A Smart City Platform with a Smart IoT Cloud

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A Smart City Platform with a Smart IoT Cloud

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Contents

Abstract

- This paper introduces our smart city middleware platform and present the cloud computing engine in the smart city middleware platform for smart city systems which support Internet of Things (IoT) Cloud.
- In constructing and operating smart city, our research uses a smart city management system, called UTOPIA, which has a 3-tier structure.
- The UTOPIA's Smart-city Unified Platform (USUP), which is installed at the smart city middleware tier, is based on cloud computing that enables big data processing, enables high performance computing and provides infinite computing resources.
- It combines the cloud computing technology with nine state-of art information and communication technologies to provide a variety of smart city services for smart cities.

1. Introduction

Background Information

Smart City

Chyoung-Kye-Chun smart-town, Seoul, Korea.

- **Smart-city is a future city that melts information and communication technology (ICT) into a city.**
- **It provides intelligent services, that is, smart services, and allows the users to use the smart-city services anytime, anywhere and with any accessing devices (3A).**

Smart City

- There was a very significant conference for the smart-city in European Union Parliament in May 2013 [1].
- Thereafter, EU launched a big and very significant smart-city project for European Countries, China, Taiwan, Middle East nations and India launched their smart-city projects as well.
- It is anticipated that they produce good results of the projects in near future.

Smart City & Cloud Computing

Seoul Metropolitan IT complex cloud computing data center.

- **Intelligence is one of the key factors to city management, such as infrastructure management, smart traffic management, smart ecological environment management, smart energy management, etc.**
- **The dramatic advances in information and communication technology I(ICT) enable a smart-city to solve challenging issues for sustainable urban development.**

