Chapter

Application of Advanced Framework Technology in Smart Cities to Improve Resource Utilization

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Abstract

Nowadays, the application technology and demand are growth; there have been millions of solutions for user communication in smart cities. However, the quality of the autonomy of handheld devices and the information exchange of applications are functions of requesting services or participating in communications. Therefore, it is very difficult and tedious to implement resource management and control in such an environment. This study here proposes distributed cyber-physical systems (CPS) for agent-based middleware framework (AMF) using to achieve technology, thereby improving the reliability of environmental communication in smart cities. The technical solution has the characteristics of avoiding the problem of data source interruption because of the proxy technology of the linear calculation model. The aforementioned agents are independent and autonomous of each other in terms of providing seamless resource sharing and response scheduling, and have nothing to do with communication time and request queries. In this study, the architecture mainly uses the best linear calculation model to classify overlapping agents, and then allocates non-overlapping resources, and finally analyzes the overall architecture operation performance by responding to processed queries, storage utilization and resource usage, pause time and response.

Keywords: smart city, resource allocation, cyber physical system, linear optimization, agent technology

1. Introduction

1.1 Smart city development

Currently the most famous smart city development organization in the world is Intelligent Community Forum (ICF), Since 1999, the most representative smart cities in the world have been selected for awards and publicity every year. ICF is the American World Teleport Association it belongs to a non-business policy research organization with members from more than 40 advanced regions and countries, including the United Kingdom, France, the United States, Russia, Canada, Singapore, Belgium, etc. Headquartered in the United States, it aims to study job creation and economic development in the broadband economy. It has research and promotion targets regardless of the size of cities, developing or developed countries. ICF believes that the broadband economy creates a whole new industry, which enables small companies to become global exporters. Including exports of skills and knowledge that have never been transported between borders, It can ensure that remote areas and internal schools have access to the latest information tools and reference materials. By improving the economy and society of the community, broadband can reduce the aggressive, ICF also assesses whether the city has three major success factors [1, 2]:

1. Collaboration: focus on the mutual cooperation among industry, government, academia, and research.

2. Leadership: partnership with industry, government, academy, research and construction, and has a focus on improving the social economy and society.

Vienna University of Technology developed an assessment tool for evaluating European medium-sized cities in 2007; Rank the medium-sized cities according to the Smart city model built by this study. The model results show that smart cities are cities that perform well in key areas of urban development. It is based on the "Smart" combination of self-government, independence and knowledgeable citizens and assignment and behavior [3, 4].

The ranking is determined based on 6 characteristics and their respective components **Table 1**.

1.2 Smart manufacturing

The industrial revolution is represented by the technological and scientific breakthroughs in which automatic machinery replaces labor, and production and operation in the factory are replaced by manual labor production lines. An important evolution in the structure of the industrial economy that can allow personnel production can change the overall economic dimension. **Figure 1** shows the evolution from Industry 1.0 to Industry 4.0 [5].

The development of intelligent manufacturing technology revolution is to integrate CPS into fiercely competitive technologies, including physical phenomena, to

Item	Description
Smart mobility	It generally includes technical content such as international/national accessibility, sustainability of transportation systems, local transportation systems, and information and communication technology infrastructure.
Smart economy	The content includes important parts such as international integration, entrepreneurship, innovation, growth, city image and labor market.
Smart people	Including lifelong learning, education, open minded and racial diversity.
Smart environment	Including air quality, sustainable resource management and eco-environmental awareness.
Smart governance	Including efficient and transparent administrative management, political and democratic consciousness, public management and social services, etc.
Smart living	Including personal safety, environmental sanitation conditions, tourism planning, hotel room quality, educational facilities, social solidarity and cohesion, historical culture and leisure sports facilities.

Table 1.
Six characteristics of smart cities.

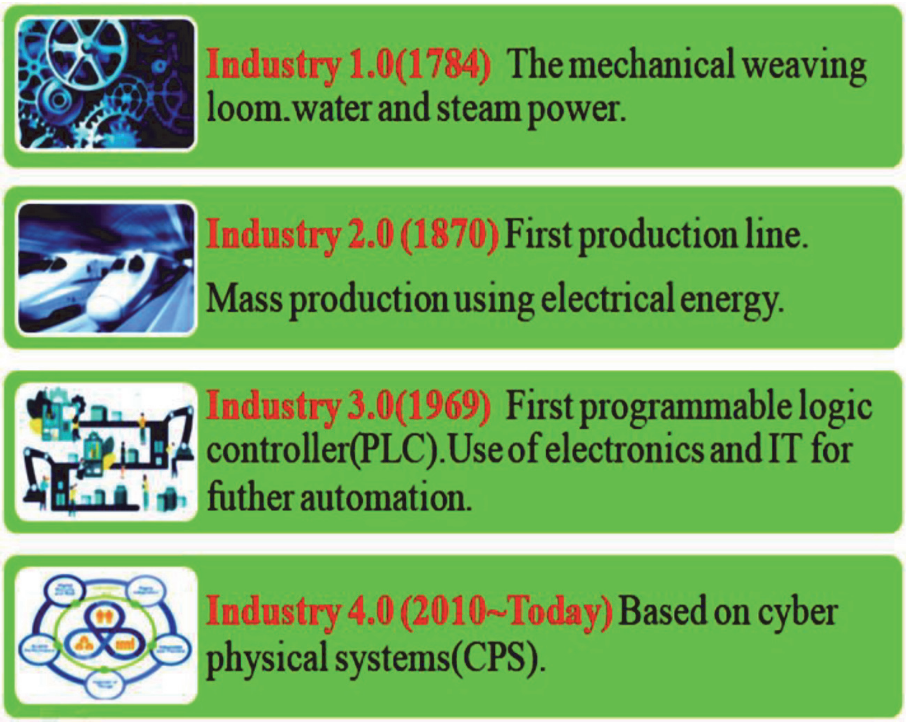


Figure 1.
Industry 1.0 to industry 4.0 evolution.

digitize physical (virtual) technology, Internet of Things (IoT), etc., and to develop necessary adaptability, resource integration efficiency and ergonomics The smart factory learned can also contact industry professionals in the manufacturing process and commercial value manufacturing process, innovative products, and customer-specific supply service functions.

There are five main levels of intelligent manufacturing automation including field level, programmable logic controller (PLC), supervisory control and data acquisition (SCADA/HMI) and mechanical equipment preventive sensing function manufacturing execution system (MES), enterprise resources planning (ERP) has become an optimized and integrated smart factory in the cloud [6, 7].

To build a smart factory based on the production process, the production machines must be intelligently optimized to improve efficiency, and the smart optimized system must be strengthened to assist in the deployment and application as shown in **Table 2**.

1	Sensor has many types and a wide range of applications
2	Data information collection framework (such as Web SCADA)
3	Communication protocol (MQTT or Ethercat)
4	Mechanical robot (flexible serial connection with production machine interface)
5	Bidirectional IoT/M2M (communication between production goods and processing equipment)
6	MES machinery and equipment preventive sensing function (inspecting the health of production machinery and equipment and process units; process scheduling procedures)
7	Scheduling items and process management of the production line.
8	Big data (big data analysis efficiency production and industrial to smart manufacturing).
9	MES/ERP serial connection and integration.

