MULTIDIMENSIONAL ANALYSIS FOR QOS IN WIRELESS SENSOR NETWORKS

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ABSTRACT

Nodes in Mobile Ad-hoc network are connected wirelessly and the network is auto configuring [1]. This paper introduces the usefulness of data warehouse as an alternative to manage data collected by WSN. Wireless Sensor Network produces huge quantity of data that need to be proceeded and homogenised, so as to help researchers and other people interested in the information. Collected data is managed and compared with other coming from datasources and systems could participate in technical report and decision making. This paper proposes a model to design, extract, transform and normalize data collected by Wireless Sensor Networks by implementing a multidimensional warehouse for comparing many aspects in WSN such as (routing protocol[4], sensor, sensor mobility, cluster ….). Hence, data warehouse defined and applied to the context above is presented as a useful approach that gives specialists row data and information for decision processes and navigate from one aspect to another.

KEYWORDS

Network Protocols, WSN, Data Warehouse, multidimensional design, OLAP, Routing Protocol

1. INTRODUCTION

As known, the demand for smart phones and portable devices has developed year by year since their introduction. These items can be used to form a MANET. A MANET consists of arbitrary deployed communicational devices such as PDAs, cell phones, laptops, etc. It is a wireless multi-hop network where all nodes insure data exchange.

WSN is managed by the network nodes themselves; as there is no special device or router involved, every node itself work as a router to forward the traffic.

Energy in ad-hoc networks is critical due to the application charges and also limited energy availability in each wireless node [2]. Communication between wireless nodes claims more energy, so it is pertinent to reduce the cost of energy required for traffic. This paper will give a comparison of the energy metrics of AODV and DSDV [3] by modifying the density of nodes and deploying warehouses technologies to depicts and crossing over some WSN's behaviours over time.

1.1. Routing protocol

Routing protocols [8] is a norm that defines how nodes decide to achieve the packets between the source and the destination node. Each node learns about neighbours nodes and the routes to attain them. Each one is owning and managing one or more tables that containing routing information data about every other node in the network. Examples for table driven protocols are:

1.1.1. AODV

Protocol AODV [1] is adequate for the restricted resources of WSN. It is not concerned by maintain routing information but it based on data exchange with its neighbourhood. AODV broadcast discovery packets - ctrl messages route request (RREQ)[12] and route reply(RREP) - only when necessary[4].

1.1.2. DSDV

Destination Sequenced Distance Vector protocol belongs to the class of proactive routing protocols. Based on the classical Bellman-Ford routing algorithm [4], also it is a distance vector protocol[1], each equipment manage a routing table that contain all of the potential targets within the network and the number of hops to each destination are mentioned [5]. Each input is labeled with a number that is affected by the target node; this operation will avert forming loops.

2. RELATED WORKS

Energy consumption, since nodes are powered by batteries, depending on the use, energy can last from days to weeks [5]. With the help of WSN, it is possible to monitor various characteristics of the environments, but these data alone or simply collected over time are difficult to be interpreted by users. In this section, we outline the context of our work on WSN. In [6] and [8] the energy metrics of AODV and DSDV are compared by increasing the number of nodes using trace file generated NS2 simulator.

For the monitored data to be recovered in a productive way by the parties, it must be organized in a repository or database, and have an interface with easy access, through which the user can view consolidated information and be able to make analysis.

The description above refers to Data Warehouse (DW) that means a set of technologies for decision support used by people interested in making decisions quickly and easily. A major contribution of this paper is an alternative to manage data collected by WSN based on a model to extract, transform and normalize this data and load it in a DW. The results showed that the crossing of tabulated data with others sources, such as technical reports could improve data accuracy and help to create better data warehouse views. Data in sensor database -trace file- is transformed, loaded in warehouse and then displayed. In figure 1 represents all sources supported by the architecture proposed.