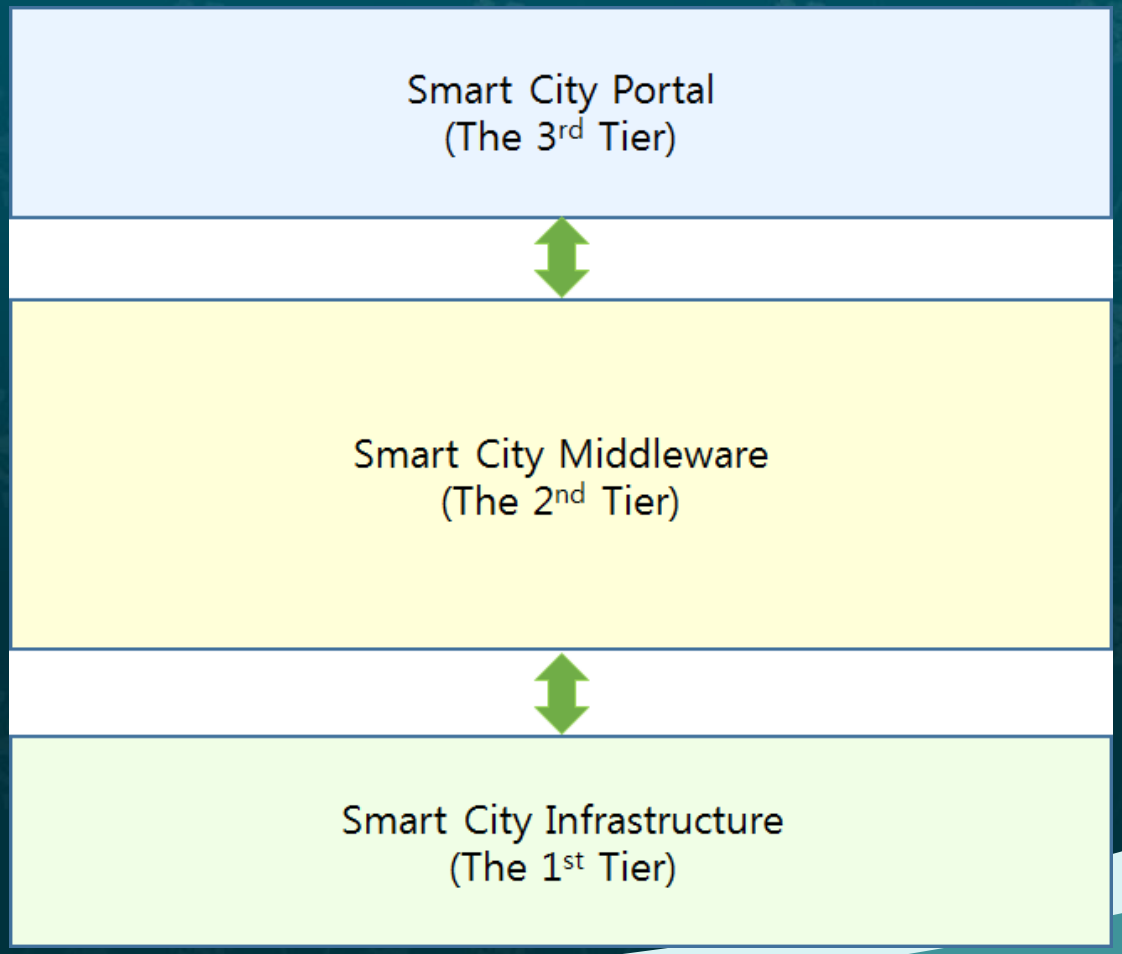
2. UTOPIA

A Smart-City Paradigm
by the Smart City Consortium.

UTOPIA

- The smart-city consortium has been doing research and development for the smart-city with the fund of near twenty million US dollars as a pioneer for the smart-city and u-city since 2005.
- We have developed a smart city paradigm called UTOPIA with the smart middleware as shown in figure 1. [2,3]
