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# Secured Scheduling Techniques of Network Resource Management in Vehicular Communication Networks

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**Abstract** – Scheduling is the need of every project. Without scheduling, projects don't fulfill time constraints, go over spending plan. It is a process utilized by teams to organize and structure their resources so the tasks they need to complete are scheduled based on availability and capability. This process is more beneficial if it is required to allocate and assign task to the resources without allocating their schedules. This paper reviews different types of network scheduling techniques, which are used to schedule a task. These techniques are very effective and help us to preplan the whole scheduling process.

**Keywords**—Program Evaluation and Review Technique (PERT), Arrow Diagram Method (ADM), Graphical Evaluation and Review Technique (GERT).

## I. INTRODUCTION

Network scheduling implies management of an activity that is used for developing any project. Network scheduling involves task identification, estimating how long they will take, resource allocation, scheduling when the task will occur. Effective network scheduling will help to ensure that tasks are delivered within cost, time and specific standard of quality.

Most common network scheduling techniques are as follows :

- i. Program Evaluation and Review Technique (PERT)
- ii. Graphical Evaluation and Review Technique (GERT)
- iii. Arrow Diagram Method (ADM) [Sometimes called the Critical Path Method (CPM)]
- iv. Precedence Diagram Method (PDM)
  - i. Program Evaluation and Review Technique (PERT): This technique helps to plan, schedule and allocate resources within network. It helps to conclude the facts which are used for decision making. With Pert, necessary facts for decision making. This helps us to analyze risk. By using PERT, the probability of completing the task has been found within the specified deadline. PERT present data in the form of well-organized diagram. PERT have ability to analyze the effect of shift of resources in program. PERT is probabilistic in nature; the risk in completing a project has been calculated. It is probabilistic in nature and used for research and development.

- ii. Graphical Evaluation and Review Technique (GERT): This technique is used for managing the project. Its concept is similar to PERT but it has some extra features such as looping, branching and multiple projects and result.
- iii. Arrow Diagram Method (ADM): Arrow Diagram method includes network diagramming technique in which the activities are scheduled by using an arrow. The connection in scheduling the different activities is called nodes.
- iv. Precedence Diagram Method (PDM): It is essence for developing a network diagram for the project schedule. It makes use of nodes to represent activities and arrows to link nodes together.

## II. LITERATURE REVIEW

In 2006, shengwei ding introduced a technique incorporating the use of network models to investigate the scheduling and throughput of multicellular devices [1]. In 2003, Kris G Mattila proposed the model of linear and repetitive scheduling. Logic of a linear construction project is used in linear scheduling, whereas in repetitive scheduling they describe the path of controlling [2]. In 2020, Ali Munir proposes a network planning schedule that builds on the policy of network planning and demonstrates better performance of network schedulers [3]. In 2018, Abdellah chehri proposed different scheduling techniques. Main objective of such techniques is to analyze the different networking properties for example throughput, fairness and delay [4]. In 2015, Omid M. Kandelusy proposes a technique of novel decentralized scheduling for the cognitive multi-user multi relay network [5]. In 2018, Lei Yang proposes the joint scheduling technique and develops a software defined network, which allocates the bandwidth to the network data flow [6]. In 2021, Takuya lwaki formulate the problem of optimization in which we have to search a network schedule and solve the subproblems of sensor selections by Markov decision process [7]. In 2019, Rajni Gupta introduced the most suitable scheduling technique for processing IoT based applications in the environment of fog

computing. It also investigates about an algorithm of multi agent based for resource scheduling which schedule resources according to load [8]. A cluster-based resource scheduling technique whose performance can measure parameters such as cell edge throughputs and peak throughputs. A heuristic algorithm can be used for general graph that can perform on scheduling in sensor networks based on the adhoc nature of sensor networks. A dynamic scheduling algorithm with an arbitrary communication network can facilitate improved performances for network scheduling techniques. In 2015, Mala kalra proposed a particle swarm optimization and league championship algorithm for solving the NP hard problem [9]. In 2014, Hasti Ahlehagh introduced a wireless channel scheduling technique using Matrix Laboratory and performed various simulations under various cache sizes. Result indicates higher video capacity with very low stalling probability [10]. The scheduling algorithm can be classified based on heuristic, metaheuristic and hybrid techniques. An overview of uplink scheduling strategies focusses on the machine-to-machine communications. It includes various factors such as power efficiency, Quality of service support, multi-hop connectivity as well as scalability for massive number of devices. In 2020, Vartika et al. reviewed about different technologies for vehicle-to-vehicle communication [11]. Vartika et al. highlight the working, execution, implementation and application of internet of things in transport management and V2V communication system [12].

### III. IMPORTANCE OF NETWORK RESOURCE MANAGEMENT IN VEHICULAR COMMUNICATION NETWORKS

Network Resource management is defined as the managing and allocating resources for the process of networking. We can allocate the resources differently which depend on the amount of network traffic that is being processed. In vehicular communication network there is a wireless signal which is used to send information between vehicles about their location, speed and direction. Vehicles will exchange information with each other's, they can disseminate their information and making drivers aware of possible crashes. They will talk to sensors on signs on stoplights, arrival of an emergency vehicle or other notification etc.

