilization. Besides, we identified the origins of the congestion and proposed some remedies, which may allow relaxing the congestion at the access.

As future works, we intend to cope with the problem of synchronization. We propose to design a smart access mechanism, which estimates more accurately the number of devices attempting the RA while taking into account the structural architecture of the 3GPP model for G2G devices.

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