- UTOPIA consists of 3 tiers, such as the smart city portal tier, the smart city middleware tier and the smart city infrastructure tier.

UTOPIA



The paradigm of the Smart-city System called as UTOPIA.

UTOPIA

- One of the main duties of the smart-city portal tier is to provide web services which enable us to use even mobile cloud [4]-[6].

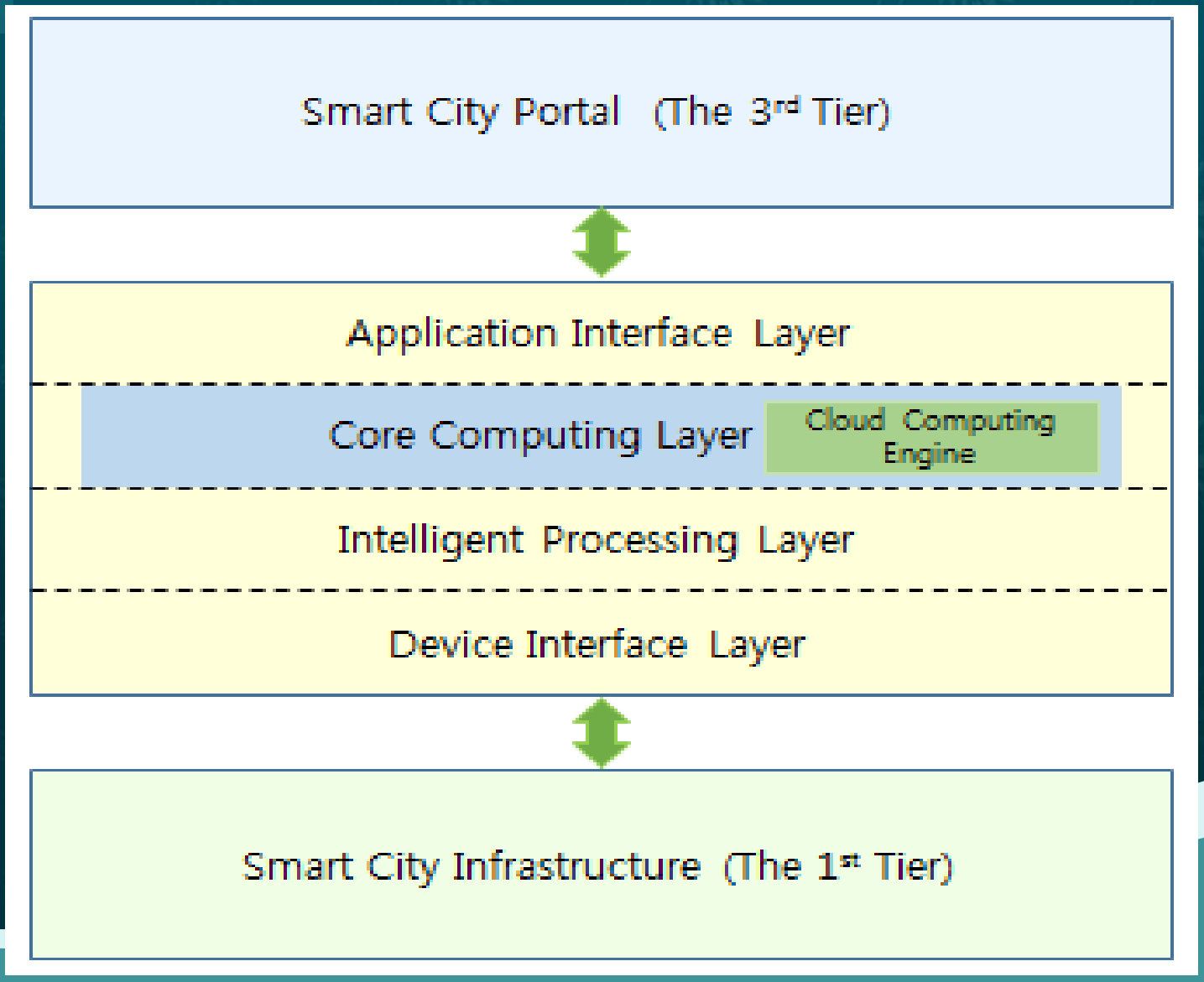
- Since UTOPIA has the portal tier, the other two tiers become transparent to end-users and end-users do not have to know their internals of the two tiers.

