

Analysing Signal Strength and Connection Speed in Cloud Networks for Enterprise Business Intelligence

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Abstract

Signal strength and speed connection data which are collected and available in a company have not been optimally and beneficially processed and stored for more added value business purposes. Therefore, the collected data need to be utilized in more strategic way for business intelligent in the company that enables management to conduct better and smarter decision making. This research is aimed to develop a business intelligence system based on cloud computing platform which is more flexible and manageable in terms of cost and resources. The developed system adopts the three tier architectures of data warehouse that provides data extraction, transform, and load (ETL) functions and the creation of dimensional models and visualization in dashboard forms. Business intelligence solutions have been created based on cloud computing using Microsoft Azure SQL Database as database storage of data warehouse and Power BI as a dimensional model and dashboard visualization. The developed system prototype has been implemented and tested for its functionalities and capabilities in a web platform.

Keywords: Business intelligence, Cloud computing, Decision support system, Signal strength, Connection Speed

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1. Introduction

Business Intelligence is increasingly popular and important in an organization or company. This is related to the global revenue prediction by Gartner, Inc. for business intelligence and analytic markets in 2016 that will increase about 5.2% from 2015 to 16 billion dollars [1]. Increasing competitive business competition makes companies need tools in business strategy decision-making. Generally, most business decision-making is done by instinct or intuition from business people or management. Decision making will be better if supported by data analysis thus the information obtained are more accurate. Business Intelligence is one technology solution that can help in decision making or also called as decision support system. Business intelligence as a support decision device enhance acces to relavant and accurate information which is a vital element of decison making process [2].

Business Intelligence is a collection of theories, methodologies, processes, architectures and technologies that transform raw data into valuable and useful information for business purposes [3]. Non-simple data elements will be transformed using ETL (extract, transform and load) process. The transformed data will be stored in a data warehouse to deal with the dynamic data growth in the future and to improve performance in the analysis and reporting. The development of data warehouse and business intelligence can be done gradually.

Business intelligence systems may be developed based on cloud computing which is a new approach compared to complex and expensive on site system implementation [4]. Business Intelligence is considered as a top priority in technology for CIOs [5]. Business Intelligence based cloud computing for small business scales has several aspects, such as cost effectiveness, ease of use, good performance, visualization and security [6]. The main advantage of using cloud computing is the ability of an organization or company to respond quickly and effectively to changes in the business environment [7], and the expenditure of information technology in cloud computing changed from capital expenditure (Capex) to operating expenditure (Opex) [8]. The development of this system does not need hardware investment.

Business Intelligence can be applied to various types of data, including signal strength data to distinguish the signal range of telecommunication operators. This data is mandatory for the data collection process through smart phones with mobile based applications. Data collection is performed continuously thus the speed of data transmission is also essential. This activity is usually done by a survey institute, particular in marketing research.

Surveyors in the field input data on the smartphone using the application and then the data will be sent online using the internet connection to the server. Data delivery is highly reliant on the internet connection at the survey location. If the internet connection is slow then data transmission will be hampered. Therefore, the addition of features to mobile applications is needed to capture signal strength in the survey location and stored in the database. This is done to determine the signal coverage of telecommunication operators.

The amount of signal strength data gets larger as the number of surveys conducted, however, these are not utilized as useful information yet. Information can be a signal strength at the survey location in the future, as a monitoring tool to improve the quality of telecommunication service providers, and to categorize signal strength from telecommunication providers in Indonesia. Therefore, customers get information service from each telecommunication provider. Utilization of data through data transformation into information can be done with business intelligence. The objective of this research is to develop a system of business intelligence based on cloud computing to analyze signal strength and connection speed. These data, that formerly only put away in the database, will be utilized to be useful information for business.

2. Research Method

The steps of research method shown in Figure 1 are business requirement analysis, data source identification, ETL (extract, transform and load) design, data warehouse design, multidimensional model design, dashboard design, testing and dashboard analysis. The aim of business requirement analysis is to understand the background of developing the applications and setting the objectives. At this step, it is required conducting Interview with related parties such as business users and information technology.