Table 2.
Intelligent automated systems.

1.3 CPSs and IoT

Two important production line manufacturing process environments for Industry 4.0 are machine-to-machine (M2M) communication and IoT. Strengthening CPS is the main key skill to integrate manufacturing and service value chains.

CPS is a collective model for evaluating the calculation process. These mass communication platforms that use collectives are absorbed as independent individuals. From miniature sensors in the environment to large data storage physical systems to detect the input process. Through various communication and information technologies, CPS provides users with security application access and support, service and data sharing privileges [8–10].

CPS will serially connect different physical evaluation computing facilities and processing components in a distributed environment, which can confirm the direction of user-centric applications and forward data and analysis to share. In addition to processing and execution capabilities, CPS can provide the best communication performance to support services, thereby supporting the sharing of information and data between users and facilities in different locations. In accordance with the use of mutual controllability, the properties and stability can be stretched and shortened to improve the reliability, service and performance of user applications, the CPS that evaluates and calculates tightness has been deployed in a large environment. In the CPS system, the physical network platform collected by the best method can be used to implement the resource co-allocation and communication security sharing in the production system and manufacturing, smart city transportation system and e-commerce. The current situation of smart cities is to provide people with the most practical and preferential sharing and communication services anytime, anywhere. The smart living environment integrates ICT and people as a whole [11–13].

For the smart city database environment with large amounts of data, it is necessary to immediately query various resources and execute processing to share aspects. These aspects require the use of many well-known technical capabilities to operate and manage. The CPS collection and synthesis in the smart city living environment enhances optimized user management to obtain applications and resources through distributed operation processing. Through the distribution of various resources from the distributed intelligent living environment, to meet the needs of users of different classes. Distributed living environments include multiple technologies, such as mobile edge computing, fog, and Internet of Things (IoT) clouds. These are examples of physical technologies. The CPS in the smart city has been deployed to inherit various technologies and resources. In the shared manual and resource allocation, it is a distributed smart environment to improve the reliability of applications and services. A process of multi-agent sharing and resource distribution is proposed. The agency skills in resource distribution and sharing have been widely used in various processes to reduce time and complexity [14, 15].

Provide distributed and combined execution for the structure and system of the agent to enhance the reliability of the system. For the agent's architecture and system to provide distributed and combined execution processing to enhance the system's reliable program. As described above, the complex processing and distributed purchase model implemented by CPS are used to process various resources sharing, distribution, and adjustment between users. In order to meet the increasing consulting needs of users and the requirements of facility setting density, it is necessary to perform optimal distribution and adjustment of data in a distributed smart living environment. CPS is based on the distribution of distribution storage resources and evaluation calculations from the distributed intelligent living environment, relying on sending and combining processing to provide services for user consultation and immediate response. The overall service provider level of resource reflection and collaborative perception, request execution, access control and adjustment levels are all stored in CPS. Distributed computing is jointly used by CPS, virtualized, and shared the best advantages of inspection and physical sensing to meet user requirements. In this kind of smart environment, the degree of resource distribution and adjustment is for the use of a dedicated operation process to build a purchase model to execute a management service platform [16, 17].

Reduce errors in the data sharing of smart telecommunication networks; it is necessary to provide a message transmission and playback classification framework. The use of collection and synthesis networks and telecommunication networks reduces the failure of data distribution and sending applications. Certain scholars developed a diagnostic system (FDDS) and model-free fault detection, used in a large number of cyber- physical systems. This communication isolation can be enhanced by performing autonomous learning on the temporal and spatial reasons of CPS. Elshenawy et al. research and develop the collection and synthesis of intelligent transportation systems used in smart cities and assist in adjusting the support structure. This architecture uses speech knowledge to display, establish a model for the collection and synthesis service operation and collection and synthesis service planning, and use the operation traffic adjustment degree and service demand in this in-vehicle application. Liu et al. in CPS, an event-driven tree model is adopted to improve faults [18–20].

In the distributed intelligent environment, the fault problem is handled according to the sorting process. The purpose of this study is to extend the hesitation model and the Internet network series model. The prevention evaluation calculation has been used for mitigation resolution and fault handling detection. This method can improve the accuracy of detecting the fault range. Past introduced a distributed computing model (DCMSP) for shared processing. Identifying the distribution task and estimating the terminal are the most important tasks of this operational model. According to the terminal's efficiency, it assists in dispatching and dispatching tasks [18–20].

Past research use CPS low-power wide area network (LPWAN) to manage radio resources. The analysis of the transmission model, according to the needs of a large number of CPS, executes the distribution of resources. Distributed CPS can effectively support two-way operation data conversion between LPWAN and extended cloud. The assimilation platform and related technologies perform the forwarding, exchange and processing of user codes. The scheduling model is used in the actual status control roles defined by the priority level. This model is suitable for pre-measurement of the model and online monitoring visits to establish a framework to solve scheduling and execution issues. The evaluation model closes the gap between physics and the network space to optimize the integration level of the estimation process. With bilateral directional quantification and network analysis, the performance of the network system can be counted. Past introduces a system (UPES-CPS) that applies a unified process to execute CPS to solve the work flow in actual data processing. The imported system can communicate, exchange and select through collection and synthesis services, and perform various texture operations with reliability. The virtual machine scheduling (QVMS), use promotion cloud system to assist CPS performance [21–24].

2. Methodology and study procedure

2.1 Smart cities physical system framework of agent-based cyber

The agency CPS is specifically designed to allow smart city resources to share and provide seamless services. Through CPS, users' applications and seamlessly integrated services are shared. Through the agent efficiency technology, it is endowed with the functional requirements of the synchronization of the smart city and the resource management of the user decentralization. It is proposed that for the agency CPS architecture, distributed task distribution and data resources can be used to manage efficiency. In the next section, you need to understand first, first explain this architecture. The agent-oriented architecture has been developed as an intermediate component between the platform layer and the application program, which can provide better interoperability. The intermediate component is composed of various agents, for example, the degree of adjustment of the visit control machine, the program of the resource management processor, etc. An agent is an integrated or mini program of applicable rules. This agent obtains the hardware and software of the facility that must be connected to the decision. In this architecture, the agents described above must be considered to solve the function of sharing and distributing the service resources of the data source together. Therefore, the intermediate component research and development concentric CPS specializes in serving in the smart city living environment. The CPS architecture of the agent is shown in **Figure 2** [9, 25, 26].

For intermediate components, the protection agent repository collects and generates agent processes, can provide reliable services to respond and can operate the application level to handle users. The agent is a context sensor developed with multiple functions to execute the model building. The multi-functional R&D design allows consulting agents to execute consultations and respond to actual cases in different time. But it can only pass when the agent needs to be released from the distribution process. Distribute to responding agents and consulting operations to exchange with the RM platform level. Therefore, the exchange of agents is of different levels, but it also handles multiple interruptions in the services of the user's smart city living environment. Agency performance technology assists in the implementation of multiple consultations on re-downloading functions and distribution methods. Unlike the conventional consulting execution system, this architecture focuses on the degree of adjustment and resource distribution. Since the agency operates in a combined delivery and distribution method, this process is already optimized for joint [27–32].

