Distributed Content Communication Architecture for the Development of Aerocity Area

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***Abstract*—The content distribution and retrieval efficiency are needed to have a business process flow. Several conditions are often a problem in a communication network, so an effort is required to provide architectural models that meet the required needed, especially in the Aerocity area. Therefore, content distribution and retrieval architecture are needed through communication networks that match the characteristics of the Aerocity area, which are generally divided into clusters, ranging from airport clusters, housing, commercial businesses, and others. Research that deals explicitly with this field is still not widely available. This paper aims to discuss the distribution and retrieval model of content that can be developed using a distributed system approach. Besides, this paper will provide a review of previous studies and propose architectural models.**

***Index Terms*—Aerocity Area; Clustering; Distributed Content Communication Architecture; Retrieval.**

I. INTRODUCTION

An assessment of the Aerocity area development model has been carried out by [1-13] with various discussions on various models of new airport cities. In this respect, much attention has been given to take airport as samples and the Aerocity area that is developing in some countries as reference. In this field, there is a lot of data that must be processed and distributed in the form of content and retrieved by various parties involved. Therefore, the content distribution and retrieval efficiency on the communication network are needed so that transactions and other business processes can run smoothly. The research on Content Retrieval has been carried out by the researchers, including [14-17]. They found that the issue of information distribution and retrieval efficiency was one of the needs of users for the realization of wide area network communication networks or the internet network.

The persistence and availability of communication networks underlie the need for reliable and available content whenever needed by users with a low level of latency, following the characteristics of the communication network designed [18]. But several conditions have always been a problem in a communication network. The system has a high level of persistence, availability, and access latency. So, efforts are needed to provide architectural models that match the requirements. This system includes the Aerocity area computer network, which will be developed in a particular country, and this should be anticipated as early as possible. Therefore, a distribution and retrieval architecture of content is necessary through communication networks that match the characteristics of the Aerocity region, which are generally divided into clusters, ranging from airport clusters, housing, commercial businesses and others [7-10]. The more groups that are connecting to Aerocity, with a lot of business activity, the higher the data processing and content retrieval take place.

The clusters' characteristics allow the spread of input and data-access devices at each place in the group. Each cluster has its sources containing data and information relating to the cluster activities. The thing that must be considered is how the various elements in each cluster can stand autonomously by paying attention to various provisions regarding the right of access to the existing network environment. Perhaps, every aspect that exists does not require special rules to join the network without going through the process authentication first. Still, the important thing is that all elements that exist, can be controlled and constitute a unity of the other components, even if the user does not know such conditions. The other characteristics deal with transparency issues from processing, location, relocation, replication, concurrency, and failure. The efficiency in the study of distributed content communication networks is realized when all sources of devices, software, and content could collaborate to facilitate the distribution and retrieval of content on networks in Aerocity.

Research that deals explicitly with this field is still not widely available. So, this paper aims to discuss the model of distribution and retrieval of content that can be developed by using a distributed system approach, provide a review of several studies that have been carried out, and propose architectural models. Meanwhile, the formal requirements that must be met when developing the model architecture of accessing distributed content are also presented. According to [18], the system must be easily accessible, hiding the fact that distributed sources must be open in the sense of interoperability, portability, and extensibility. Further, distributed systems must be scalable.

The rest of this paper will discuss the problem of distributed network models that can be developed for the Aerosity area in Section II. A general framework proposed to support the communication model in the Aerocity region in Section III, discussion in Section IV, and conclusions in Section V.

II. DISTRIBUTED SYSTEM FOR AEROCITY

A. Distributed System

The demand for transparency in distributed networks is also related to energy transparency at the distribution level. This energy transparency discussed in research [19] is about

energy transactions related to power distribution in blockchain technology. The results of the study provide an idea of the problem of energy exchange in the peer-to-peer network from a technical perspective, where this problem is different from other digital businesses because energy transactions are strongly influenced by the support of the exchange of infrastructure strength. The issue of availability in distributed networks is a problem that receives attention, primarily related to the fulfillment of user requirements. If there is a failure in the maintenance process, the virtual machine will move from one server to another server, whose position is still in one cluster, thus sharing storage resources is very important [20]. The article tries to discuss the application of virtualization to server cluster systems using virtual machines as shared storage, where shared storage affects the engine's performance. The discussion of cost reduction in the application of transparency is also given, for example, in cloud computing, as discussed in [21]. The article discussed the openness in the cloud, the approach to maintaining transparency and reducing the cost of cloud transparency, and the challenges in the future. This approach is related to unrecognized service problems suitable for hidden forms of communication, including their physical location.