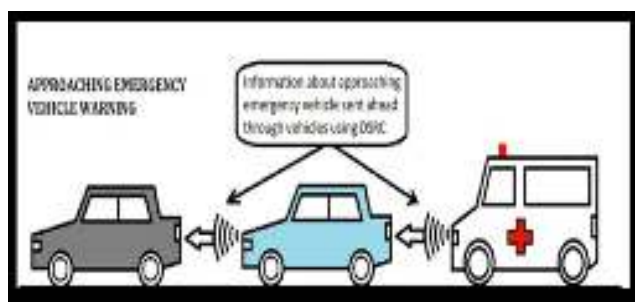


Fig. 1. Vehicular communication networks.

In Fig.1, we see that how communication between vehicles happens? Information between arrivals of an emergency vehicles disseminate among vehicles so that an emergency

vehicle can reach their destination quickly. Vehicular communication makes message passing safer and an efficient by providing timely information to drivers and concerned authorities. In order to maintain the authenticity of a message, vehicles sign each message by using their private key and verify the key using a sign message when another vehicle receives a message. This is appropriate for the purpose of security.

### IV. SECURED SCHEDULING TECHNIQUES

#### a. Program Evaluation and Review Technique

##### Advantages:

- It is basically used when we introduce new features in a project.
- It provides a tool for predicting the impact of a particular resources for a project. It is also useful for analyze the challenges which occur while using resources.
- Its results in an improved communication. Here various resources can understand each other's roles and contributions.
- The network will highlight those resources which require high attention so that task can be completed on time.
- It is an event-oriented network scheduling technique. It minimizes delays, interruptions and conflicts.

##### Disadvantages:

- **Time Focused Method** -PERT is time scheduling technique, here time is main factor, and hence the time duration is necessary for each activity for completing task on time. Lot of time is incurred for prediction of time.
- **Subjective Analysis in PERT** – The task managed by PERT will be new, project information that make data collection to be subjective in nature. These are the opportunities to have inaccuracy and inclination in the source of information.
- **Prediction Inaccuracy of PERT** –Sometimes lot of time is wasted for prediction. We get inaccurate result after wasting too much time and resources.
- **Costly** – High cost is incurred, and it is very expensive.

#### b. Graphical Evaluation and Review Techniques (GRT)

##### Advantages:

- Address the limitation of other scheduling techniques This technique is similar to project evaluation and review techniques, but it allows looping, branching in a network.

- Allows nondeterministic sequences in execution- GERT works for probabilistic approach sometimes we get inaccurate result after time prediction.

**Disadvantages:**

- Complex algorithm required to model the GRT System- The fundamental constraint related with GERT procedure is the complex program needed to display the GERT framework. Advancement in GERT incorporates Q-GERTS permitting the user to consider queuing within the system.
- Rarely used –Popularity of GERT is very less in comparison of other network scheduling techniques such as PERT, arrow diagram method etc. It is very rarely used.

- d. Precedence Diagram Method** –Precedence Diagram technique is utilized for creating diagram of project network where each box addresses a specific activity.

**Advantages**

- It gives an opportunity to more accurately estimate time and make more accurate decisions based on a deep knowledge of each dependency.
- It helps us to find relationship and dependency among activities.
- It is a good communication tool. Without it we cannot schedule our project.

**Disadvantages**

- This kind of diagram takes more time in comparison of an arrow diagram method.

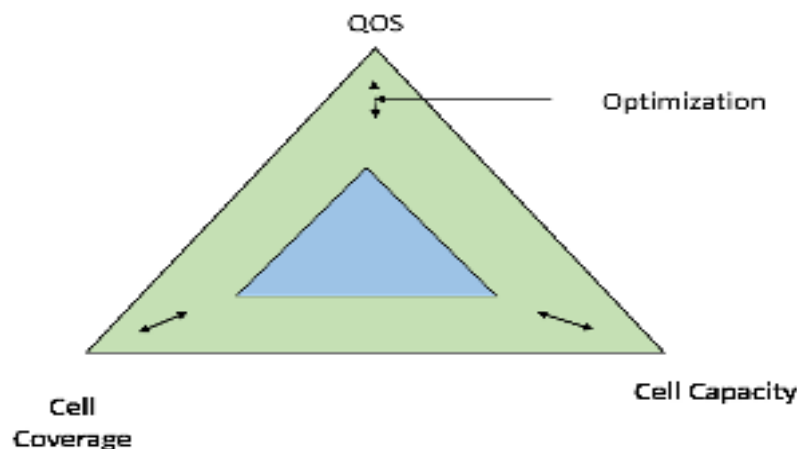


Fig. 2. Objectives of radio resource management scheduling.

