

14TH ITU ACADEMIC CONFERENCE

ITU KALEIDOSCOPE
ACCRA 2022

Metaverse Interoperability With Composability in Hyper-connected and Hyper-personalized Virtual Environments

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Keynote Session

Metaverse interoperability with composability
in hyper-connected and hyper-personalized
virtual environments



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What Is The Metaverse?

- **Metaverse** is a set of virtual worlds that are independent or connected to reality, in which it is possible to create economic, social, and cultural values by interacting with various objects.
 - Extended reality (XR) is a generic term for immersive technologies including virtual reality (VR), augmented reality (AR), and mixed reality (MR).
 - Metaverse refers to a digital society in social and cultural aspects, and XR is a technology that supports such a society in the virtual world.



Is Metaverse Interoperability Necessary?

- A user wants to access metaverse through one of those platforms and interact with other users in virtual worlds through other platforms.
 - ▶ **Interoperability** refers to the property of allowing one thing (e.g., a reference system) to be used interchangeably with other things (e.g., target systems) of the same or heterogeneous type without any restrictions.
 - ▶ **Metaverse Platform** utilizes technologies such as XR, AI, and cloud computing to provide a simulated environment where many people can have new virtual experiences.
 - ▶ Users can access more virtual worlds with different characteristics. Service providers can get more users to access their virtual worlds.
 - Many users improve the quality of service.



User Experience in Metaverse Services

- **Metaverse UX** needs to be considered so that people can conveniently access virtual worlds and have more immersive experiences.
 - ▶ **User Experience (UX)** refers to the overall experience that users feel while using a product, system, or service directly or indirectly.
 - ▶ When 'Second Life' was released in its early days, UX was less intuitive and user motivation to access the virtual world was not sufficient. It continues to improve.
 - ▶ For the design of an interoperable metaverse platform, the diversity in user's access types, interactions, and service experiences should be discussed.

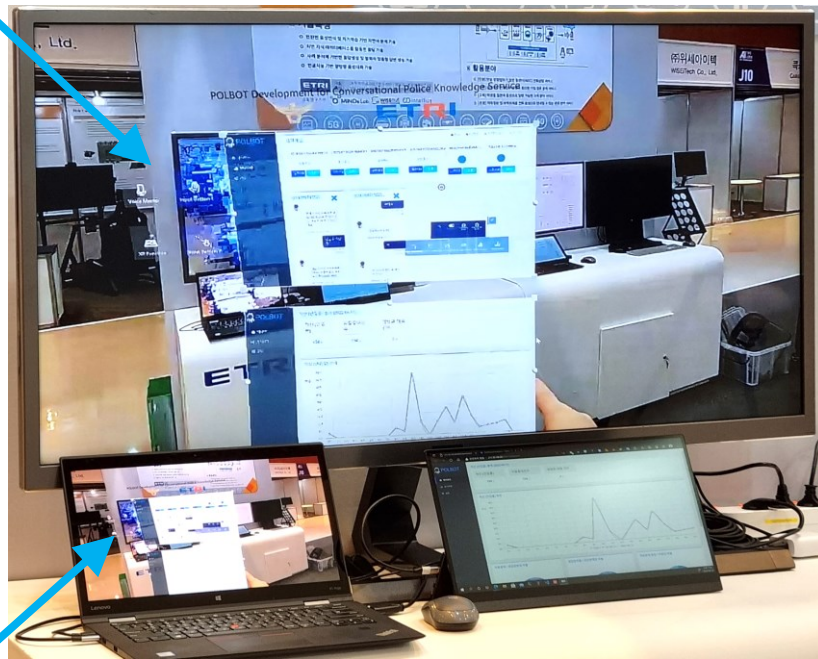
chat, voice commands, gestures, etc.



User Experience in Metaverse Services

- “If UX is not considered, technology exists but the service may not exist.”

conventional UI
→ inconvenient



real-time monitoring
with multiple screens
→ useful



voice-based control
→ easy to handle



gesture-based control
→ difficult to handle

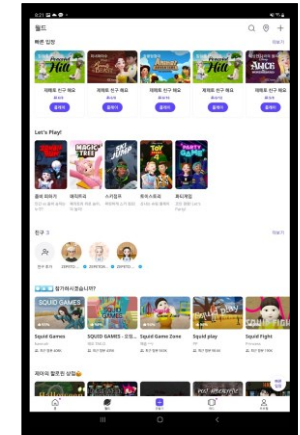
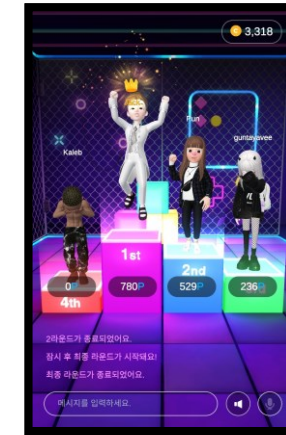
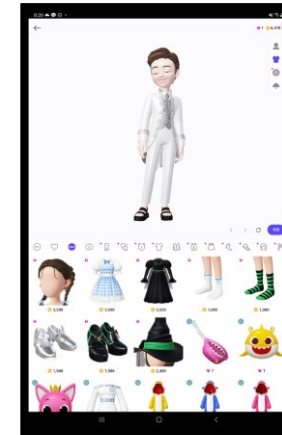
< Conversational voice bot system >
(AI Expo in Korea, 2022)



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User Experience in Metaverse Services

- Action-based change model -



- ▶ The metaverse platform should be implemented to have interoperability for various services by referring to the metaverse user behavior wheel.