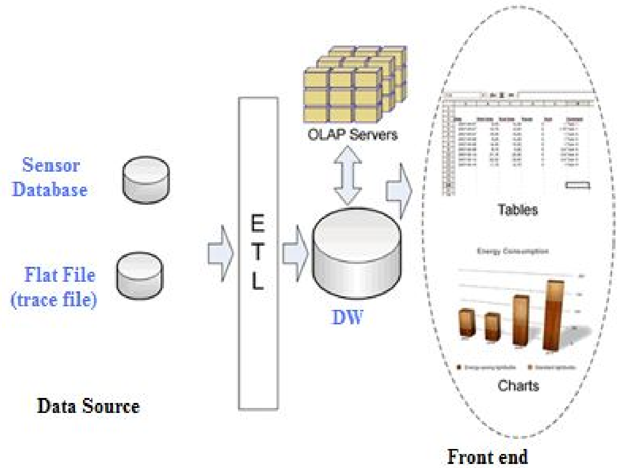

Figure 1 : Data Warehouse architecture

The paper is organized as follows. Section 3 reviews the technologies and terminologies used in the whole paper, presenting products used in the prototype developed. Section 4, modeling our proposed warehouse and data extraction-analyze data collected by WSN. Section 5 presents the architecture proposed focusing on the process of acquiring and delivering data from WSN to DW. Section 6 shows the results obtained using collected by WSN. Conclusion is for the section 7 it is outlines our future works.

The main purpose of this research was to monitor some measures behaviors in situations, such as energy [6]. To analyze data from WSN, [9] introduces an approach based on tasking sensor networks through declarative queries. Given a user query, a manager creates a plan for this statement execution. A leader node is necessary to consolidate data from other nodes.

3. DATA WAREHOUSE AND OLAP

OLAP consists objects that are a part of dimensional model. The dimensional data model contains many definitions figure 2 shows a short description:

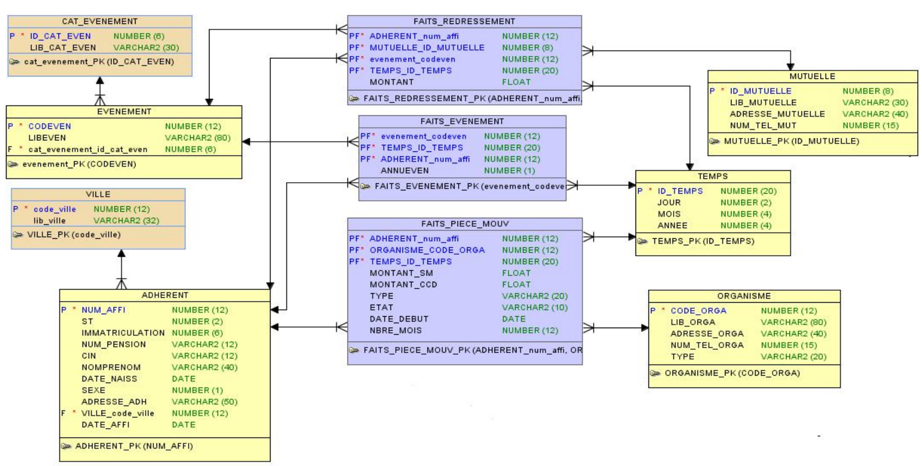

Figure 2 : Dimensional modeling –constellation schema

This constellation schema for an example of data warehouse contain three processes each process is presented by blue fact table surrounded by dimensions that give additional information about process.

Fact table contain a set of attributes, it can be divided into 2 subsets:

- Set of foreign key relationships with each dimension table involved.
- Set of measures that describe concerned process such as *annueven* for the business *faits_evenement*.

Most measures are numeric and would be descriptive, Boolean ….etc.
Measures are typically additive (aggregated for all dimensions), semi additive (aggregated for some dimensions) and non-additive (unit_price). This characteristic is important for summarizing row data. In general, facts tables are constructed with the lowest level – atomic level- of detail.

In viewing data, analysts use dimension hierarchies [10] to ensure navigation: drill down to lower levels and roll up to higher levels to have large understanding of data behavior and what affect the business.

Some attributes are descriptive and offer additional information about the data.

Online Analytical Processing (OLAP) allows navigation of the data in a DW, having a suitable structure for both research and for presenting of information. In the navigation tools, OLAP can navigate between different granularities of a cube [11]. Through a process called Drill, the User can increase (Drill down) or decrease (Drill up) the level of detail of the data. For example location dimension figure, a report may be consolidated by the country. With the Drill down, the data will be submitted by region, state and so on until the lowest level possible figure 3. The opposite process, Drill up, causes data to be consolidated at higher levels. Note that Data provided by sensors are reorganized in multidimensional warehouse, (real time processing will be crucial in term of energy, resources and time) and require more high technology to enhance this process.

