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Routing Protocols for Neighbor Area Network of SGCN: A Review

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ABSTRACT:-

In Smart Grid Communication System (SGCN) the whole system is divided into three segments: Home Area Network (HAN), Neighbor Area Network (NAN), Wide Area Network (WAN). This paper will focus towards NAN. NAN is responsible for the exchange of data information between the network of Smart Meters to perform various tasks and applications. Greedy Perimeter Stateless Routing (GPSR) and the Routing Protocol for Low-Power and Lossy Networks (RPL) are considered to be two most promising protocols to be implemented in layer-3 of wireless mesh NANs. In this paper, we will have a short review on these two protocol techniques.

Keywords:

Smart Grid (SG); Neighbor Area Network (NAN); Greedy Perimeter Stateless Routing (GPSR); Routing Protocols for Low-Power and Lossy Network (RPL)

INTRODUCTION: Smart grid (SG) is an automated and widely distributed network deploying for the delivery of energy in a

much smarter way. Two way flow of electricity and information exchange makes the network capable to monitor and respond to any change occurring between power plants and customer preferences and individual appliances [1].

A SGCN is consists of three segments: Home Area Network (HAN), Neighbor Area Network (NAN), Wide Area Network (WAN). NAN is becoming the focus for both academia and industry since it is gathering various types of data of various services being offered in SGCN. NAN is the network of Smart Meters (SMs). SMs are installed at customer premises and distribute important control signals between themselves.

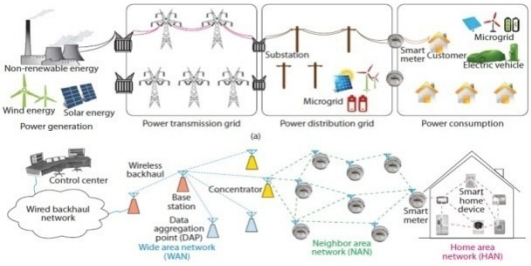

Fig. 1[7]

Various wired and wireless communications technologies can be used in the implementation of NAN such as broadband or power line communications (PLC), wireless mesh networking (WMN). Each type of technology has different type of advantages and disadvantages [2], [3]. Fig. 1 shows the implementation of WMN in SGCN, where WMN is deployed in WAN and NAN network jointly. The Network of

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SMs is connected via mesh topology scheme of WMN and mesh topology is resilient to node failures and the maintenance costs are very low. In every cluster of SMs, whole information data is collected at one, which is called Data Aggregation Point (DAP) and from this point the data is relayed to the cellular network (3G/4G) for the transmission with high data rate and low latency. There are two types of protocols, which are considered to be the most promising for WMN in NAN: Greedy Perimeter Stateless Routing (GPSR) and Routing Protocols for Low-Power and Lossy Network.

ALGORITHMS OF ROUTING PROTOCOLS:

We now describe the GPSR algorithms and RPL algorithms. The GPSR algorithm consists of two methods for forward packets i.e. Greedy forwarding and Perimeter forwarding. Greedy forwarding is used whenever it is found to be possible and Perimeter forwarding came into action at that time when Greedy forwarding cannot be used. An extensive survey of existing work dealing with GEO protocols is presented in [4].

1. Greedy Forwarding:

In GPSR, packets are marked with destination point by the originator, this makes forwarding node locally optimal, greedy choice in choosing next hop of packet. Packets are moved towards the destination by passing through the closest hop from every point. Forwarding in this way, follows nearest geographic hops, until data packets reach the destination. An example of Greedy Forwarding is shown in the example in Fig. [2]

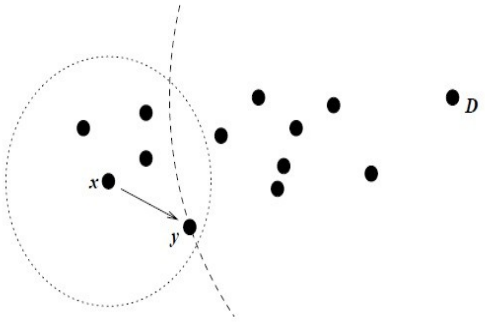

Fig. 2[8]

2. The Right-Hand Rule: Perimeters:

This rule states that when incoming at node *x* from node *y*, the next edge traverse is the next one in sequence counter-clockwise about *x* from edge (*x*,*y*). It is known that the right-hand rule traverses the inner of a closed polygonal area (a *face*) in clockwise edge order—in this case, the triangle enclosed by the edges between nodes *x*, *y*, and *z*, in the order (y→x→z→y). The rule traverses an exterior region, in this case, the region *outside* the same triangle, in counter clockwise edge order.

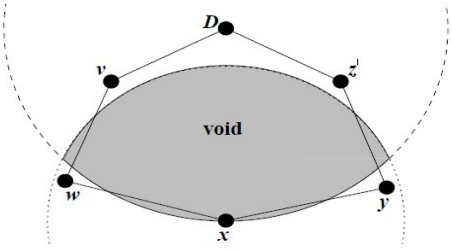

Fig. 3[8]

3. RPL(ROUTING PROTOCOL):

RPL belongs to the self-organizing coordinate routing class that builds a viable coordinate system based on communication distance rather than geographic distance

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used in location based routing. The key concept used in RPL is the destination oriented directed acyclic graph (DODAG) which is a tree structure specifying the routing paths between a root and remaining nodes. The root is typically a gateway which acts as a common transit point that bridges every node and a backbone network [5].

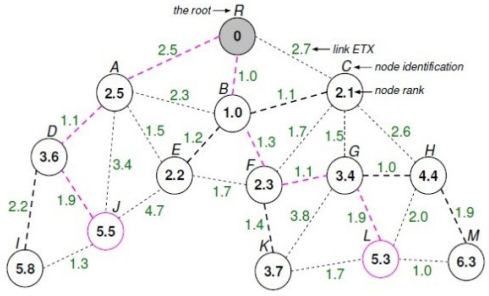

Fig. 4[9]

Each node in DODAG is assigned with a rank that represents the cost of reaching the root as per objective function (OF). The OF is designed to guide traffic to the root over paths that minimize a particular routing metric, such as hop-count or expected transmission count (ETX). A list of possible metrics that could be used for OF in RPL is presented in [6]. The rank of a given node is calculated based on the ranks of its neighbors, the costs to reach each of these neighbors and other routing metrics. Initially, the root of DODAG starts sending out DAG information option (DIO) messages with a predefined lowest rank indicating that it is the traffic sink. Upon receiving a DIO, each node calculates its own rank based on information carried in the message and its local states. Each DIO contains the information about the identification of DODAG, the rank of the broadcasting node and parameters specifying the OF. DIO's are periodically broadcasted from each node, triggered by the trickle timer. In this way, DIO's are gradually propagated down to most distant nodes from root and help create a DODAG of the physical network. For a given node, any neighbour whose rank is lower than that of the node itself is considered as a parent. When a node receives a packet destined to the root, it forwards the packet to its most preferred parent that results in the most cost-effective path to the root. As illustrated in Fig. [**], selected paths for traffic originated from J and L are J → D → A → R (5.5 transmissions) and L → G → F → B → R (5.3 transmissions), respectively.

Conclusion:

This paper conclude that GPSR and RPL both routing protocols are considered to be very promising in SGCN. But there are some latency in transfer of data. To remove this latency, we need to optimize these protocols. So the information, which needs to be available at destination in real time, can be there.

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