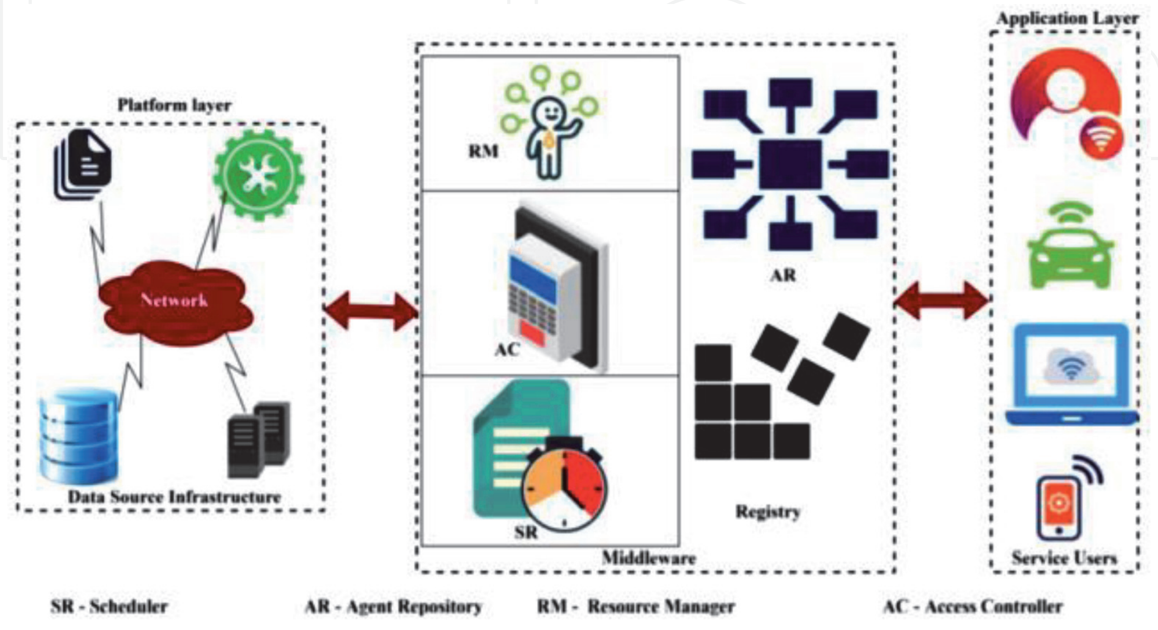


Figure 2.
CPS of agent-based.

2.2 Problem formation

The command $\rho_{i,j}$ represents the probability that user i has been assigned agent j, then

$$\left.\begin{array}{c} \rho_{ij} = \begin{cases} 1, if\ i^{th}\ user\ is\ assigned\ with\ j^{th}\ resource \\ 0, \qquad\qquad\qquad\qquad\qquad otherwise. \end{cases} \\ such\ that \\ f(x) = \min\left\{t \cup q_d\right\}, \forall \rho_{a(i,j)} = 1 \end{array}\right\} \tag{1}$$

In the formula (1), $f(x)$ represents a linear combination, which represents t is delay and qd drops. If ρij = 1, let qd and dq become the maximum in the time interval Δt. The problem of using a proxy is an important goal, the definition is like below.

$$\frac{\sum_{a\in A}\rho^{a}_{i,j}}{|A|} < \rho_{i,j} \le \sum_{a\in A}\rho^{a}_{i,j}, \forall i \in user\ and\ j \in resource\ and\ a\ connects\ i\ with\ j \tag{2}$$

The meaning representative is that if the user's consultation is executed by the agent a $\in A$, then the user is used to distribute the resources. On the contrary, in a single process, an agent is distributed to the user to prevent the same agent from overloading the load, defined as like below.

$$\sum_{i}\rho^{a}_{ij} \le 1 \forall j \in R \& a \in A \tag{3}$$

Let R represent the distribution and distribution of the i^{th} user's valuable resource through the RM agent.

2.3 Resource allocation

The distribution of resources in the distributed intelligent environment is performed by the source of the database that does not require complicated execution and the largest connection. The commands Pt and Δc represent the processing execution time and the connection of R resources and the demand for first-in-first-out distribution. The execution time of processing of Δc and R are suitable for equation evaluation calculation. Formula (4) is show in below.

$$\left.\begin{array}{c} P_t = \rho_{i,j}\sum_{n}(t_a - t_s) \\ \Delta c = \dfrac{\sigma_n}{|n|} \end{array}\right\} \tag{4}$$

The main σn is the activity consultation that can be noticed at ta, and at (ta-ts) is the time to search for services and acceptance. The service time is to search for the response through the distribution and distribution resources. The enhancement of resource distribution and distribution rate optimizes resource utilization. On the contrary, the search response will be affected by both qd and t. If qd is high, it will continue to destroy resources and increase downtime. The reduced quantity estimate is calculated as like below.

$$q_d = \left(1 - \frac{\Delta c}{S_r}\right) + r_a\left(\frac{\Delta c}{S_r} - \frac{t_s}{t}\right) \tag{5}$$

The ra is the search consultation arrival rate. The combined optimization uses a separate method to separate the linear display patterns classified into t and qd. Linear model display of qd show like below.

$$S(o) = -f(x)_{q_d} + P_t.\frac{\Delta c}{S_r}\forall\begin{matrix} i \in quires\ and \\ j \in R \end{matrix} \tag{6}$$

The sequence of the formula (6) Relatively the system output $S(o)$ is promoted and developed as like below.

$$S(o) = -\begin{bmatrix} q_{d11} & q_{d12} & \cdots & q_{d1j} \\ q_{d21} & q_{d22} & \cdots & q_{d2j} \\ \vdots & \vdots & & \\ q_{di1} & q_{di2} & \cdots & q_{dij} \end{bmatrix} + \begin{bmatrix} P_{t1} \\ P_{t2} \\ \vdots \\ P_{ti} \end{bmatrix} \frac{1}{S_r} \begin{bmatrix} \Delta c_1 \\ \Delta c_2 \\ \vdots \\ \Delta c_i \end{bmatrix}$$

$$\forall \frac{P_t}{(t_a - t_s)} \le \rho_{ij.} S_r \tag{7}$$

In the formula (7), the linear display of $S(o)$ is simply $\frac{1}{S_r}P_{ti}\Delta c_i - q_{dij}$. As stated earlier, in the formula (2) and (3) will allow users to control the load download of the limited agent when they are in different processes. This means that $\left\{q_{d11}, q_{d22}, \ldots q_{dij}\right\}$ is the only collection of non-load downloads, show in below.

$$S(o) = \begin{cases} -q_{dij} + \dfrac{P_{ti}\Delta c_i}{S_r}, \forall \dfrac{P_t}{(t_a - t_s)} < \rho_{ij.} S_r \parr i = j \\ \left.\begin{matrix} -q_{di+1j} + \dfrac{P_{ti}\Delta c_i}{S_r} \\ -q_{dij+1} + \dfrac{P_{ti}\Delta c_i}{S_r} \end{matrix}\right\}, \forall \dfrac{P_t}{(t_a - t_s)} < \rho_{ij.} S_r \parr i \ne j \parr S_r = S_r + 1 \end{cases} \tag{8}$$

From formula (7), it is shown that Δc_i_i and P_{ti} are available in the S_r and $S_r + 1$ slots of R. Through the largest slot in S_r of, the R resource management component agent will connect to other information, intermediate component of CPS. Communication must be executed in R before it can be executed $\frac{P_t}{(t_a - t_s)} > \rho_{ij.} S_r$

i. You can use R to reduce the waiting time for exchange search.

ii. The new R must meet the requirements in the balance formula (2) and (3) are to prevent overload downloading.