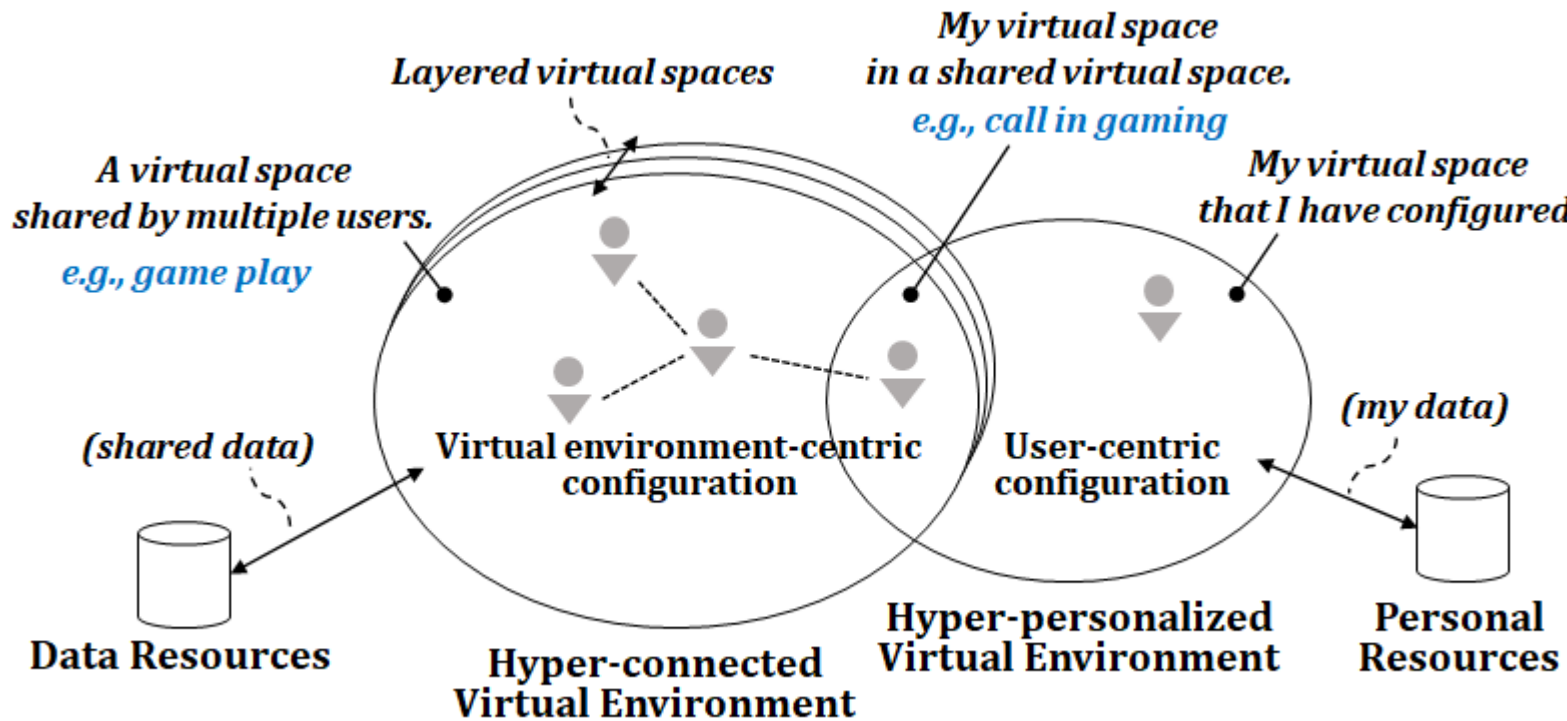
< Metaverse User Behavior Wheel >



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Hyper-Connected & Hyper-Personalized Virtual Environments

- It is necessary to look at the user experience of metaverse services in hyper-connected and hyper-personalized virtual environments.



- ▶ Since the hyper-connected virtual environment is a space shared by multiple users, arbitrary services are provided to users by synchronizing with the virtual environment.
- ▶ Since the hyper-personalized virtual environment is an individual user's space, it is reconstructed around personal data and presets.

< Virtual environments for metaverse services >



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Composability For Interoperable Metaverse

- It is necessary to consider 'composability' in order to deal with the interoperability of heterogeneous metaverse platforms and their internal systems and technologies.
 - ▶ **Composability** is a system design approach that deals with the interrelationship of standardized components.
 - ▶ The configurable system can be selectively implemented in various combinations according to user requirements.
 - It is advantageous to design and implement a metaverse platform.
 - Some parts, such as security, become difficult and complex to implement.