According to [18], referring to the nature of a distributed system, the characteristics include a collection of autonomous computers and a single coherent system.

Table 1
Characteristics of Distributed System

Characteristics	Indicators
Autonomous computer set element	a. Associated with synchronization because there is no global clock b. Group membership 1. Open 2. Close c. The distributed system as an overlay 1. Structured 2. Unstructured
Single coherent system	d. Transparency 1) Access 2) Location 3) Relocation 4) Replication 5) Concurrency 6) Failure

Then, the formal requirements must be considered when designing a distributed system. The other problems are about the ease of access to resources and the hidden support that comes from the network in the eyes of users or network users. The system must be open both interoperability, portability, and extensibility, and distributed systems must be scalable.

The availability of information about the content will be verified by users or other related parties. [22] discusses some cases in data management that illustrate the type of replication or strategies of replication. The conclusion is that an automated therapeutic replication is a core of the issue for research in the field of replication, which is expected to occur for scalability reason, in terms of size, geography, and administration. Furthermore, this research argued that replication requires various demanding strategies at multiple layers of data. Besides, there are several topics aimed at the development of future internet architectural models, in which one is reviewed by [23], where this study attempts to propose architecture and implementation for network devices and services, communication, management, and naming models. In this study, they argue that distributed models of architectural Information-Centric Networks (ICN) models indicate the potential to replace host-centric model internet architecture. This effort is primarily the goal of the Internet of Things (IoT) network designed to help life.

Meanwhile, in a distributed network system, congestion problems are also often discussed. One of the discussions is done by [24] by proposing the problem of distributed dynamic based dynamic rates as a congestion management method in distributed networks. This method is a method for optimizing based on composition, so that it can obtain transparency. In reality, the process can realize cost efficiency used for energy use purposes. Another study related to transparency is proposed by [25], where this study proposed an architecture for automated public distribution systems that can help transparently transact transactions and manage accountability. The public distribution system in the discussion consists of government components, community and government machinery layers, and community representatives as mediators. There are problems related to the issue of transparency, manuals and paper-based work, card errors or duplications, and the ineffectiveness of monitoring systems. Therefore in this study, a web-based system for public distribution systems was proposed using QR-Code.

When doing data management in distributed systems, naming activities are one of the components discussed by researchers. One study related to this problem, which tries to discuss the persistent identification is done by [26], by proposing the idea of the resolvability of the handle issuer identifier through traffic domain name system (DNS) and evaluating the concept through specific equipment. This persistent identification problem is related to data management problems, which requires a system that can control the performance properly. In line with the research [26] about naming, the study conducted by [27] discusses some techniques that can use flat naming rates and payment standards. This approach can improve the middleware performance and performance of software instrumentation, which is an essential aspect of a real-time distributed system. It allows obtaining real-time feedback from the feasibility of the system, such as the use of resources and the state of the component, for performance analysis.

The distributed system development process requires system security testing procedures. These security issues are an essential problem in communication networks. Research conducted by [28] introduced a list of threats based on real standards and practices and the development of a six-layer model for mission generation tests based on technical specifications and end-user requirements. In his discussion, a formal approach to automatic design and generation of security mechanisms has been described for sophisticated distributed systems. While discussing the development of distributed systems, there are challenges to the system because often, the system requires operations through the internet and different administrative domains. This challenge is mainly on the need for transparency of distribution, which comes from users and systems. The paper [29] concentrates on the new challenge that, in reality, modern distributed systems are part of a massive computer environment. The problems to the large distributed systems that exist are related to the transparency of distributed systems, the internet of things, the development of collaboration systems. At the

same time, the new challenges related to socio-technical distributed systems lead to users' interests to be part of the system.