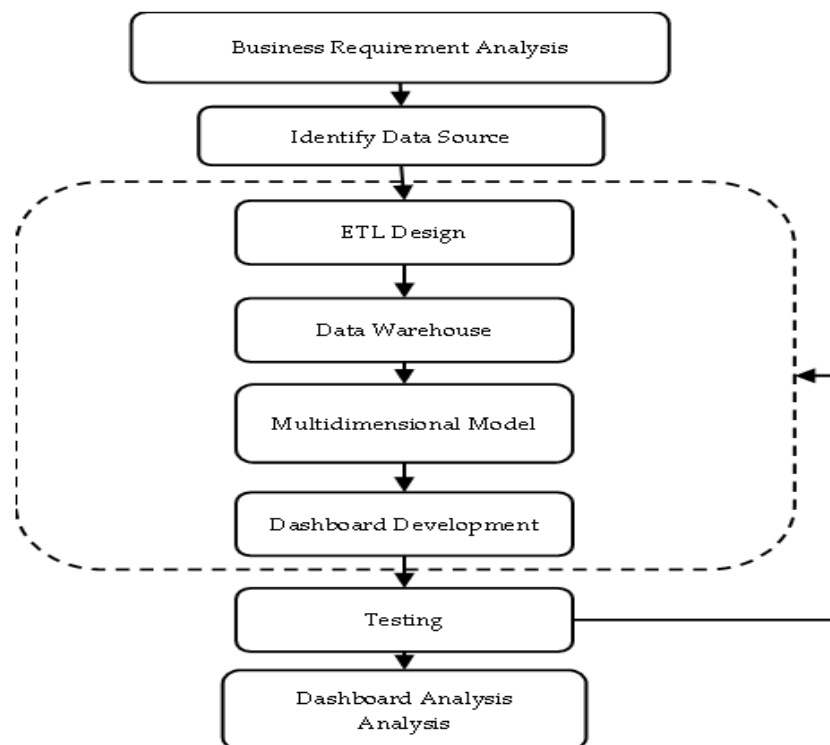


Figure 1. Research methods

The second step is to identify data sources in order to know data elements to be stored in a data warehouse. The database for data warehouse is developed and the data transformation is performed. The next step is the ETL design and data transformation which is an advance process of learning the data sources. This process is conducted in order to transform the data source structure into a relational database that will be the data source for a dashboard.

The data warehouse design is also needed to store data historically over several periods. The data warehouse is a subject-oriented, integrated, time-variant, and non-volatile data set that supports decision-making process [9]. The data warehouse refers to Kimball's dimensional modeling concept of a star scheme. Relational between factual tables that contain values or measurements and dimension tables are perspective or descriptive context.

The dimensional modeling is one of the methods in business intelligence to simplify the data analysis. In the study, it uses the concept of star schemes namely factual tables and dimensions. The analysis can be done with several operations such as drill down, slice and dice. The dimensional modeling is a technique for displaying analytical data that is widely used because it refers to two simultaneous needs [10].

Dashboards are used to visualize information from processed data sources. All the required information will be displayed in one visualization so that it easier for the user to do the analysis. The testing phase is to ensure every function of the application is in accordance with the needs of businesses that have been done in the beginning.

3. Results and Analysis

3.1. System Architecture

The development of business intelligence system uses three level architecture [11] as shown in Figure 2. The three levels of the system are as follows:

- a. Data source.
The data source is the signal strength data generated by the mobile survey application. Data are generated using Android or IOS application programming interface (API). This application can retrieve signal strength information, data access speed, brand and mobile phone model.
- b. ETL, data warehouse and dimensional.
There is a process of extracting and transforming data from the source and the results are stored in the data warehouse. The dimensional modeling process for data analysis is also carried out.
- c. Reporting and Dashboard as the presentation layer.
The data that has been processed will be displayed in the form of reports or dashboard so that users can easily get information.