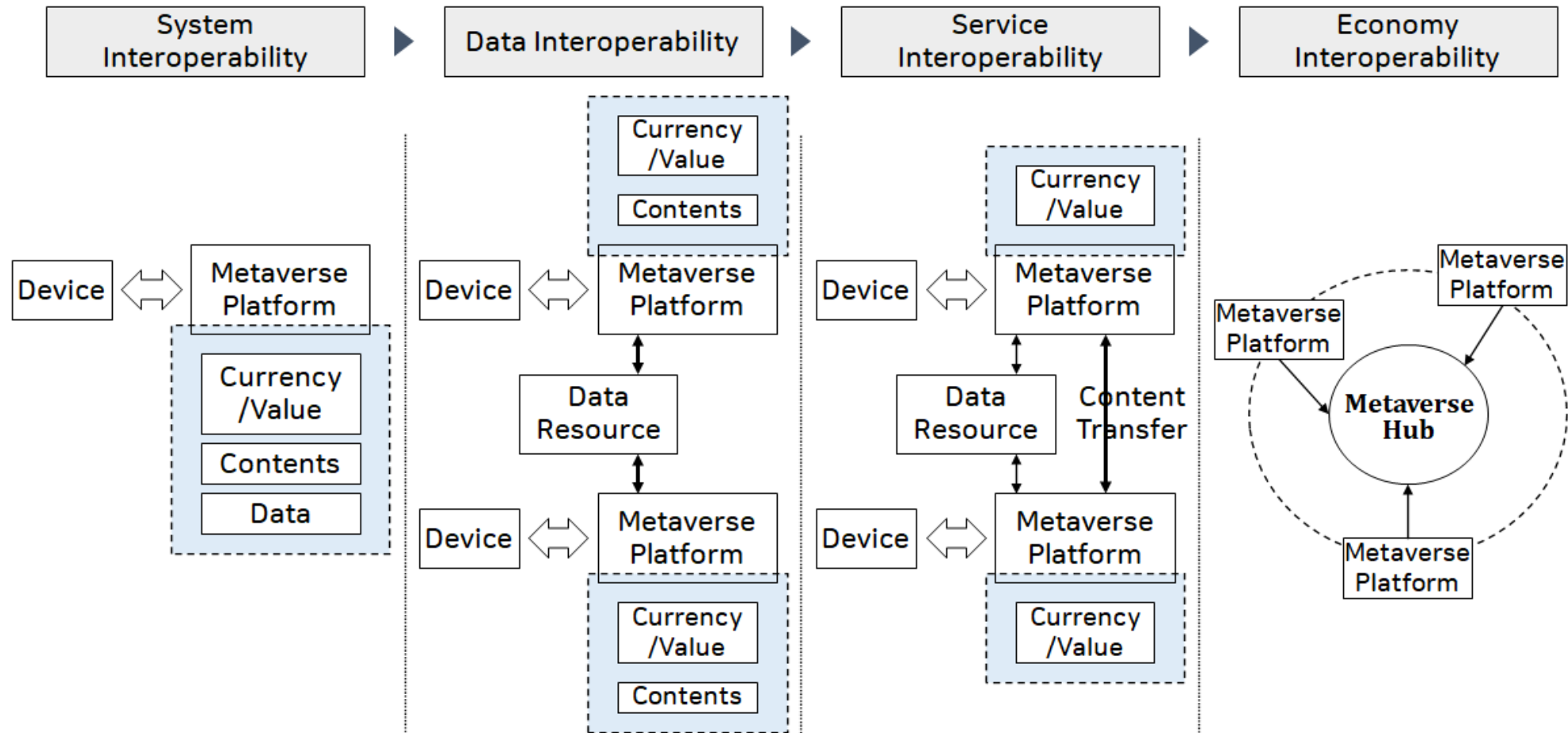


Metaverse Interoperability

- Although the technologies required for one metaverse platform are different depending on the purpose of the service, operators and developers will want to escape the dependency on specific hardware and software constituting the platform.
 - ▶ However, it is not easy to characterize the interoperability of a metaverse platform.
 - ▶ Interoperability is described in terms of system, data, service, and economy, considering the evolution of service platforms.



Evolution of Platform For Metaverse Services



< Evolution of metaverse platform with interoperability >



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System Interoperability

- System interoperability is to build a platform infrastructure that comes into the range of system performance for metaverse services using standardized ones without technical dependencies on hardware and software. **We are already considering this.**
 - ▶ This includes user terminals (to access and interact with the metaverse), network infrastructure, service infrastructure, and the like.
 - ▶ System-level interoperability can be easily achieved through interface standardization for the metaverse platform.
 - ▶ However, connectivity verification and performance verification are required whenever a user do actions in the metaverse.



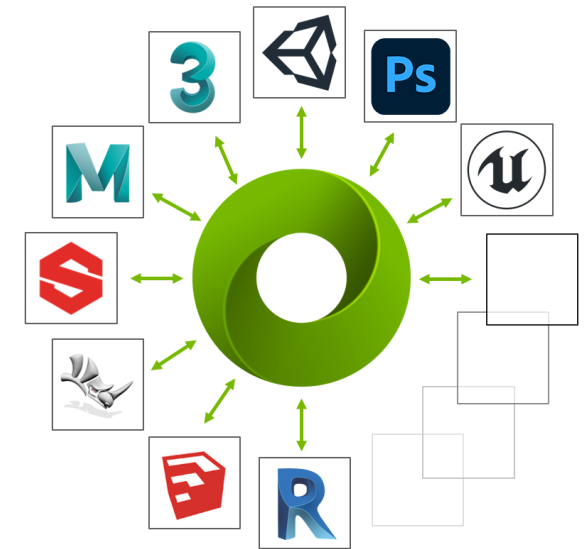
Data Interoperability

- Interoperability in data includes the ability to analyze and represent information (i.e., visualization) without losing the meaning of information in the process of accessing and processing multiple data sources, and integrating data as needed.