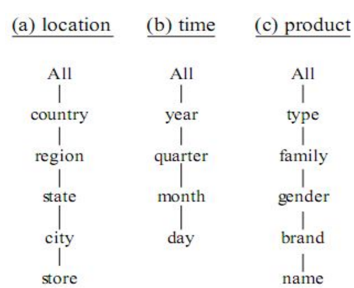

Figure 3 : dimensions hierarchies

4. ARCHITECTURE

After extracting and transforming data -flat file-, it is necessary to load this information into a DW that modeled in dimensional modeling. In [11] authors are focused to dimensional modeling where data is classified as fact table or dimension figure 2.

Figure 4a depicts the proposed multidimensional model; the prototype contains energy, temperatures and some others measures such as send or receive number of exchanged paquet there is three dimensions DSensor, DPaquet and DTime presented with hierarchies mentioned to ensure navigation between levels.

The same as above another version is to take a restriction of data warehouse for manipulating just protocol with relative measures (type, energy.…)

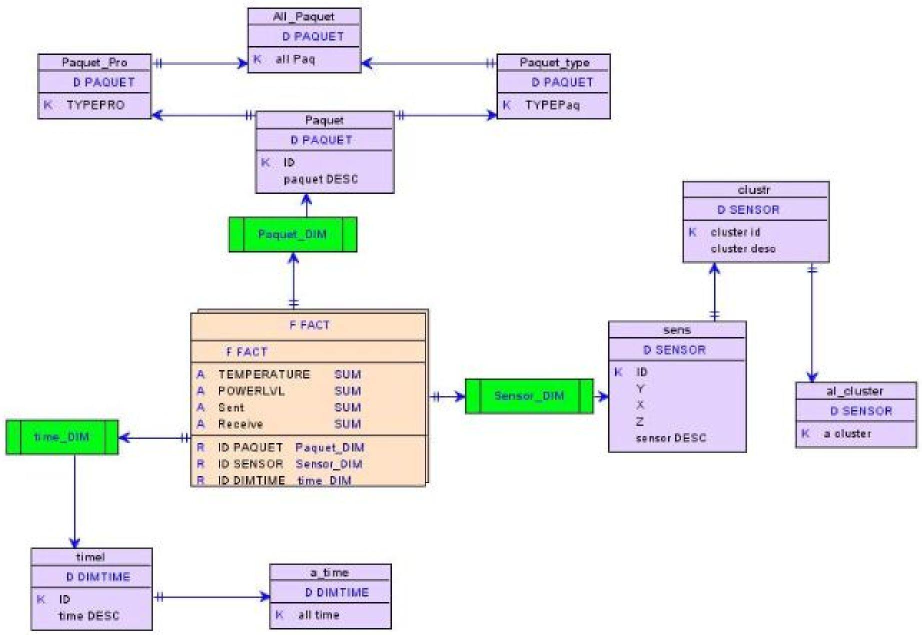

Figure 4a: Proposed Multidimensional Model

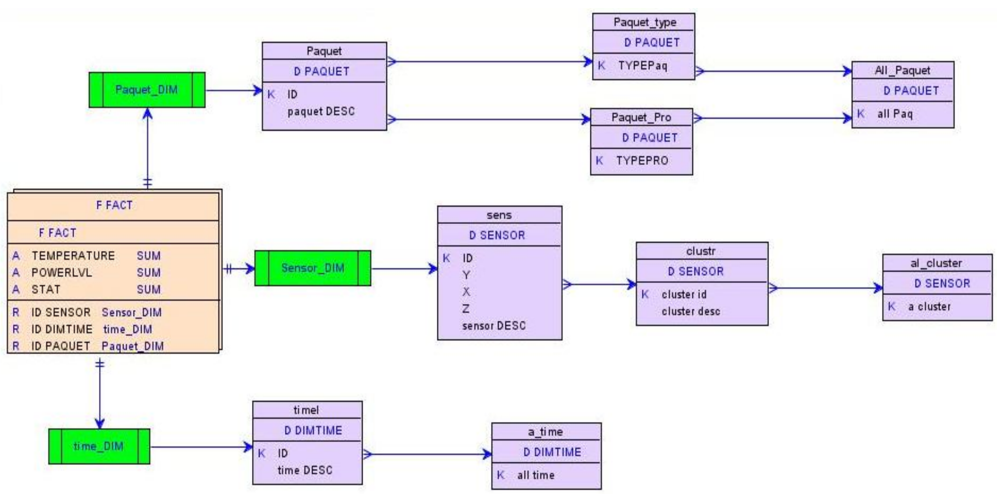

Figure 4b : Proposed Multidimensional Model.