Realization of the ten functions in UTOPIA

The smart city middleware tier uses the smart city middleware platform called Utopia's Smart-city Unified Platform (USUP) where the cloud computing technology and the nine state-of art ICT technologies converges.

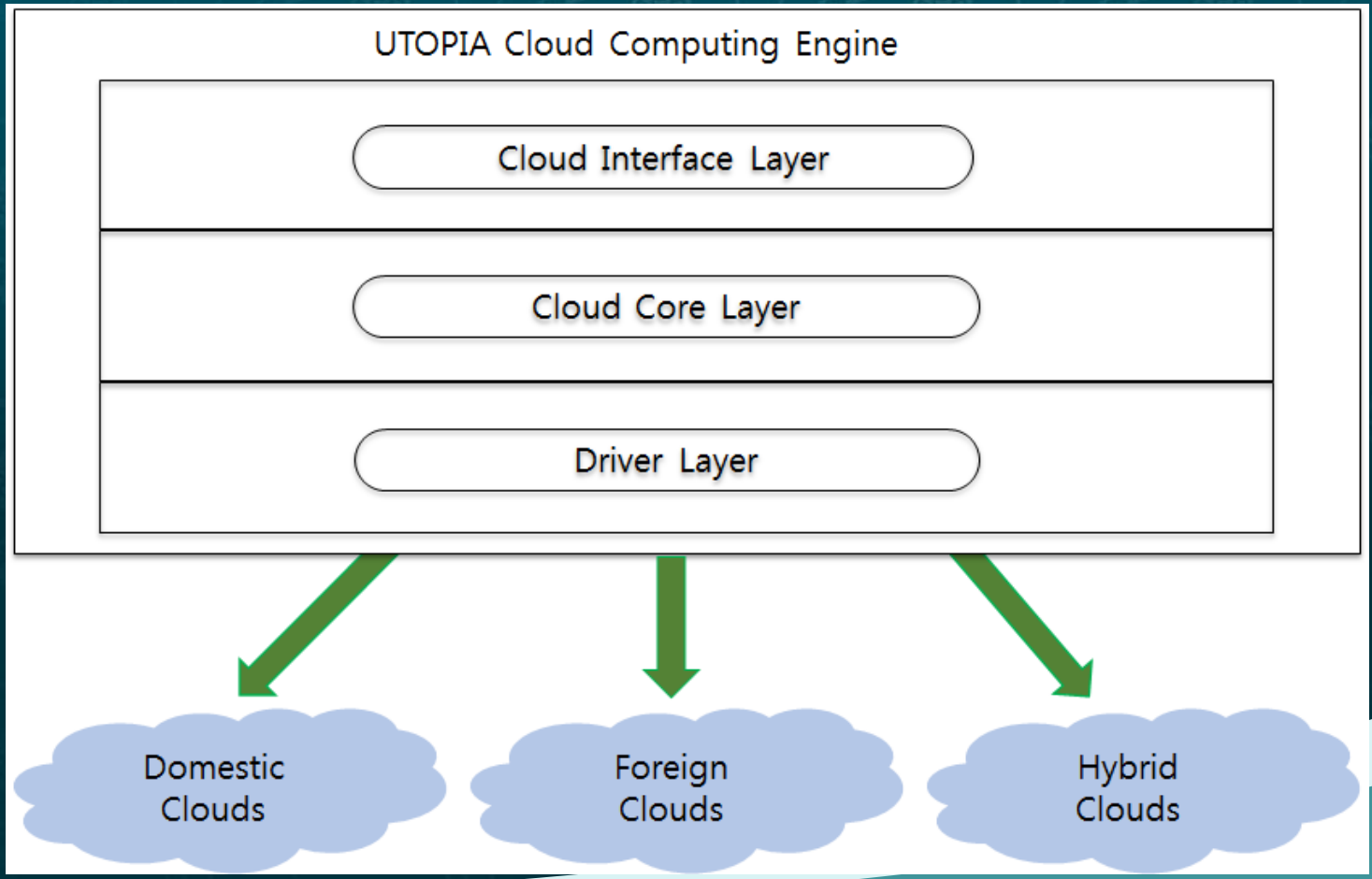
The nine ICT technologies are 1) IoT, 2) intelligent processing, 3) real-time processing, 4) location-based processing, 5) GIS, 6) Multi-media management, 7) Ubiquitous computing, 8) Computer Supported Cooperative Work and 9) Convergence.