- ▶ Interoperability helps people find, explore, and understand the structure and content of data sets.
- ▶ Various data will be accumulated in the process of user interactions in a virtual world of metaverse.



by user's creative activities



< Nvidia Omniverse >



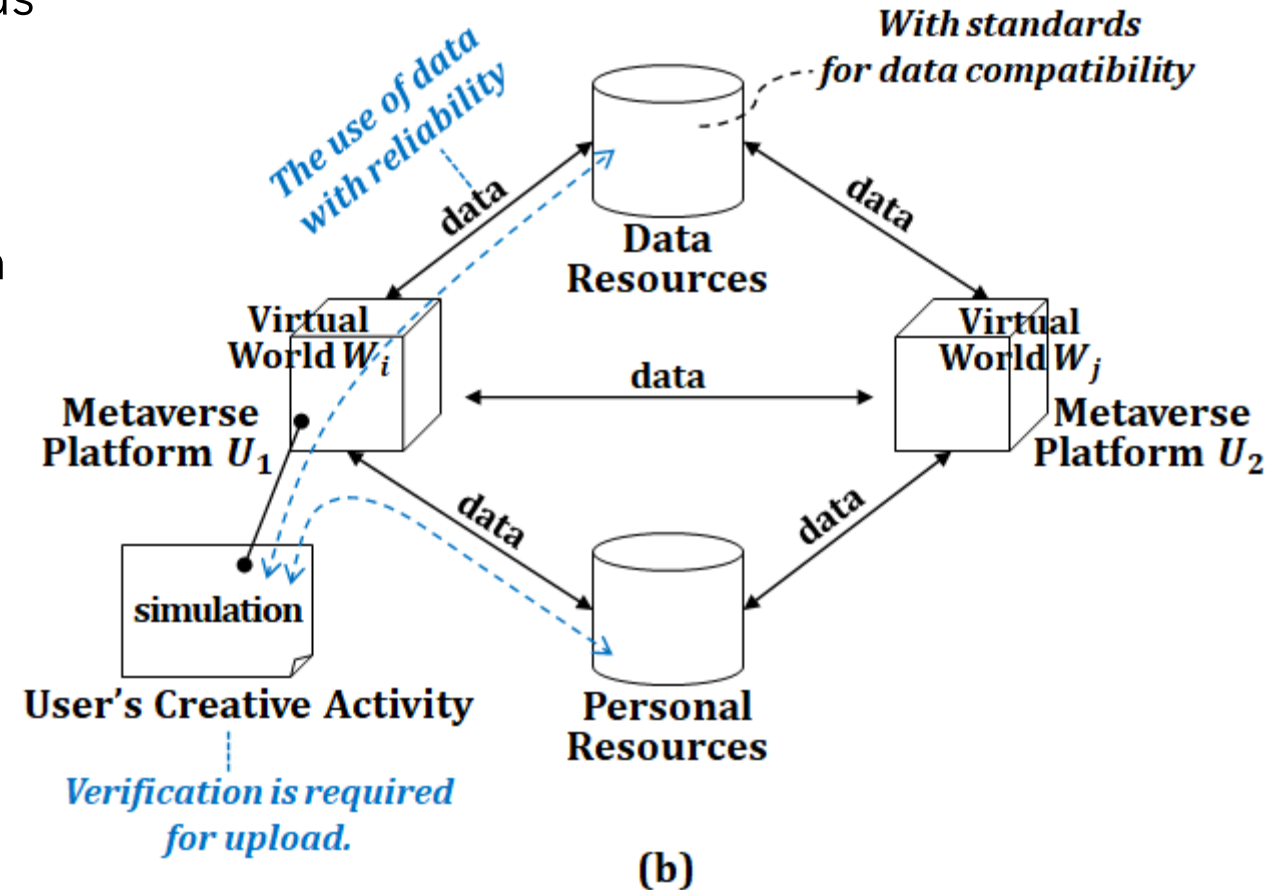
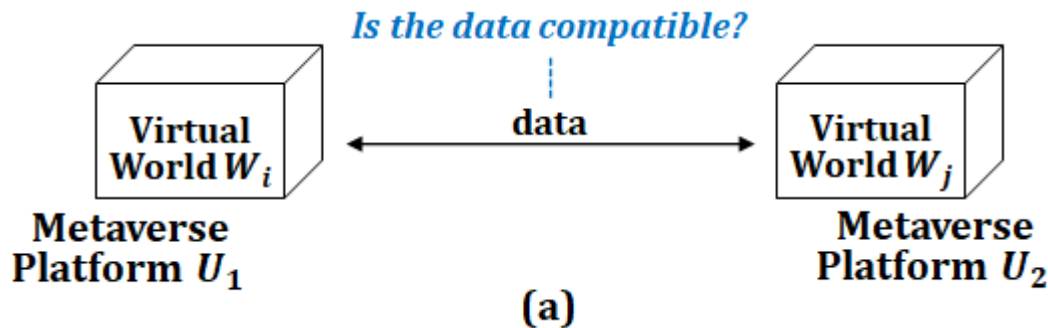
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Data Interoperability

▶ If data is to be shared between heterogeneous metaverse platforms, a data standard system should be discussed.