- c. Arrow Diagram Method-** The Arrow Diagram Method is meant to apply arrows for outlining different activities.

**Advantages**

- It is easy to create and understand and does not need formal training.
- The network diagram shows logical connections among different activities that happens inside the project.
- It provides an overview resource utilization for a project.

**Disadvantages**

- A major difficulty with Arrow Diagram is “Dummy” activity. Dummy activity requires time and experience.
- It is suitable when you know the step of process or project; otherwise it does not work effectively.

Sometimes its complexity is too high and difficult to discern visually.

**V. IMPORTANCE OF SCHEDULING IN RADIO RESOURCE MANAGEMENT (RRM)**

RRM involves sharing of scars, spectrum amount all users of the system. It incorporates performance gains in term of efficient energy uses higher throughput, lower delays and decreased packet loss [18]. It encompasses a wide range of technique and procedures including network scheduling. Network scheduling is the most important areas for optimizing RRM [19]. In network scheduling energy aware can be used to solve RRM issues. RRM may be treated as a central application and is responsible for communication between different protocols so that message can be transferred to different nodes across different interfaces [20]. RRM facilitates independence and customization to lower and upper level of network. The hardware and software include user control divided, self-organization of RRM networks and separate the core network (CN). The fundamental idea of RRM is to choose the type of traffic to be serving of spectrum or radio licensing

using the various advanced technologies and then select the appropriate technologies to manage resource algorithms and allow them to function. If RRM is applied to the MAC layer, then the algorithms for resource management can represent individual planners or access schemes managed by a program coordinator. If this is applied to the radio control layer, different cells can be managed using the single traffic steering method. This approach allows the network policy and operation to be adjusted according to the current situation in network traffic. RRM assumes significant part in controlling power utilization just as scheduling of radio assets. RRM characterize mechanism and strategies to share radio resources related data between various types of networks. It minimizes intercell interference. RRM is able to solve network related issues. RRM is utilized in numerous wireless systems, for example, fixed channel allocation as well as modulation and demodulation. RRM change the radio network limits to the traffic load, user positions as well as quality of service

requirements. Objective of RRM is to utilize the limited radio recurrence range assets and radio network infrastructure as productively as could be expected. It considered time and frequency resource allocation. The main objectives of RRM are as follows (Fig. 2):

- Ensure planned inclusion for each service.
- Ensure quality of required connection.
- Optimize the usage of system capacity resource.
- Ensure Planned max blocking.

## VI. COMPARATIVE STUDY OF SECURED SCHEDULING TECHNIQUES

In Table I, we have compared different network scheduling methods like PERT, GERT, arrow diagram and precedence diagram methods according to the different views of authors.

Table I. Comparative study of secured scheduling techniques .

Author	Feature	PERT	GERT	Arrow Diagram Method	Precedence Diagram Method
<b>Tanmay Ramani [13]</b>	Definition	This technique is based on statistical network analyses and works on time, resources as well as technical performance specification.	It is a stochastic network examination procedure that allow for conditional and probabilistic treatment of logical relationship between projects.	It is associated with time and flow of job activities.	It is associated for establishing relationship among different activities
<b>Richard Graham Nelson [14]</b>	Features	PERT includes average time taken by resource to start and finish activity.	GERT includes probabilistic branching Network looping, Node realization logic, Distribution of activity times, Terminal event etc.	It includes all activities which are needed for finish to start relationship.	It contains nodes that represent an activity and connect it to arrows that show the dependencies.
<b>Salman Ali Nisar [15]</b>	Function	It identifies the high priority activities so that project can be completed on time.	It predicts uncertainty which can arise directly during execution of each separate control tasks	An arrow diagram addresses a function if one arrow should leave every component of the domain and highlight one component in codomain.	The PDM provides the project in the planned network with a more realistic view.
<b>V V Baranov [16]</b>	Method	It uses deterministic approach.	It allows both probabilistic as well as deterministic approach.	It is a deterministic method	It is a probabilistic method.
<b>Taylor [17]</b>	Application	PERT uses network logic and it is used when there is a case of uncertainty.	It is used for those activities that may be performed more than once loop.	It is an activity diagram and basically used for calculating the critical path of a project.	It is an activity scheduling diagram and basically used for constructing a project schedule network.

## VII. CONCLUSION AND FUTURE SCOPE

Network scheduling is required because it help the planner to know in advance about how to use resources so that we can achieve a goal within less time and less cost. It minimizes the gap between initial stage and final stage. We have different types of network scheduling techniques which help the planner to schedule a task within less time. Some network

scheduling techniques are PERT, GERT, Arrow Diagram and precedence Diagram method etc. Way of using these techniques is different but goal is to remove obstacles which occur during project scheduling. Now the days, software companies have to face a lot of problems because they have to work on many projects within same time. They have to make an effective plan to ensure that projects should be delivered on time within less cost. In this case they can use various

scheduling techniques for effectively and efficiently managing projects. This scheme works well for academics as well as for large business.

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