The architecture of Utopia's Smart-city Unified Platform.



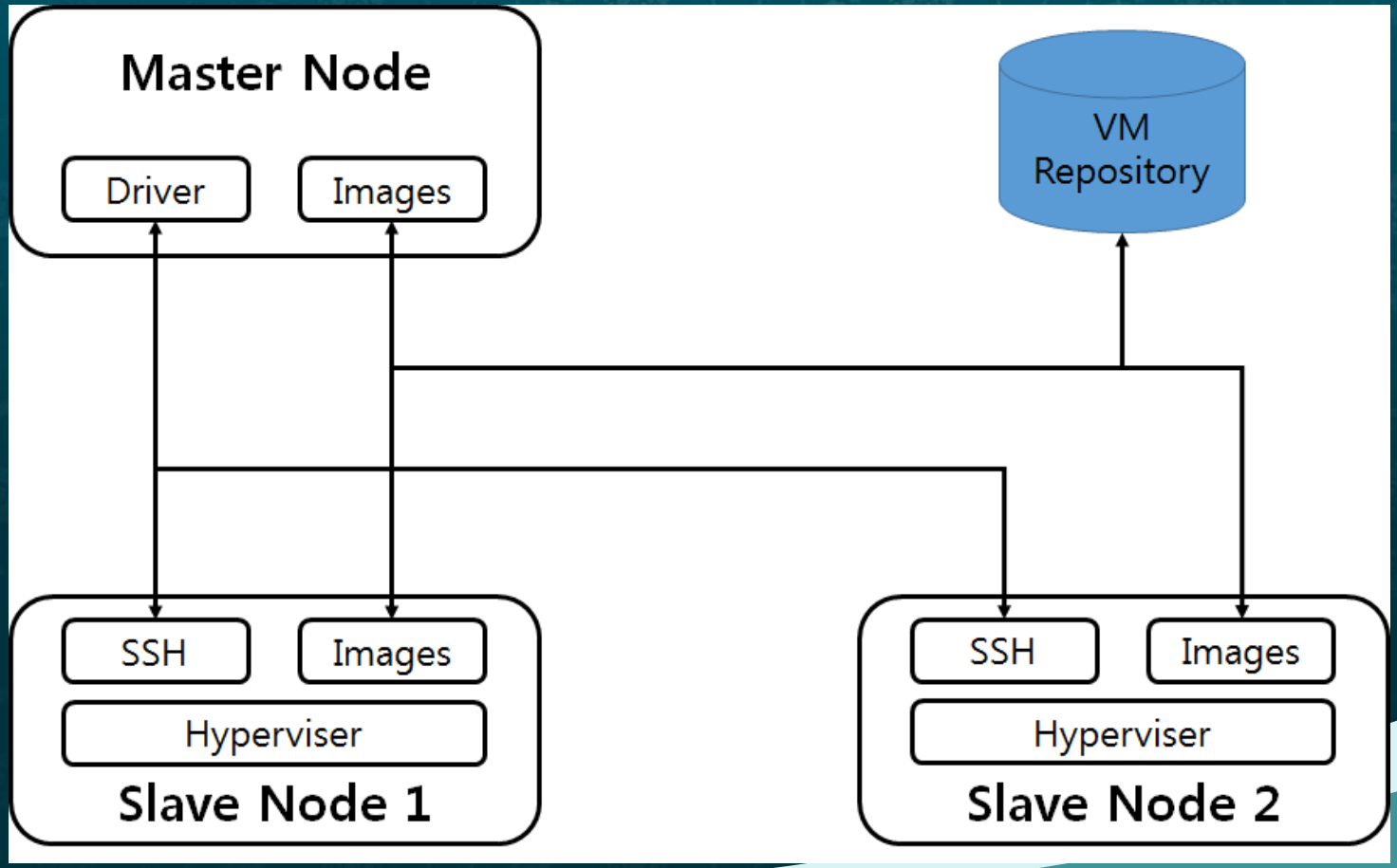
3. The Cloud Computing Engine and Realization of Cloud Computing