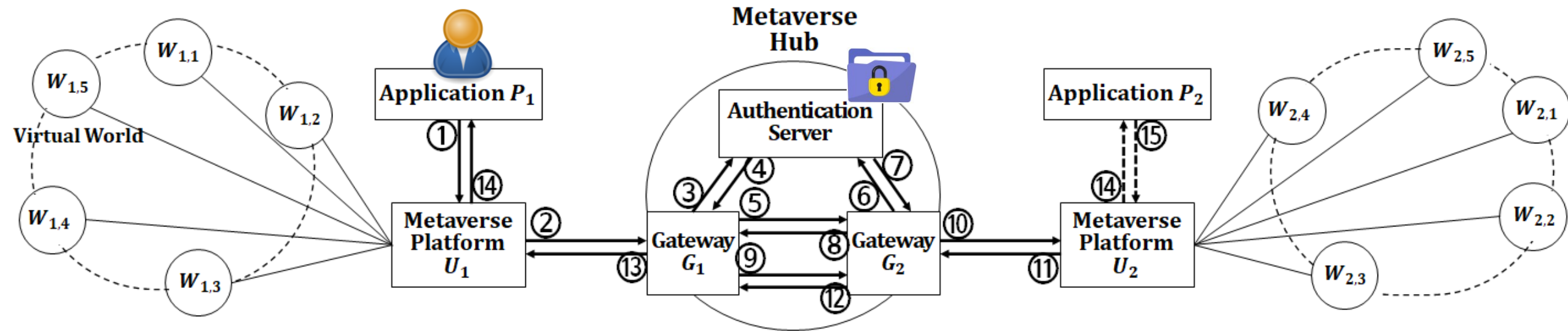
▶ **Individual agreement** is required among on the data systems for metaverse platforms.

data generation rules, data management rules, or ...



Service Interoperability

- In order for a user to access the virtual world of another metaverse platform, authentication and an agreement between the two platforms are required.

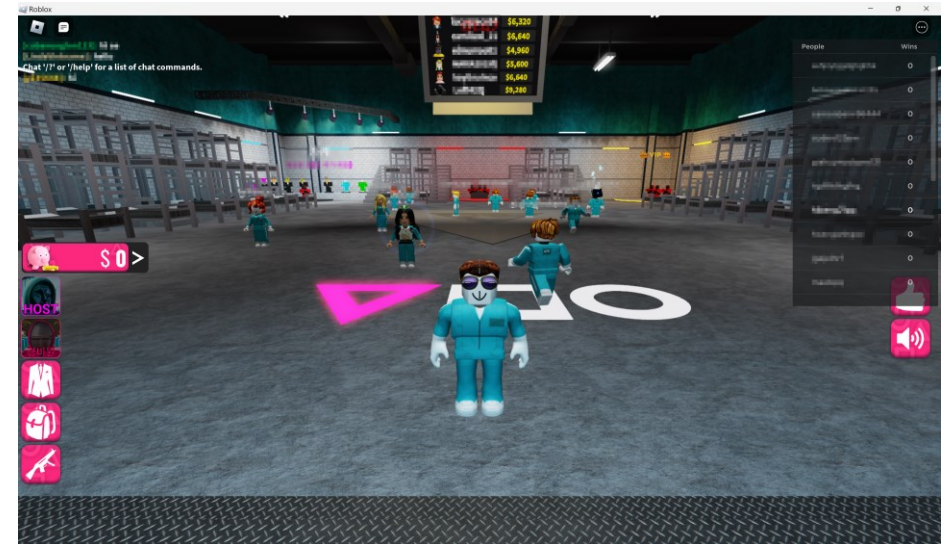


< Example of the user access to a virtual world on a different metaverse platform >