In the formula, the information distribution process of the above two cases. (7) is shown in **Figure 3(a)** and **(b)**.

In response to the request of the access mark to identify the overload downloading agent process to obtain the overflow, it is necessary to perform the verification and verification of the information distribution process. The structure shown in **Figures 2** and **3** analyzes this information distribution and distribution. In **Figure 4(a)** and **(b)**, the progress process overload download has been divided into

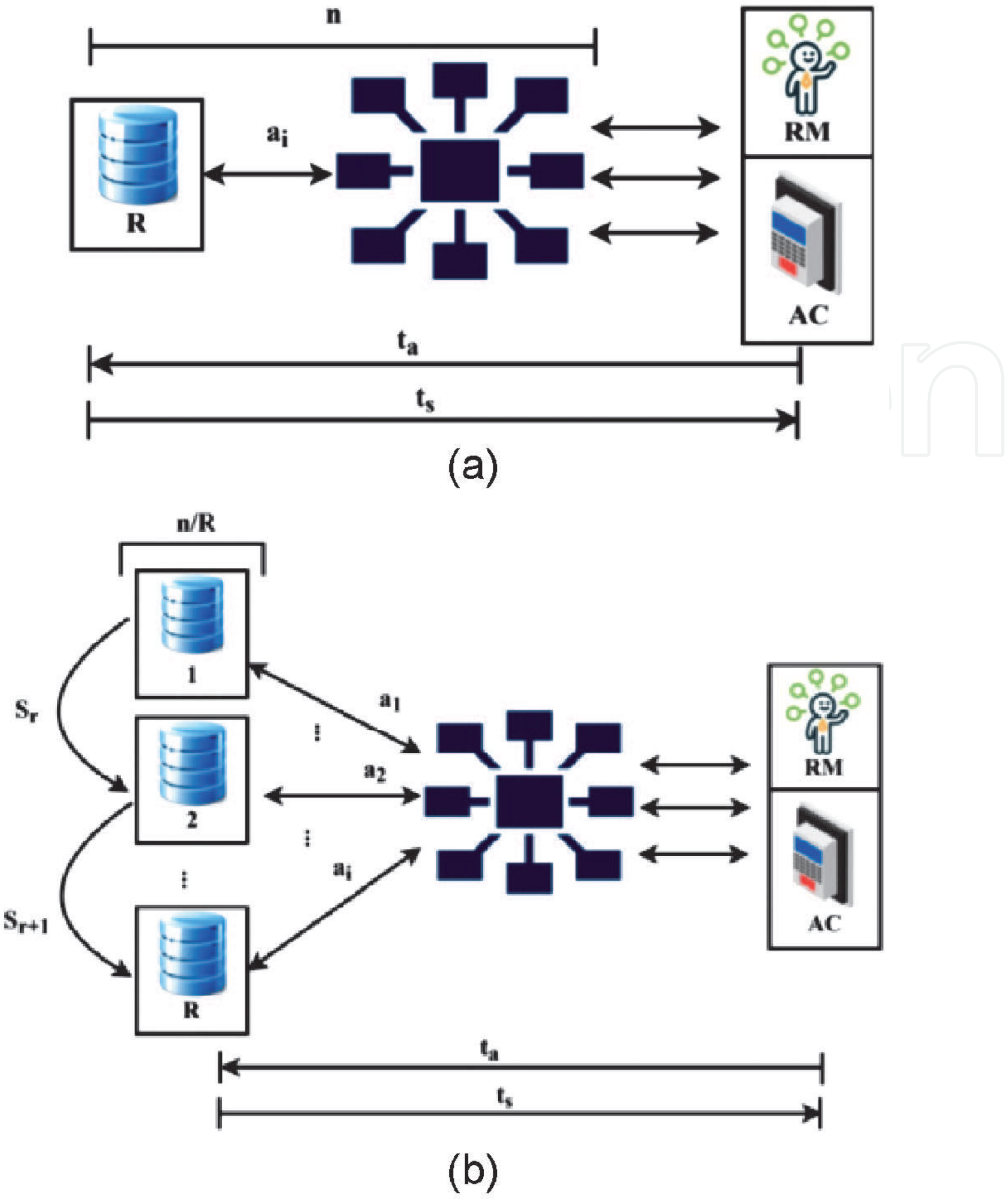


Figure 3.
(a). i = j *condition* (w.r.t qdij). *(b).* i≠ j *condition* (w.r.t qdij).

separate categories to prevent q_d. If resource distribution is not seamless, q_d cannot be restricted by control. Relative to t, the system output is linearized, for example in the formula (9)

$$S(o) = \frac{S_r}{(t_a - t_s)} + \frac{\rho_{ij}.a}{t} \tag{9}$$

Such as formula (10) is the expansion in the below.

$$S(o) = S_r \begin{bmatrix} \dfrac{1}{t_{a_1} - t_{s_1}} \\ \dfrac{1}{t_{a_2} - t_{s_2}} \\ \vdots \\ \dfrac{1}{t_{a_i} - t_{s_i}} \end{bmatrix} + \rho_{ij} \begin{pmatrix} a_1 \\ \vdots \\ a_2 \\ \vdots \\ a_i \end{pmatrix} \begin{bmatrix} \dfrac{1}{t_{11}} & \dfrac{1}{t_{12}} & \dfrac{1}{t_{ij}} \\ \dfrac{1}{t_{21}} & \dfrac{1}{t_{22}} & \dfrac{1}{t_{2j}} \\ \vdots & \vdots & \vdots \\ \dfrac{1}{t_{i1}} & \dfrac{1}{t_{i2}} & \dfrac{1}{t_{ij}} \end{bmatrix} \tag{10}$$