UTOPIA Cloud Computing Engine



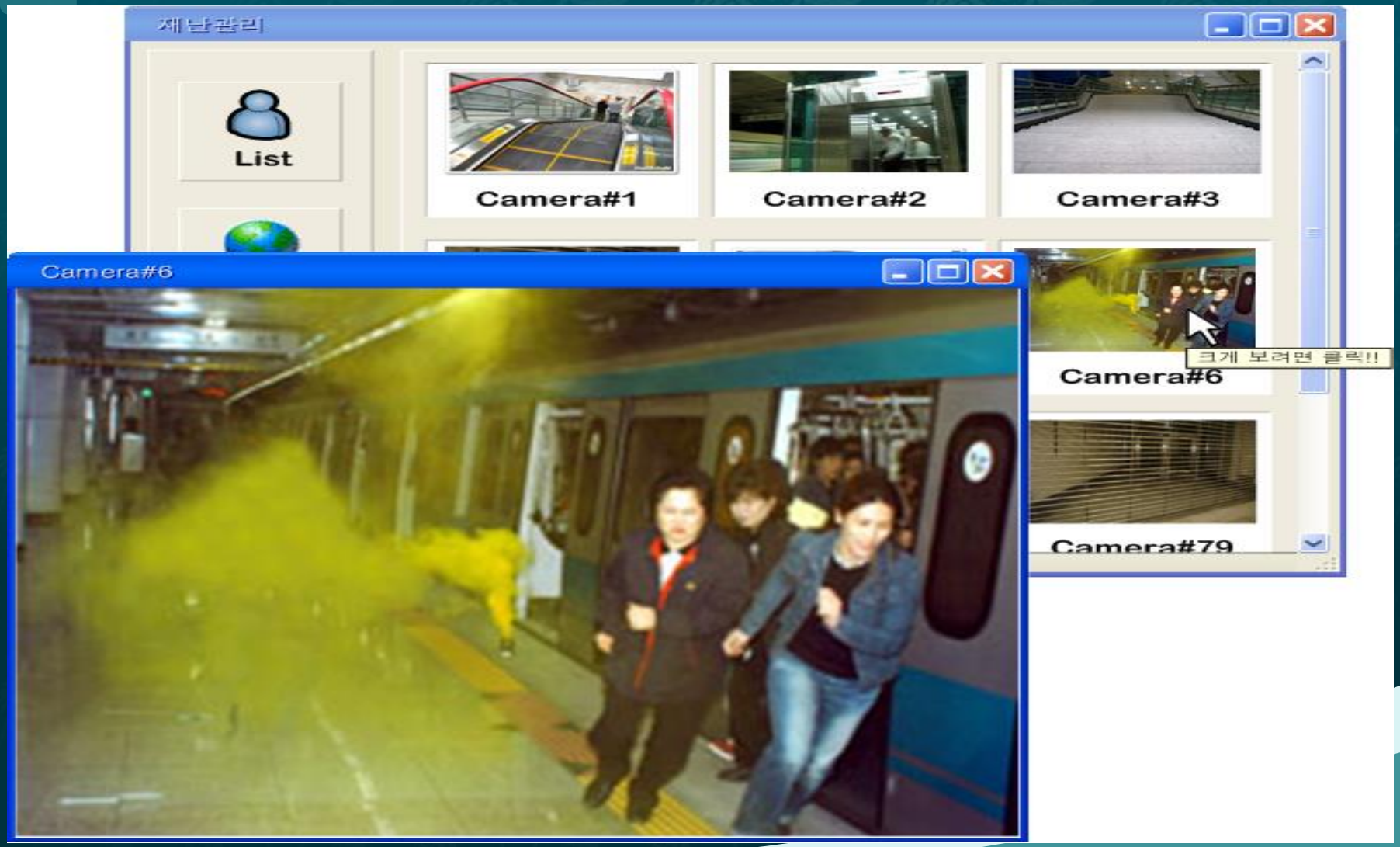
UTOPIA Cloud Computing Engine

UTOPIA's IaaS cloud computing in a master-slave type cluster



Using the cloud computing

Ontology based Smart Processing



Fire Accident Management

4. Related Works

4. Related Works

- Representative open source softwares to construct an IaaS platform for cloud computing are CloudStack [7], OpenStack [8], and OpenNebula [9].

4. Related Works

- Cities around the world seeks to be smart cities through the implementation of Internet of Things (IoT) devices. [10]
- Gartner predicts that by 2020, 95% of all new products will use Internet-of-Things technology.
- There are many commercial IoT Platforms which can be used in smart cities.
- The cloud services provided by Amazon include an IoT suite that supports Internet-of-Things applications [11].

4. Related Works

- Google Cloud Platform [12] is a global cloud provider that supports IoT solutions.
- The Microsoft Azure IoT Suite [13] provides both preconfigured solutions and the ability to customize them and create new solutions based on project requirements.
- SAP Cloud Platform [14] for the Internet of Things is a convenient environment for remotely managing and monitoring all connected devices in a target IoT system.

4. Related Works

- Oracle Internet of Things [15] platform supports the processing of extremely large amount of data, thus allowing users to build large-scale IoT networks.
- Cisco provides a platform for mobile cloud-based IoT solutions [16].
- The IBM Watson Internet of Things platform [17] supports effective remote device control, secure data transfer and storage in cloud, real-time data exchange, and machine learning in integration with AI technology.

Conclusion

Conclusion

- Our smart cities use the smart city management system, called UTOPIA, to build and operate smart cities in the three tier structure. The three tiers of UTOPIA are the smart city infrastructure, the smart city middleware tier, and the smart city portal.

Conclusion

- The smart city middleware tier uses the smart city middleware platform called USUP (Utopia's Smart-city Unified Platform) where the cloud computing technology and the nine state-of art ICT technologies converges.
- The nine ICT technologies are 1) IoT, 2) intelligent processing, 3) real-time processing, 4) location-based processing, 5) GIS, 6) Multi-media management, 7) Ubiquitous computing, 8) Computer Supported Cooperative Work and 9) Convergence.
- USUP has four layers such as the device interface layer, the intelligent processing layer, the core computing layer, and the application interface layer.

Conclusion

- The Cloud Computing Engine resides in the third layer, the Core Computing Layer of USUP.
- The Cloud Computing Engine manages the virtual infrastructure, and provides the ability to lease computing resources based on virtual machines.
- The cloud computing engine supports IaaS with a master and slave architecture.7

Conclusion

- The Cloud Computing Engine consists of three layers such as Cloud Interface Layer, Cloud Core Layer, and Driver Layer.
- The Cloud Interface Layer consists of the Cloud Interface and Administrators Tools.
- The Cloud Core Layer consists of nine managers, such as Virtual Machine Manager (VM Manager), Scheduler, Network Manager, Storage Manager, Congregation Manager, Image Manger, Information Manager, Security Manager, and Accounting Manager.
- The Driver Layer consists of three drivers such as Domestic Cloud Driver, Foreign Cloud Driver and Hybrid Cloud Driver. Thus the Cloud Computing Engine supports three kinds of cloud computing paradigms such as domestic cloud computing which does cloud computing using its own cloud computing resources, foreign cloud computing which does cloud computing using external cloud computing resources that the smart city does not have, and hybrid cloud computing which does cloud computing by combining the domestic cloud computing with the foreign cloud computing.