Service Interoperability

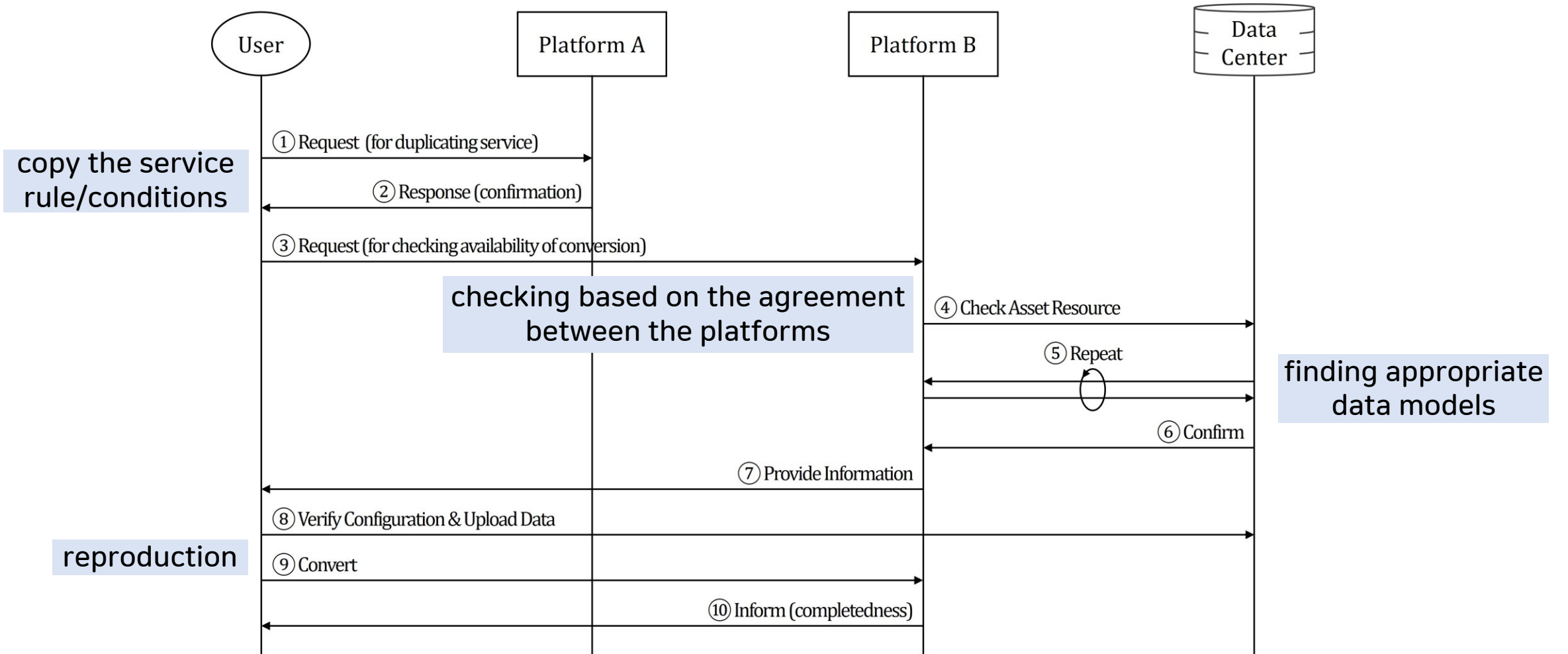
- Service Configuration Transfer
 - ▶ When a user starts an application, it should be able to load the user-specified settings to configure the application (even across different metaverse platforms).
- Service Reproduction (or, Rule Transfer)
 - ▶ A user may want to reproduce an application he/she has played as a similar service in another virtual world.
 - ▶ Service rules as well as data models should be reusable.