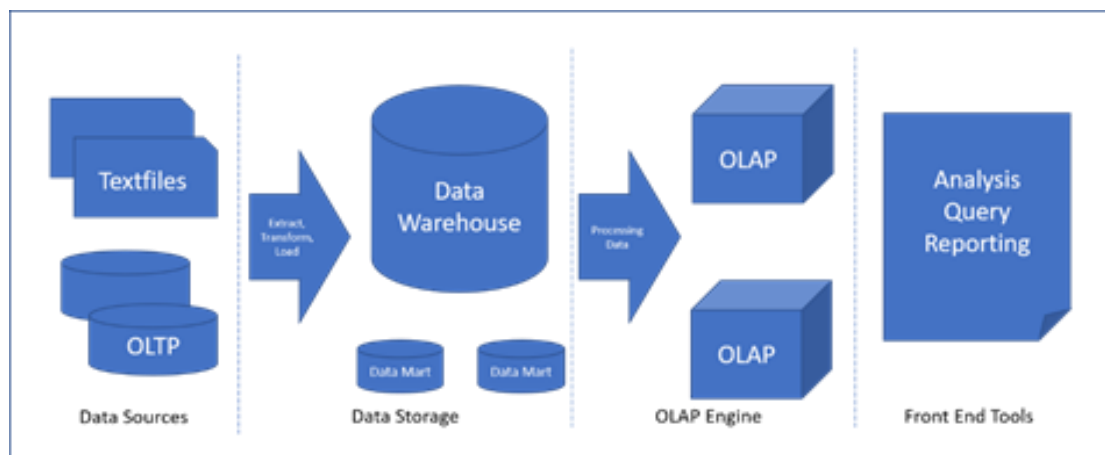


Figure 2. Three tier architecture application

3.3. Extract, Transform, Load (ETL) Design

The ETL process is divided into three stages of the process ranging from data sources, staging and data warehouse. The signal strength data exported from the mobile survey application will be placed in a folder accessible by the ETL system. ETL's system will process all text files contained within the folder. The data is processed sparsely without any further processing and stored in the staging table.

The staging table is a temporary table to store extracted results from a data source ie a text file. The purpose of the staging table is to reduce the complexity of the transformation process if directly performed from the data source. So the staging process aims to equate the database platform used by data warehouse with data source for database transformation process. So the data source will be extracted into the database directly without going through the transformation or cleaning process.

The last stage in the ETL process is data storage into the data warehouse historically. Before the data is stored into the data warehouse it will go through several processes such as cleaning, transformation and change the data type. It is intended that the quality of data to be stored in the data warehouse is good. The cleaning phase aims at filtering the data to be stored in the data warehouse. In addition there is a transformation process to convert the coordinates into detailed locations such as kelurahan, kecamatan, municipality and provinces using google maps API.

3.4. Dimensional Design Model

The design of the dimensional model follows Kimball's dimensional theory of making the database structure into factual tables and dimensions. The dimensional model can be seen in Table 1.

Table	Type
FactSignalStrength	Fact
FactSpeedConn	Fact
DimClassSignal	Dimension
DimDate	Dimension
DimLocation	Dimension
DimNetworkType	Dimension
DimOperator	Dimension
DimCellTower	Dimension
DimBrand	Dimension
DimDevice	Dimension

3.5. Implementation

Dashboard display for signal strength business intelligence system uses Power BI. Dashboard view is divided into two pages. The first is the signal strength while the second is the data access speed. In accordance with the needs of the dashboard design, there are five components of dashboard visualization. Those components are:

- a. Card, which is a writing box that displays the total spot (point) of the signal and the average signal strength in Dbm.
- b. Bar graph, which consists of total spot by operator and dbm average dbm by operator. The first bar graph represents the total signal point of each operator while the second graph is the average signal strength of each operator. The color of the bar graph matches the identity of each operator.
- c. Filter dashboard, which consists of filter operator, date, classification, location, network type, brand segment and mobile phone brand. Filters are useful for more specific analysis processes. So, the data shown is not too much. Date filters can be hierarchical starting from year, quarter, month, and day.
- d. Interaction between component of dashboard, which is, if clicking a component of visualization then data in whole component will be filtered. For example, if a point on the map is clicked then the specific data at the point location will be filtered.
- e. Maps, which is the main visualization of the signal strength dashboard by displaying the spread of signal points. The color of the points following a bar chart indicates the operator

identity. The point size on the maps indicates the signal strength at the location. The bigger the point, the stronger the signal strength. Other features required on maps are detailed information of each point of signal location. If the point is highlighted then there will show the information of the coordinate point, signal strength, operator, and location. The interface of business intelligence system can be seen in Figure 3 and 4.