Table 2
Relations Distribution System Topics and Ref

Topics	Ref
Distribution system characteristics, designs	A brief of distributed system [18], Transparency in transactive energy [19], Distributed replicated block device [20],Reduction cost in cloud [21], A formal approach to distribution security [28], Designing distributed system [32]
Managements	Replicating [22], DNS as resolution infrastructure [26], Optimization [24], Name node cluster [16]
Applications, middleware	Architecture for automating public [25], software instrument middleware [27]
IoT, challenges	Distributed ICN-based [23], Challenges in distributed system [29]
Clusterings	Data clustering over P2P [30], Parallel spectral clustering [31]
Grids	Developing infrastructure [34], Accessing to library [35], Implementation globus[36]

Paper [30] proposed an algorithm for cluster distributed databases. The method applied uses optimization techniques to obtain better objectives. The results of this study indicate the superiority of the technique proposed above the algorithm based on the distributed version of the algorithm known as K-Means. Besides, several articles examine investigations and the Special spectral approach, one of which is an article [31], who investigates and discusses large-scale grouping spectral approaches. Two approaches, were discussed namely, sparsifying the similarity of metrics and the Nystrom approach, where the problem of a parallel application was proposed in the article, including doing scalability problems. In this study, the problem of spectral algorithms proven to be effective compared to other algorithms. Furthermore, it is necessary to improve agility, reliability in distributed systems [32]. With respect to data management, research [33] reviewed the Hadoop problem and proposed a distributed file system as a framework consisting of several name nodes, where this framework is for the interests of big or big data management.

According to [18], cluster computing and grid computing are subgroups of distributed systems, where computing clusters consist of the same workstation and intimately connected. Each node runs on the same operating system. In contrast, grid computing includes a structured distributed system as a federation of computer systems with different administrative domains on the hardware, software, and network technologies developed. [34] proposed a national grid computing infrastructure to meet the needs of researchers. The national grid computer intended to utilize the resources that spread in various regions by using their respective systems and resources so that everything can be connected through this computer grid technology. The system used is the Globus Toolkit System, which is one of the most popular and widely used grid computing technologies for those who want to integrate their computing resources that spread into one unit. Meanwhile, [35] conducted a study to create a grid-based digital library architecture using iRODS middleware, which was named DLinGrid. DLinGrid architecture, which consists of three layers, namely: data, grid middleware, and application. According to [36], the Architectural standard of Grid computing defined by Open Grid Services Architecture (OGSA), where this architecture defines the overall structure and various services that must include in a grid environment.

B. Aerocity

[8] claimed that airport city or Aerocity is part of aerotroplis and is considered limited to airport property. Based on [1-7], they have the same orientation, where Aerocity and aerotropolis are areas around the airport that integrate regional planning, business, and infrastructure transportation so that it can increase economic growth and public welfare. [10] says that Aerocity in the Kertajati region is Indonesia's aerotropolis.

An article that tries to examine the relationship between airports and the economy of the community, [1] discussed the existence of airports. The airports are expected to increase the economy at the regional level, especially for local communities around the airport. The development of a city centered on the airport by combining business development between business people and communities around the airport is the concept of Aerocity. This article [1] aims to produce a business center development model at airports in Indonesia, where the population determined in the study was 296 airports, both those under government and military management. So, in the end, the article produced the Aerocity development canvas business model in Indonesia. It can conclude the growth of the commercial business center and airport management related to the program of the business center of development at airports supported by a partnership system. In line with the previous research, research [2] tried to analyze the relationship between airport performance and the growth of the Product of Gross Domestic using quantitative methods. The airport performance explained includes the production of waste management, water supply, etc. as well as other indicators, and the results of their studies indicate that airports are essential assets for the country, so they need to have competitive advantages. Another research conducted by [3], where this article analyzes the performance of airports in Indonesia, especially about the effect of information and communication. The study conducted by [4] on the development of airports, it was mentioned that the social economic and political impacts in developing BIJB in terms of the content policy still needs some improvements and input, and the results of this study strengthen the results of research on policy content and the context of implementation.