< Squid game in Roblox >



Service Interoperability



< Service reproduction >

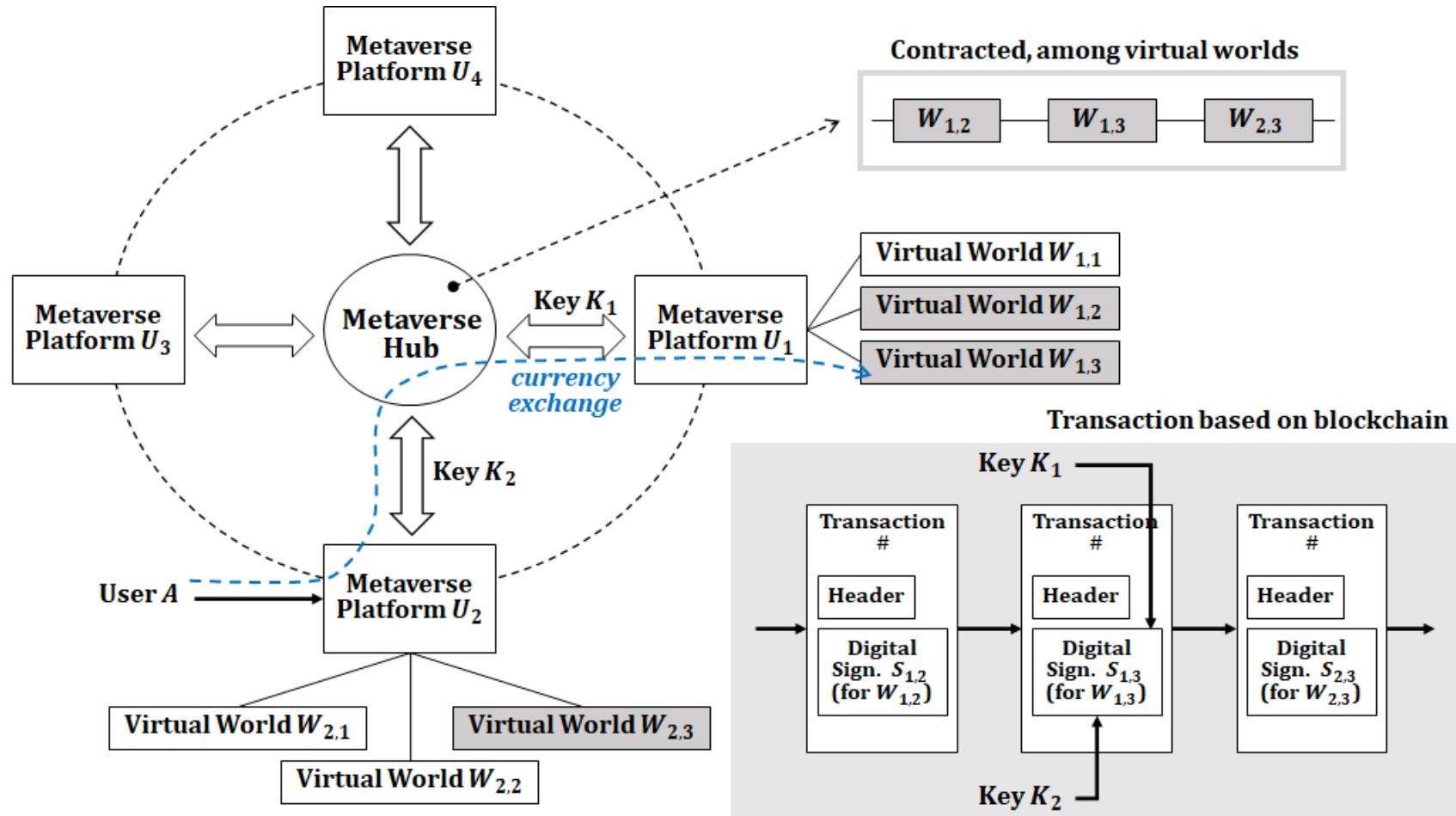


Economy Interoperability

- One metaverse platform operates multiple virtual worlds. However, these virtual worlds can transact under a single currency system.
- When a user accessing through one metaverse platform moves to the virtual world of another metaverse platform, a difference may occur between the two currency systems.
 - ▶ If interoperability in currency systems is not organized, users who visit the virtual world of other metaverse platforms will have limited services and activities.
 - ▶ How can we solve it?



Economy Interoperability



< The use of blockchain technology for economy interoperability >



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Interoperability By Virtual Environments

Interoperability	Hyper-connected Virtual Environment	Hyper-personalized Virtual Environment
System Interoperability	Consideration of interfaces to metaverse platforms.	Consideration of each user's access environment to a metaverse platform.
Data Interoperability	Use of data resources for all users (e.g., public data, open assets).	Verification of personal data and products and their compatible use.
Service Interoperability	Content synchronization for multi-user experience in metaverse.	Configuration with personal data and each user's contextual situation.
Economy Interoperability	Related to something of value that everyone uses in common (e.g., coins, products).	Related to something that may be of value by the creation of an individual user (e.g., artworks).

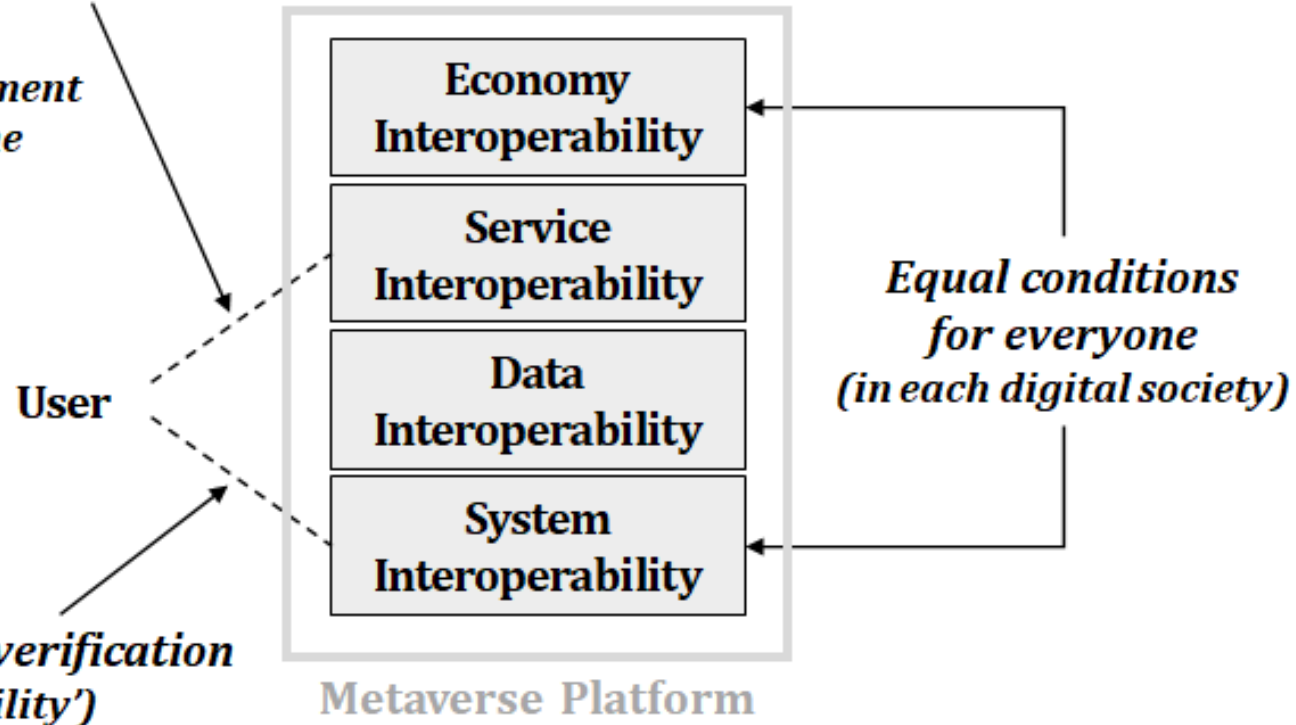


Metaverse Platform With Interoperability

Service reconfiguration

(if 'diversity' & 'inclusion' need to be considered)

- *Checking data and virtual environment*
- *Checking rules for the service*



Access environment verification
(to guarantee 'accessibility')