. Other possibility is to present the warehouse in relational model, by defining table instead of dimension by rearrange columns and rows figure [5].

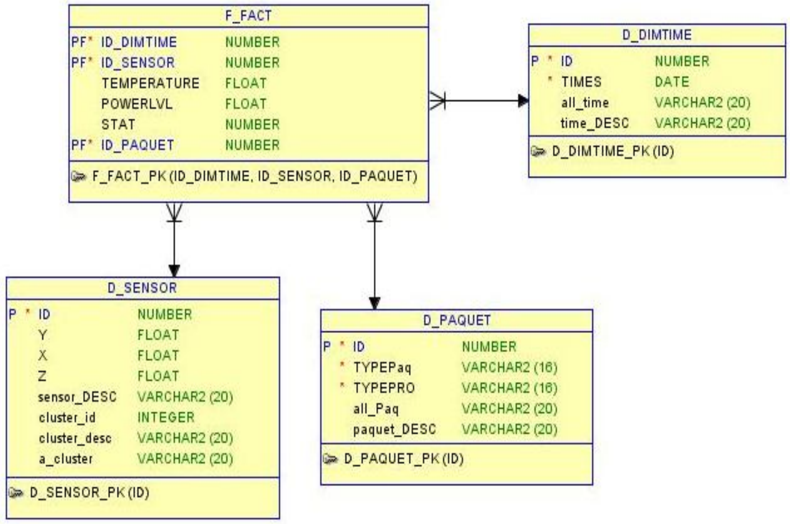

Figure 5 : Warehouse relational star schema.

Normally data is collected at different times and transformation process is accounts for consolidating this data in the same time zone and granularity, this action will be critical, because the traffic is huge.

5. RESULTS

In this section we show the usefulness and some technical report extracted from the proposed warehouse, implemented in Oracle tools: Oracle Analytic Workspace Manager (AWM), Oracle SQL Developer Data Modeler and other package in order to fill the data warehouse by mapping source to target DW.

Collected data [6] is loaded in DW; using AWM [13] can present data –Energy behavior -in tabular or graphically form figure 6.

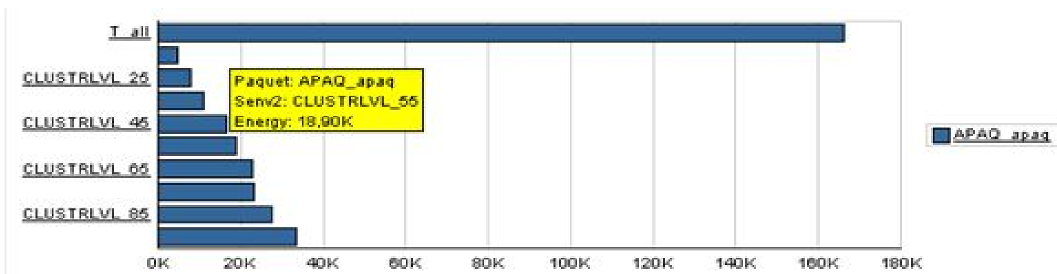

Figure 6 : Sample data from OLAP cubes

Hence, data warehouse applied to the context above shows to be a useful alternative that helps specialists to obtain information for the whole process, which could generates energy and observation of many measures.

The analysts can manipulate cube objects with use of drag and drop methods. They may also limit the scope of the presented data using filters that limit data on individual dimensions, hierarchies and levels. They can also drill down or drill up using level figure drill down to specify protocol type in order to evaluate energy figure 7.

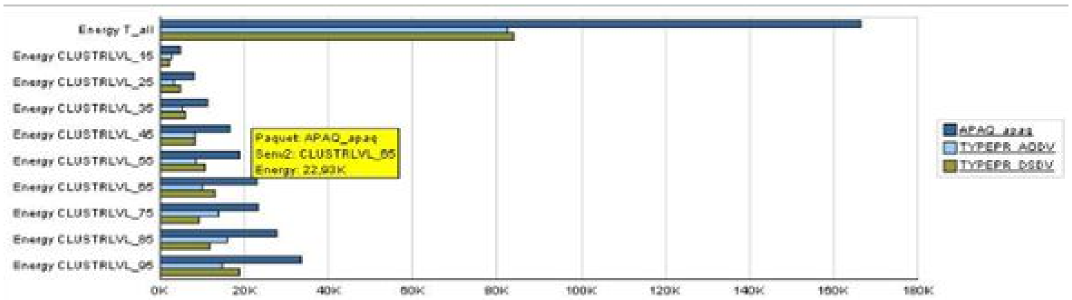

Figure 7 : node cluster level Vs consumed energy

Drill down to low level we can display the energy figure 7 for the component defined in the multidimensional schema.