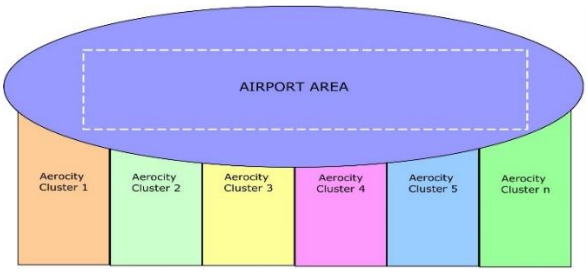

Figure 1: Mapping of Aerocity

Research conducted by the research community also relates to the relationship between human resource development and the success of the Aerocity model. This research is a quantitative explanatory and quasi-experimental study. The results of his research indicate that a society is dependent on trade and transportation, where there is competition in air

transportation models so that the term airport as waves of transportation development, seaports, rivers, and canals, railroads, vehicular transportation and airport as drivers for the development model. Meanwhile, the research conducted by [6] discussed the advantages of aerotropolis competitiveness and its key components, the principle of planning, criticism, and counterpoint to the aerotropolis plan in Nigeria. The study claimed that the construction of aerotropolis in the country could not be implemented because of various factors influencing it.

The research conducted [7] related to the development plan of Ratulangi aerotropolis, aimed at identifying the principles of aerotropolis at the airport to develop the area around the airport. The results showed that eight principles of aerotropolis were the principle of spatial structure, distance principle, first designation regional functions, zoning principles, land use principles, the principle of providing business areas, the principle of integration, and the law of connectivity. At Ratulangi Airport, almost all are under the prerequisites of the aerotropolis planning principle. Meanwhile, the study conducted by [8] discusses the competitive advantage of Aerocity along with key components, planning, criticism, and counterpoints. Furthermore, it is said that carrying aerotropolis is one form of urban that has an association with airports and other integrated transportation infrastructure so that stakeholders can connect, primarily related to business activities, which in turn will provide a close period to meet supply and demand needs from suppliers, customers and company partners located far away from them. This area usually consists of commercial centers based on multimodal (Airport City) airports, related aviation business groups, and other commercial fields, including housing, where among them have mutually beneficial relationships and have accessibility to the airport. And the study conducted by [9] discussed airport city design was made based on airport planning and development, airport master plan, and strategic planning.

Table 3
Relations Aerocity Topics and Reff

Topics	Reff
Relation airport with economics or other variables	Business model airport [1], Airport sustainability [2], E-business airport [3], Aerotropolis [12]
Designs, concepts, develops aerotropolis	Human capital [5], Policy of Kertajati airport [4], Gateway airport [6], Prinsip of aerotropolis [7], Aerotropolis [8], Airportcity [9], Sustainable technology [11], Hygiene congress [13]
Aerocity Profile	Aerocity investment [10]
Content Retrieval	Distributed dynamic cuckoo filter [14], Distributed multimedia [15], Information retrieval agent [16], Decentralized information retrieval [17]

In the profile of West Java International Airport (BIJB) [10], they have a plan for developing Aerocity, which is divided into clusters as follows: a) Aerospace Park, the center of the aviation industry with an integrated ecosystem. This cluster consists of MRO Hangar, Engine Shop, Mechanical Shop, Spare Parts Warehousing, Aircraft Assembly Plant, and Aviation School, b) Logistic Hub, namely the Multi-Capital Logistics hub which will become the new logistics center in Indonesia; including the packaging and naming industry, and cold storage for perishable cargoes, c) Creative Technology Center, which is a center of excellence for high-tech industries with leading research and development and manufacturing centers. This cluster will also consist of a college campus and bio-life science industry, d) Business Park, which is a business center and financial institution that will support all industries within the region. This cluster will also be equipped with MICE and various recreational parks, e) Residential / Township, namely exclusive residential areas with property ownership rights for expatriates and f) Energy Centers, namely sustainable renewable energy sources to support industrial activities. Research conducted by [11] discusses the evolution of the shape of a new city from a commercial terminal to an airport city and becomes an aerotroplis. Airport city plays an important role in accommodating growth and enlarging the capacity of several key locations in the world. The concept of an airport city and its successes and failures begins with a change from the airport as a city port accompanied by its quality. Meanwhile, the research conducted by [12] reviewed the airport transportation problem into airport city, which has received attention, especially in the fields of economy, logistics, and transportation infrastructure with the presence of the industrial, business, and commercial clusters, namely a different feature of the future physical quality. Finally, the research carried out by [13] concluded that airports have a large role in modern life and have been shown to influence the formation of city layouts and structures, along with passenger growth, and logistics activities, airports being developed into city-based airports, namely aerotropolis integrated with cities, airports and business areas which are solutions to achieve regional efficiency, acceleration, and connectivity.