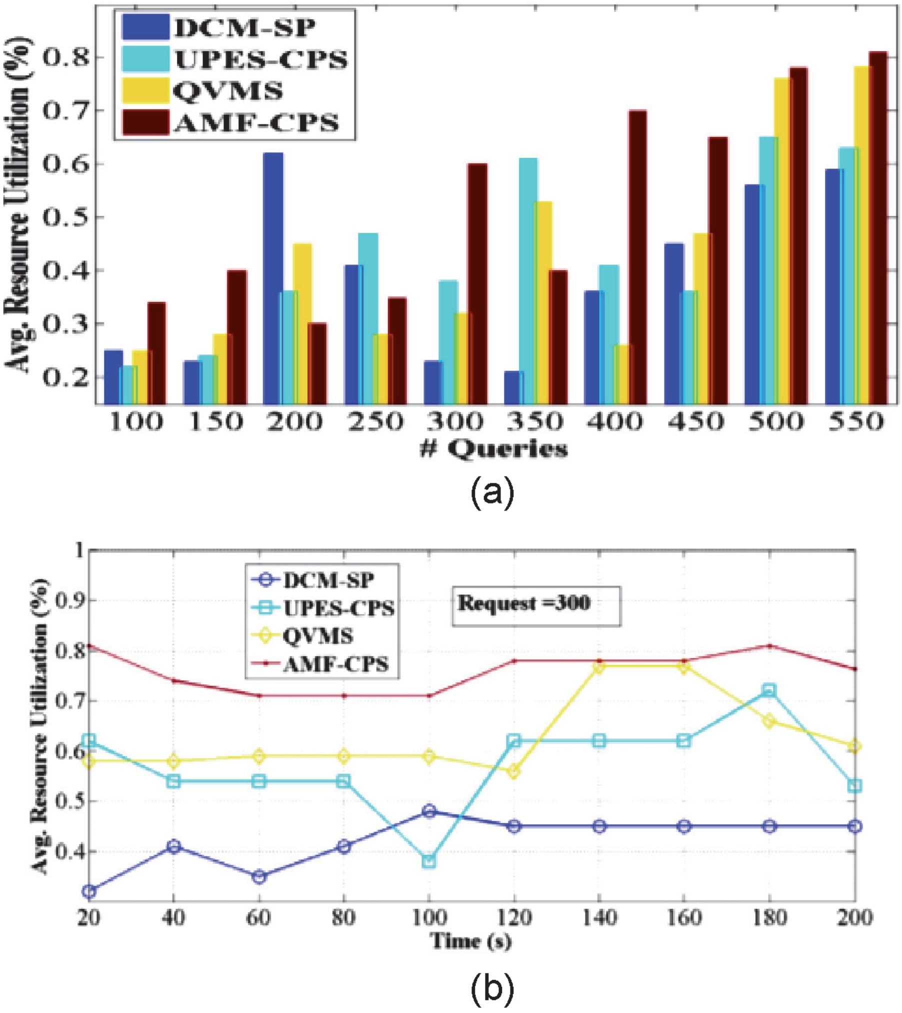


Figure 4.
(a). Average resource utilization vs. queries. *(b).* Average resource utilization vs. time.

As mentioned earlier, new resources are distributed and distributed to the overloaded downloading agents.

$$S(o) = \begin{cases} \dfrac{S_r}{(t_{a_i} - t_{s_i})} + \rho_{ij}. \dfrac{a_i}{t_{ij}}, \mathit{if}\ i = j \\ \dfrac{S_r}{(t_{a_i} - t_{s_{i+1}})} + \rho_{ij}. \dfrac{a_i}{P_t + t_{ij}}, \mathit{if}\ i \neq j \end{cases} \tag{11}$$

The output from the formula (11), the optimization requirements in the formula (1) If the classification reflects the conditions of t and q_d for $i = j$ and $i \neq j$ condition, then formula (2) and (3) are met. The illustration of $S(o)$ for t and $(t_{a_i} - t_{s_i})$ is shown in **Figures 1** and **2**, as shown in **Figure 5(a)** and **(b)**.

From this point of view, the equations solved can be used to check and verify the conditions for optimal distribution in formula (8) and (11),

$$\left.\begin{array}{r} \dfrac{P_{t_i}\Delta c_i}{S_r} - q_{d_{ij}} = \dfrac{S_r}{(t_{a_i} - t_{s_i})} + \rho_{ij}. \dfrac{a_i}{t_{ij}}, \mathit{if}\forall i = j \\ \dfrac{P_{t_i}\Delta c_i}{S_r} - q_{d_{ij+1}} = \dfrac{S_r + 1}{(t_{a_i} - t_{s_{i+1}})} + \rho_{ij}. \dfrac{a_i}{\sum P_{t_R} + t_{ij}}, \forall \mathit{if}\ i \neq j \end{array}\right\} \tag{12}$$

In the formula (12), the first condition meets the non-loaded download search, and the second condition shows the loaded download search. The search and

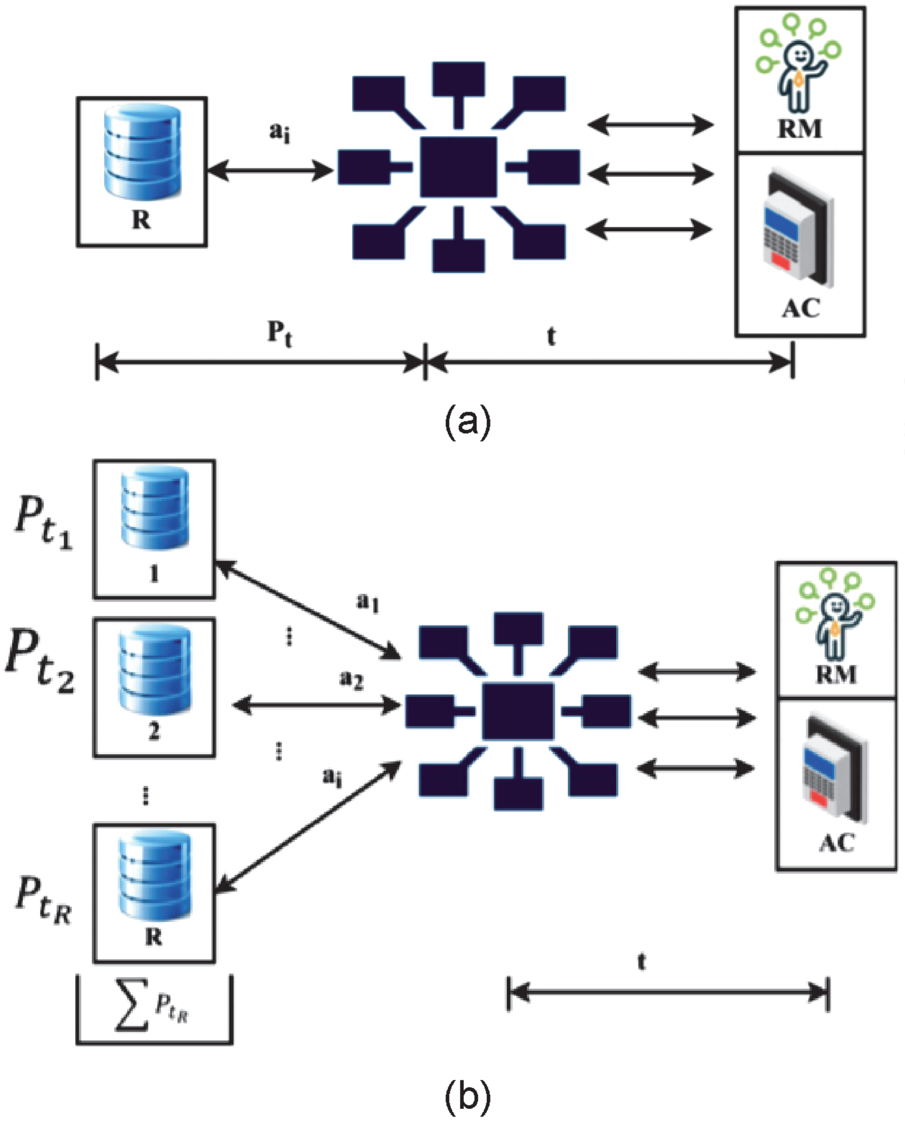


Figure 5.
(a). i = j condition (w.r.tPt). *(b).* i $\neq$ j *condition* (w.r.tPt).