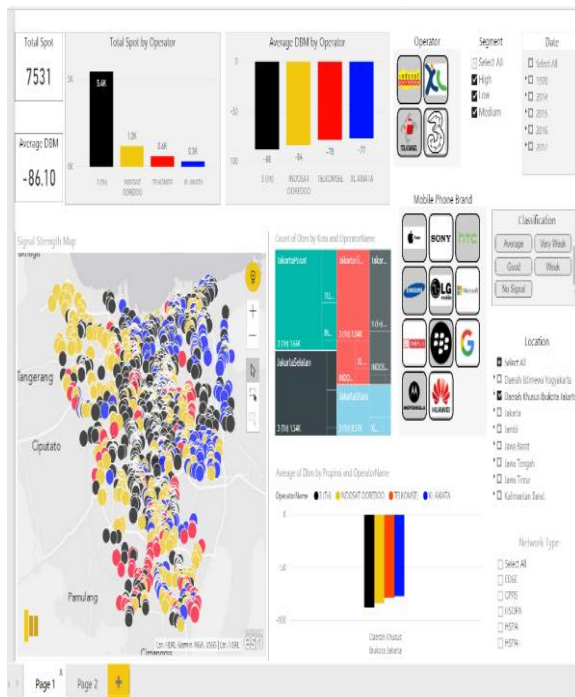


Figure 3. Interface page 1 signal strength dashboard

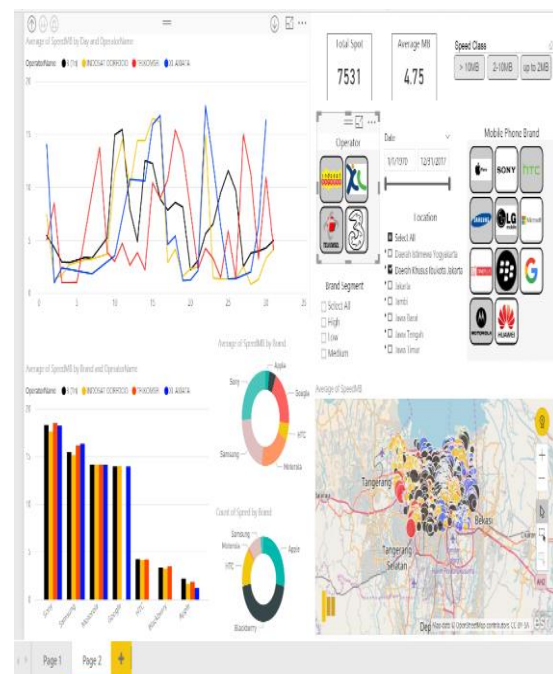


Figure 4. Interface page 2 connection speed dashboard

3.6. Managerial Implication

Dashboard in business intelligent system can be used to analysis signal strength in every region. It will be useful for someone at the time of conducting a survey can use telecommunication provider with the best signal strength to support data transfer. Dashboard of signal strength can potentially be as the tool to monitor telecommunication provider in order to know services quality and condition in the field according to user experience.

The correlation between type of cellular phone and signal strength should be considered. Telecommunication provider can identify and profile users based on their cellular phones. The types of cellular phones can be classified into three categories, i.e. high, medium, and low. This information can be used by provider telecommunication for marketing strategic plan. Users can know a provider with the best signal strength and speed connection in a region because the dashboard has data of every telecommunication operator. Users can adjust to telecommunication operator when they visit the region. For example, the application of dashboard in business. If an investor will open restaurant or cafe, then he can find the location with a good signal strength.

The dashboard can also be used to make decision in business cellular phones. Before doing promotion and selling the phones, the best signal strength of the cellular phones in a region should be considered. Telecommunication operators could work together to improve signal coverage in Indonesia. The signal strength dashboard can be compared to base transmission receiver data to know the gap between their transmitters and receivers. In addition, the signal strength dashboard can be implemented in another company with some data adjustments. For example, a company in the field of mobile game applications can first analyze

the data of the region with good signal strength and can do promotion in the region because of its infrastructure.

4. Conclusion

Business intelligence system of signal strength has been built using cloud computing solutions. The development of this system is intended for reporting in the form of dashboards for signal strength data that has not been utilized and only stored in the database. The signal strength dashboard has the capability to be a tool for monitoring and improving signal strength services for every telecommunication provider in Indonesia. In addition, the view can also be filtered based on operator, location, signal strength classification and network type if more specific analysis are required. Dashboard signal strength supports to perform analysis from a brand perspective or mobile phone model and data access speed. Acceptance of signal strength is also affected by the antenna contained in mobile phone hardware [12].

The signal strength data is incomplete because the data is taken only based on the survey project done thus it cannot perform the signal strength ratio of each telecommunication operator in a region. If the data can be collected completely for each operator, then the dashboard can be used as a signal strength monitoring tool. It can also view the quality and coverage of telecommunication signal operators in a region.

In this study it does not cover data security issues. There is research on the level of security awareness of smartphone users in Indonesia in 2014 which is still good about 80% with some areas still need improvement [13]. However, security issues must be considered because the exchange of data uses a mobile internet connection thus potential security threats will always exist. Some security threats from mobile internet are intelligent terminal development, Network infrastructure, business diversification, diverse platform and user lack security awareness [14].

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