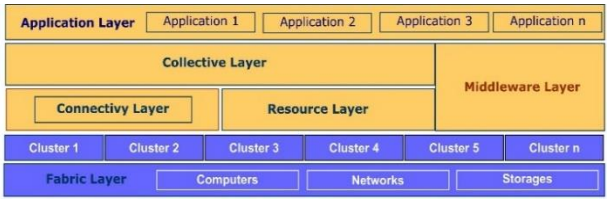

Figure 2: General framework

III. GENERAL FRAMEWORK

The general framework of distributed content communication architecture for the development of the Aerocity area is based on the Aerocity model. This model is clustered based on the fields of activity that have similarities with diverse and various data processing systems, based on grid computing technologies. These technologies are in distributed systems and have the advantage of being able to combine various sources that exist in each cluster so that it can result in efficient content distribution and retrieval process.

In the framework above, there are five layers that have different roles for each layer.

(a) Fabric layer
It provides interfaces at local sources that are spread out in each cluster in the aerocty area to be developing.
(b) Resource layer
This layer is tasked to provide arrangements to each source that is owned by each cluster
(c) Connectivity layer

Consists of communication protocols to support all transaction processes on the grid and is responsible for controlling access that occurs.

(d) Collective layer
Associated with handling access to various sources consisting of source search, allocation and task scheduling.

(e) Application layer
Consists of various applications that are used and needed by management, parts, or other parties involved in business activities in the Aerocity area.

Collective, connectivity and resource layers are called grid middleware layers. These layers provide access and manage resources that are potentially spread through various clusters.

Above the fabric-layer are described clusters in the Aerocity region that will be developed, the amount of which match with the Aerocity concept itself. Each cluster will be placed physical resources that will function the server and other functions. Meanwhile, the middleware layer will be the intermediate layer of interest between the application and the sources that exist in each cluster and will function according to the task. Among them is the middleware, which is supported by software programmed to complete complex tasks at the middle-layer level. In this framework, the hardware and software needs have not been raised in more detail. This is because this framework is still a proposition, and further research will carry out as well as a challenge for the community of researchers in this field to supplement the deficiencies that still exist. While at the application layer, it will fill with various applications needed by each cluster with an integrated concept, so that the communication network can reach all business processes in the area.

IV. DISCUSSION

A key issue of grid computer systems is that sources from different organizations are brought into collaboration groups of people from different institutions and even form a federation of systems [18]. This system's thinking is based on various data processing processes using various devices that will be connected to many communication networks. Therefore, adequate communication technology support and distributed systems with a computer grid approach is more an option.

Security issues aimed at all transaction processes are a component that is a fundamental concern of this architecture. Security on the distribution and retrieval of content is the focus of this architecture. The support for mobility on this architecture is possible because mobile devices' use is a component that cannot separate from the planning of the development of communication networks in this Aerocity area.

The use of devices to access various applications that exist on the system in the form of computers, tablets, or mobile phones is a part that must be prepared and constitutes an existing network system. However, this issue explicitly does not appear in the proposed framework. Mobile problems are mainly related to connection problems that must always stay connected to the network.

In this study, the components related to the software model as middleware and the applications used by the user must be studying further because this component is an essential part of the proposed architecture. The minus plus of this architecture can be specified as follows:

- Framework on this architecture requires a rigorous and accurate system design process, and this is necessary so that the management and control processes can establish with good.
- The support of strategic and technical policies from parties involved in the development of the Aerocity area is needed.
- It is necessary to create an environment used as a test tool for architectural performance to obtain maximum results.

V. CONCLUSION

The persistence and availability of communication networks that match the characteristics of distributed systems and clusters of environments in the Aerocity area can support content distribution and retrieval efficiency. A review and discussion of several articles have been carried out to get an idea of the types of Aerocity development planning and distributed computer systems, which subsequently raised as proposals for distributed content communication architecture for the development of communication networks in Aerocity.

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