- *Checking the interfaces*
- *Checking performances of network and devices*



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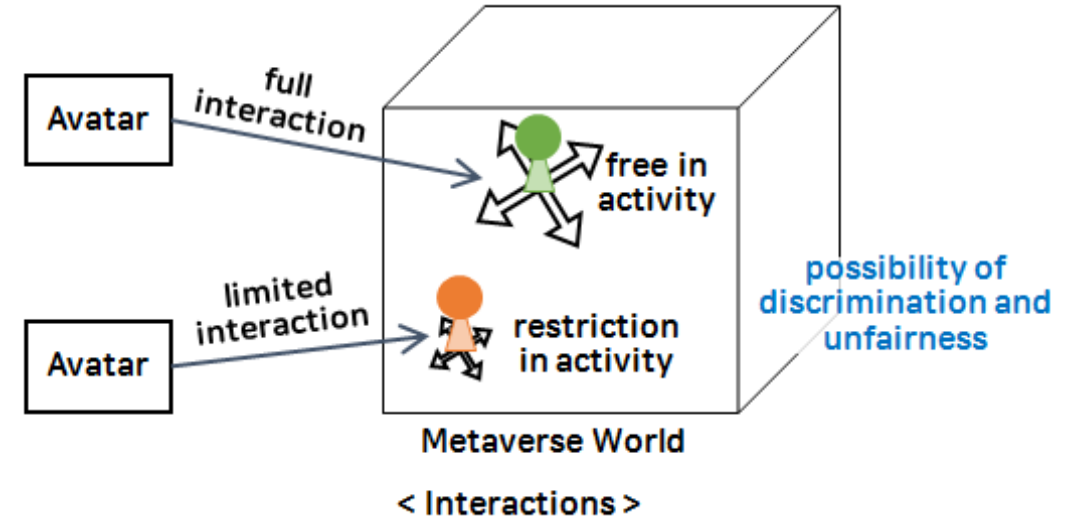
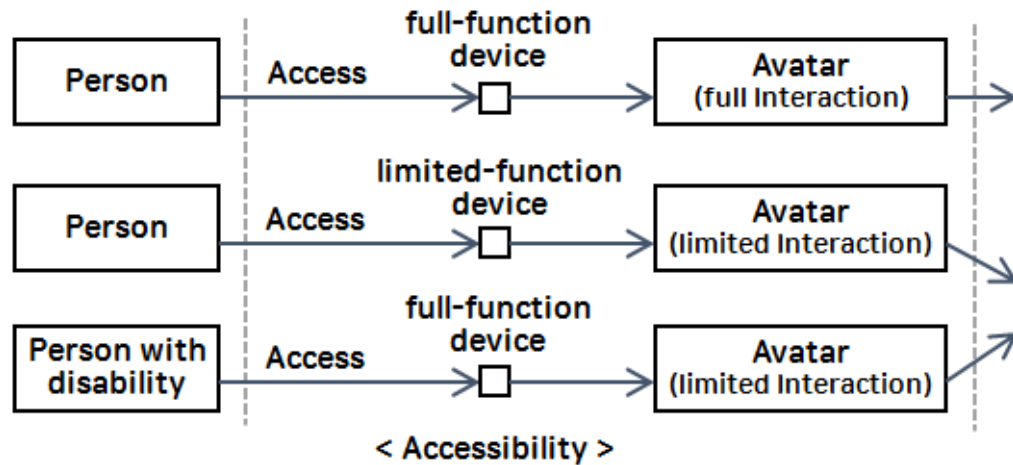
Metaverse Ethics

- Metaverse platforms need to be implemented with considering metaverse ethics. Metaverse ethics should be viewed as infrastructure.
 - ▶ **Metaverse Ethics** (or its guidelines) can be used as basic data to resolve disputes and controversies that may arise in the metaverse.
 - **Ethics** are guidelines for social values and norms of behavior that follow the direction pursued by humans and society.
 - **Computer Ethics** is one of the realistic methods for formulating and justifying policies related to the impact of technology on individuals and society and the ethical use of technology to lead the decision-making process through computing.
 - * The IEEE SA has been discussing and publishing a report on XR Ethics from 2021.
 - ▶ How is metaverse ethics different from AI ethics?
 - AI ethics can be interpreted focusing on the impact on humans and society who use the service system, but metaverse ethics is based on the relationship between human users, AI avatars, and objects in the virtual/real world in the metaverse world.



Metaverse Ethics

- Diversity and Inclusion



- Programmable ethics

- ▶ In order to automatically apply ethical guidelines to the metaverse, conduct audits, and maintain metaverse as a sustainable virtual world, the metaverse ethics guidelines must be systematically implemented.
- ▶ Scenario/case-based ethics



What To Focus On For Metaverse Interoperability

- ▶ Discussions on metaverse interoperability require consideration of the direction of industrial development.
- ▶ Technically, XR, AI, and cloud computing will receive attention. However, in terms of interoperability, it is necessary to examine various service scenarios from a user-centered perspective, with considering UX and metaverse ethics.
 - Concepts such as spatial computing and service reproduction need to be discussed.
- ▶ In order to expand metaverse services, research on data, service, and economic interoperability as well as interoperability at the system level is required.
- ▶ Blockchain technology (e.g. the concept of smart contracts) helps create and implement rules between metaverse platforms in a decentralized manner.



Thank you!

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