distribution under heavy load will have new $a \in A$ and R, which will gradually increase S_r. The same via t_s (through combined sending execution, $P_{t_R} = t_s$, therefore,

$$\left.\begin{array}{r} \sum P_{t_R} + t_{ij} = \sum t_s + t_{ij} \\ \sum t_s + (t_a - t_s)(n - k)t_s - t_a \end{array}\right\} \tag{13}$$

It is the time to perform k searches for overload download. By identifying q_d to maximize the feasible and available R in t_a, the downtime can be reduced. The downtime observed in the proposed architecture will be compared with the current job execution in **Figure 6(a)** and **(b)**.

2.4 Scheduling of query response

RM and AC are responsible for resource information management through distribution. The other item, AC and adjustment level is the response to the user scheduling search consultation. The model for CPS has been established as intermediate component architecture, so the response will be provided as needed. The agent will complete the task and continue to release it to enable users to search and

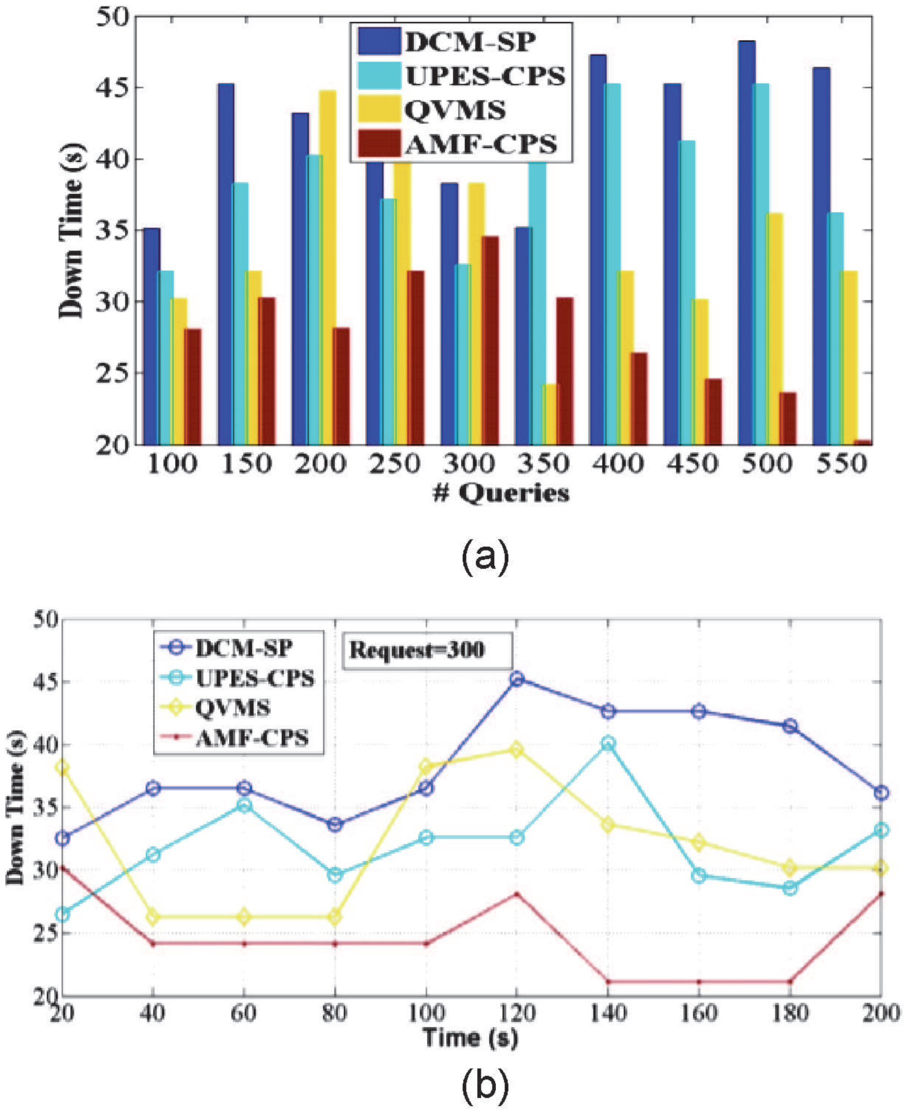
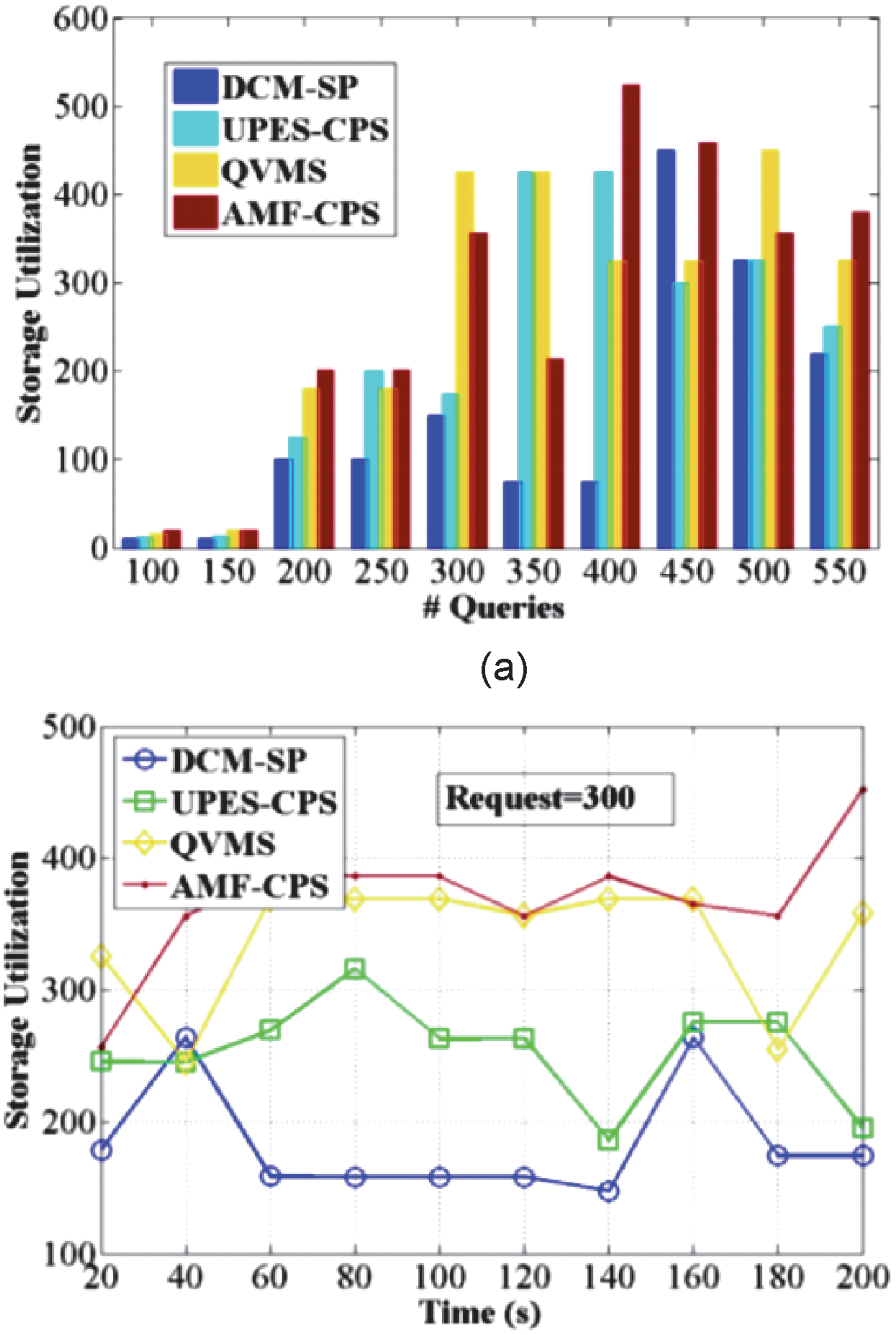