Conclusion

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Conclusion

- We have been doing the research on the UTOPIA, UTOPIA's Smart-city Unified Platform, the Cloud Computing Engine. We will continue the research so that what we have been doing can be available in more smart city services in future.

Acknowledgment

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Reference

1. Yong Woo Lee, “Smart-city,”European Union Parliament Seminar, May 2013. [Online]. Available from: http://www.europarl.europa.eu/document/activities/cont/201305/20130514ATT66084/20130514ATT66084EN.pdf, 2018.12.
2. Hae Sun Jung, Chang Seong Jeong, Yong Woo Lee and Phil Doo Hong, “An Intelligent Ubiquitous Middleware for U-City: SmartUM,” Journal of Information Science and Engineering, vol. 25, no. 2, pp. 375-388, 2009, doi: 10.1688/JISE.2009.25.2.3.
3. Hae Sun Jung and Yong Woo Lee, “Smart Platform Softwares for Smart Buildings,” Proceedings of the conference: International Conference on Intelligent Building System 2017, Seoul, Korea, pp. 53-67, June 27-28, 2017.
4. Yong Woo Lee and Seungwoo Rho, “U-city portal for smart ubiquitous middleware,” In Proceedings of the 2010 The 12th International Conference on Advanced Communication Technology (ICACT’10), Korea, Vol. 1, IEEE, pp. 609–613, Feb, 2010, ISBN 978-89-5519-146-2.
5. Seung Woo Rho, Chang Ho Yun and Yong Woo Lee, "Provision of U-city web services using cloud computing," Proceedings of the conference, 13th International Conference on Advanced Communication Technology (ICACT), Korea , pp. 1545-1549, Feb, 2011, ISBN 978-1-4244-8830-8.
6. Yong Woo Lee, “Orchestrating Internet of Things (IoT), Smart Devices, Opensource Software, Cloud Computing and Standards for a SmartCity,” Proceedings of the conference: The Seventh International Conference on Cloud Computing, GRIDs, and Virtualization, Tutorial, Rome, Italy , March, 2016, ISBN: 978-1-61208-460-2
7. Cloudstack. [Online]. Available from: https://cloudstack.apache.org 2018.12.
8. OpenStack. [Online]. Available from: https://www.openstack.org/ 2018.12.
9. OpenNebula. [Online]. Available from: https://opennebula.org/ 2018.02.
10. Chang Ho Yun and Yong Woo Lee, “Internet of Things for Smart Building,” Proceedings of the conference: International Conference on Intelligent Building System 2017, Seoul, Korea , pp. 291-315, June, 2017.
11. Amazon Web Services. [Online]. Available from: https://aws.amazon.com/ko/ 2019.02.
12. Google Cloud IoT. [Online]. Available from: https://cloud.google.com/solutions/iot/ 2019.02.
13. Microsoft Azure IoT Suite. [Online]. Available from: https://azure.microsoft.com/en-us/features/iot-accelerators/ 2019.02.
14. SAP Cloud Platform. [Online]. Available from: https://www.sap.com/products/iot-platform-cloud.html 2019.02.
15. Oracle Internet of Things. [Online]. Available from: https://www.oracle.com/solutions/internet-of-things/ 2019.02
16. Cisco IoT Cloud Connect. [Online]. Available from: https://www.cisco.com/c/en/us/solutions/internet-of-things/overview.html 2019.02.
17. IBM Watson Internet of Things. [Online]. Available from: https://www.ibm.com/internet-of-things 2019.02.


תודה
Dankie
Gracias
Спасибо
شكراً
Merci
Takk
Köszönjük
Terima kasih
Grazie
Dziękujemy
Dėkojame
Ďakujeme
Vielen Dank
Paldies
Kiitos
Täname teid
谢谢
Thank You
Tak
感謝您
Obrigado
Teşekkür Ederiz
감사합니다
Σας Ευχαριστούμ
ขอบคุณ
Bedankt
Děkujeme vám
ありがとうございます
Tack