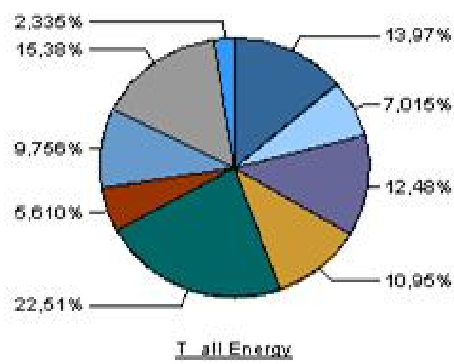

Figure 8 : Sectorial graphic of consumed energy for lowest level

6. CONCLUSIONS

The association of WSN and DW is little explored a research area. However, the benefits of using DW to manage data collected by WSN are shown here. Among the things that stand out is the possibility to help technical decision-making.

In this paper, we have presented a simulation tool/prototype which can give a set of graphs and interactive interface in order to compare many aspect and measures of a WSN such as energy, and navigate across dimensions and levels to crossover and have a global view.

As our future works, we would like perform more analysis in WSN especially exchange traffic and QoS using DW environment.

REFERENCES

[1] Sunil Taneja Ashwani Kusj, "A survey of Routing Protocols in Mobile Ad-Hoc Networks", International Journal of Innovation, Management and Technology, Vol. 1,No. 3, August 2010, ISSN: 2010-0248

[2] Aravind B Mohanoor, Sridhar Radha Krishnan, Venkatesh Sarangen, "Online energy aware routing in wireless networks", September 2007.

[3] M.Z Aslam, A. Rashid. " Comparaison of Random waypoint & Random Walk Mobility Model under DSR, AODV & DSDV MANET Routing Protocols". International Journal of Advanced Research in Computer Science (IJARCS) Vol 2 Issue 1, Jan-Feb 2011 Page 381-386

[4] Bhabani Sankar Gouda "A Comparative Analysis of Energy Preservation Performance Metric for ERAODV, RAODV, AODV and DSDV Routing Protocols in MANET" International Journal of Computer Science & Engineering Technology (IJCSET),Volume 3,Issue No. 10, pp. 516-524,Oct 2012.

[5] V. Kanakaris, D. Ndzi and D. Azzi, "Ad-hoc Networks Energy Consumption: A review of Ad-Hoc Routing Protocols", Journal of Engineering Science and Technology Review 3 (1) (2010),pp.162-167.

[6] Vijayalakshmi P, V.Saravanan ,P. Ranjit J.T, Abraham D.J. " Energy-Aware Performance Metric for AODV and DSDV Routing protocols in Mobile Ad-Hoc Networks". IJCSI International Journal of Computer Science Issues, Vol. 8, Issue 4, No 1, july 2011 ISSN (Online): 1694-0814.

[7] Y. Yao and J. Hehrke, "The cougar approach to in-network query processing in sensor networks" in ACM SIGMOD Record, vol. 31, New York, NY, USA, 2002.

[8] S.A. Gupta and R. K Saket, "Perfermance Metric Comparaison of AODV and DSDV Routing Protocols in MANETs using NS-2", June 2011, Volume 7, Number 3, pp: 339-350.

[9] S. Chaudhuri and U. Dayal, "An overview of data warehousing and OLAP technology," ACM SIGMOD Record, vol. 26, no. 1, pp. 65-74, Março 1997.

[10] Mazon, ´ J.-N. and Trujillo, J. (2006). "Enriching Data Warehouse Dimension Hierarchies by using Semantic Relations". In XXIIIrd British National Conference on Databases (BNCOD 2006), Belfast, Northern Ireland, volume 4042 of LNCS.

[11] R. Kimball, "A Dimensional Modeling Manifesto," in DBMS and Internet Systems, San Francisco, 1997, pp. 58-70.

[12] Rachid Haboub & Mohammed Ouzzif, "Secure & reliable routing in MANET" in IJCSES Vol.3, No.1, February 2012.

[13] Oracle OLAP - User's Guide 11g. Release 1 (11.1). B28124-03.

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