Figure 6.
(a). Queries vs. down time. *(b).* Time vs. down time.

distribute intelligent resources. Under the response, storage management is a challenging process, because the response can be used to obtain different large and small data messages. The optimized method is to use storage to help limit the response beyond the limit and prolong the hesitation. Therefore, the joint combination of AC and SR has been designed and developed to respond with an optimized method that uses available storage to distribute and distribute.

The adjustment level of this setting is different from the conventional first-in first-out process, because the searched t_a and P_t will vary with the user. From this time on, the agent will enhance the utilization efficiency of t storage. For all n requirements for distribution, the response waiting time is evaluated as $t + P_t$ (minimum value) and $t + [(n-k)t_s - t_a]$ (maximum value). The criteria in formula (1) need to be considered; you can evaluate and calculate the maximum value response waiting time. Seamless is the resource information supply, through the S_r or $S_r + 1$ slot to distribute and distribute $t + P_t$ **or** $t + [(n+k)t_s - t_a]$**.** The final evaluation calculation Search execution. The successful completion of the framework is evaluated and calculated based on the response time and storage utilization efficiency. Storage is a linear, first-in-go, first-out search system, where the first entry (response message) is based on the verification time (t_v) for confirmation. Therefore, storage must first conform to the $t_v = t + P_t \forall i = j$ **and** $t_v = t + [(n-k)t_s - t_a) \forall i \neq j$ of the agent distribution. Therefore, the linear model for t in formula (9)–(11) must be considered to optimize storage utilization efficiency. Let S_s display put into $'m'$ fan-shaped area to use the storage size and quantity of storage utilization efficiency is affected, causing response time delay. To deal with this problem, the response adjustment degree and storage utilization efficiency are modeled for the least amount of free time. In this architecture, regular idle time scheduling is not used. To meet the purpose of formula (1), the repeated stacking time is analyzed on the basis of the interval, and the equation of the model is established under the coordination of t_a and t_s, and the model is established for the idle time t_{s_i}. A comparison will be made in **Figures 1** and **2** for different search and time scenarios. See **Figure** 7**(a)** and **(b)** respectively.

Use formula (14) to evaluate and calculate the response schedule time (t_{dis}) like below.



(a)

(b)

Figure 7.
(a). Storage utilization vs. queries. *(b).* Storage utilization vs. time.

$$\boldsymbol{t_{dis} = P_t - t_a, \forall i = j \ and \ i \neq j} \tag{14}$$

When using $\boldsymbol{S_r}$ and $\boldsymbol{S_r + 1}$ to reflect the search query to $\boldsymbol{R}$, the scheduling time will be different. The sub-categories consulted for $\boldsymbol{t_a}$ and $\boldsymbol{k \times t_a}$ have been identified as formula (15) that provides a linear distribution ($\boldsymbol{\tau_{t_a}}$).

$$\tau_{t_a} = \frac{1}{S_r}\left[\int_0^k r_a P_t dt + \int_k^n r_a (P_t + t) dt\right] \tag{15}$$

Among them, one level $\boldsymbol{\int_0^k r_a P_t dt}$ provides services through the available S_r time gap, so $\boldsymbol{t + P_t \leq t_v}$. On the contrary, the second level $\boldsymbol{\int_k^n r_a (P_t + t) dt}$ cannot meet the requirements of $\boldsymbol{t_v}$, so the classification must be able to have a better degree of adjustment. Within the time of ($\boldsymbol{k \times t_a}$), the second-level derivative of $\boldsymbol{\tau_{t_a}}$ should be activated, and $\boldsymbol{P_t (n - k) + \sum t}$ will be regarded as prolonged hesitation. In this case, it can be confirmed that at least ($\boldsymbol{n - k}$) storage space $\boldsymbol{S_s}$ can be used to receive information responses, and the capacity in the storage space can be considered. If it is to perform virtualization/replication ($\boldsymbol{n - k}$), the distributed nature of CPS will provide more information than that. For the estimated time, the information in $\boldsymbol{P_t}$ used to analyze the allocated demand in $\boldsymbol{t_a}$ can be applied. Therefore, the linear form of formula (8) with $\boldsymbol{i \neq j}$ has been modified to

$$\left.\begin{array}{c} \dfrac{\alpha}{S_r} - \Delta = \dfrac{S_r + 1}{\left(t_{a_i} - t_{s_{i+1}}\right)} + \dfrac{\rho_{ij} a_i}{\sum P_{t_R} + t_{ij}} \\ where, \alpha = P_{ti} \Delta c_i \ and \ \Delta = q_{d_{ij+1}} \end{array}\right\} \tag{16}$$

From formula (15) and (16) the linear class is only given to the second class, such that

$$\left.\begin{array}{c} \boldsymbol{\dfrac{1}{S_r} \tau_{t_a}(\alpha, \Delta) = \dfrac{1}{S_r} \int_k^n r_a (P_t + t) dt} \\ \boldsymbol{\tau_{t_a}(\alpha, \Delta) = \int_k^n r_a (P_t + t) dt} \end{array}\right\} \tag{17}$$

As mentioned above, as in formula (13), $\boldsymbol{Pt}$ and $\boldsymbol{t}$ need to be used instead like below.

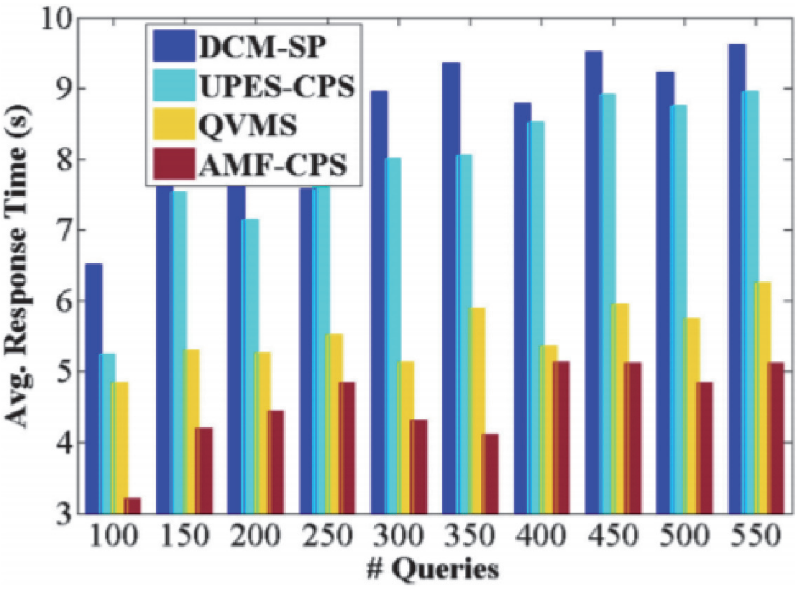
$$\boldsymbol{\tau_{t_a}(\alpha, \Delta) = \int_k^n r_a [(n - k) t_s - t_a + t_a - t_s] \, dt} \tag{18}$$

$$\boldsymbol{= \int_k^n r_a [t_s (n - k - 1)] dt} \tag{19}$$

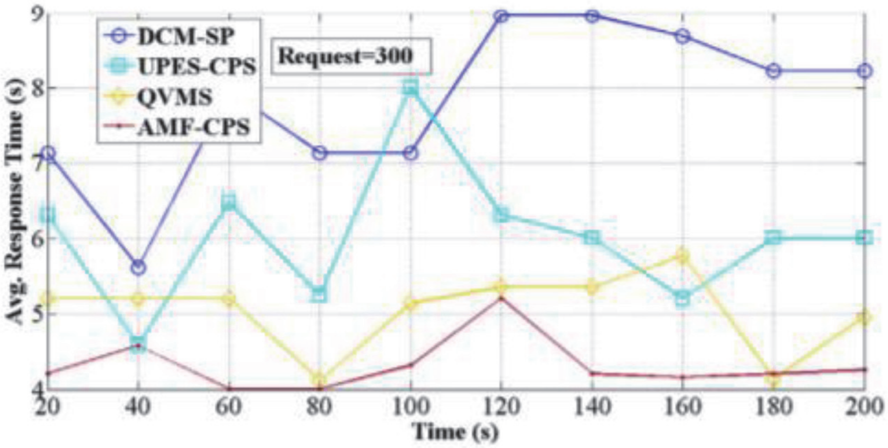
The time obtained from formula (19) is the maximum response to prolong hesitation, so that $\boldsymbol{(P_t + t) \leq (\alpha, \Delta) < [(n - k) t_s - t_a] + t}$. All the executed second-level consultation searches must meet this requirement. Therefore, $\boldsymbol{t_{dis} = t_s - t_a - t_a = t_s - 2t_a}$ is the execution time of the second level of the opening action. Therefore, the degree of adjustment is outside the time $\boldsymbol{[n - k) t_s - t_a](t_s - 2t_a)}$ and is processed in time, which can reduce the waiting time for users to reserve when responding to inquiries. In the end, the overall proposal will be compared with the current situation discussed in the previous section for the overall proposal for the perceived waiting time in the agent structure, and the consultation search and time have been changed (see **Figure 8(a)** and **(b)**) . Comparison and analysis have represented the proposed architecture by limiting the response time control to $(t_s - 2t_a)$, and set aside to extend the delay $[(n - k)t_s - t_a] + t$ has been limited.

Through the deployment of smart cities at different levels, users (in terms of application categories) are used to analyze the performance of the proxy CPS architecture using the OPNET simulator. The application scenarios need to include voice, multimedia, database and Http harsh users. The size and capacity of the application varies from 100Kb to 5 Mb, and it executes requests from users in the form of consulting queries. CPS has been deployed as an intermediate component that utilizes cloud and various other communication performance technologies. In **Table 3**, a detailed explanation and analysis of the settings and their values in the experiment are presented.

As mentioned in the foregoing, we have compared the downtime, resource utilization efficiency, storage utilization efficiency and response time of the



(a)



(b)

Figure 8.
(a). Response time vs. queries. (b). Response time vs. queries.

Experimental parameters	Values
Users	180
Application Type	Constant Bit Rate
CPS Middleware	8
AR Capacity	25
Application Rate	100Kb-5 Mb
Query Requests	30/sec
Storage Size	100 Mb
Slots/Storage	20

Table 3.
Experimental parameters and values.

Metrics	DCP-SM	UPES-CPS	QVMS	AMF-CPS
Down Time (s)	46.32	36.25	32.14	20.25
Resource Utilization	0.59	0.63	0.782	0.81
Avg. Storage Utilization	220.32	250.12	325.4	380.25
Avg. Response Delay (s)	9.62	8.96	6.25	5.12

Table 4.
Comparison and analysis of various query searches.

Metrics	DCP-SM	UPES-CPS	QVMS	AMF-CPS
Down Time (s)	36.14	33.22	30.21	28.14
Resource Utilization	0.45	0.53	0.61	0.763
Avg. Storage Utilization	174.2	195.24	358.41	452.32
Avg. Response Delay (s)	8.22	6.01	4.96	4.26

Table 5.
Different time comparison analysis.

proposed architecture to measure the degree of execution. In the comparison performed, it has been considered that the current way DCPSM, UPES-CPS and QVMS are regarded as indicators. In **Tables 4** and **5**, the results of comparative analysis for various different queries and time have been listed.

3. Conclusion and suggestion

This content manuscript mainly introduces the structure of the CPS intermediate component agency in the smart living city service. The operation process of resource information distribution and service provision is controlled and managed with the assistance of CPS and agency performance technology. A separate agent has already distributed and used for consulting query execution and resource information distribution and distribution without causing overload downloads. In addition to the task of solving and responding, the agent of the intermediate component can also handle the classification and time scheduling of the consultation query to reduce the downtime caused by the failure of the available resources. In the distributed CPS, the linear evaluation and calculation model is used to solve the problem of prolonged delay and loss. The improvement is transformed into a minimized joint optimization, which can respond to processing delays in the fastest time and improve resource utilization.

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