

QoE Assessment of Interactivity and Fairness in First Person Shooting with Group Synchronization Control

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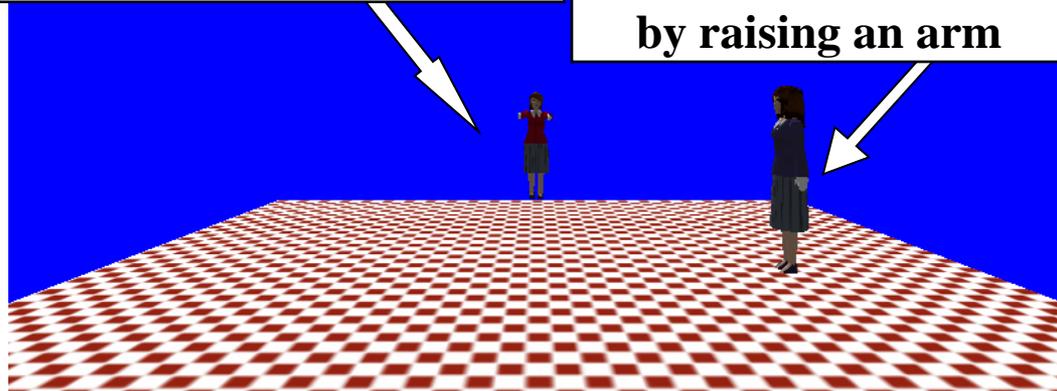
We applied **group synchronization control**, which adjusts the output timing among multiple terminals, to First Person Shooting (FPS) and investigated the influence of network delay and a parameter of the control by the **Quality of Experience (QoE) assessment**.

Character operated by partner

Characters fire bullets and hit the bullet to each other

Umpire character

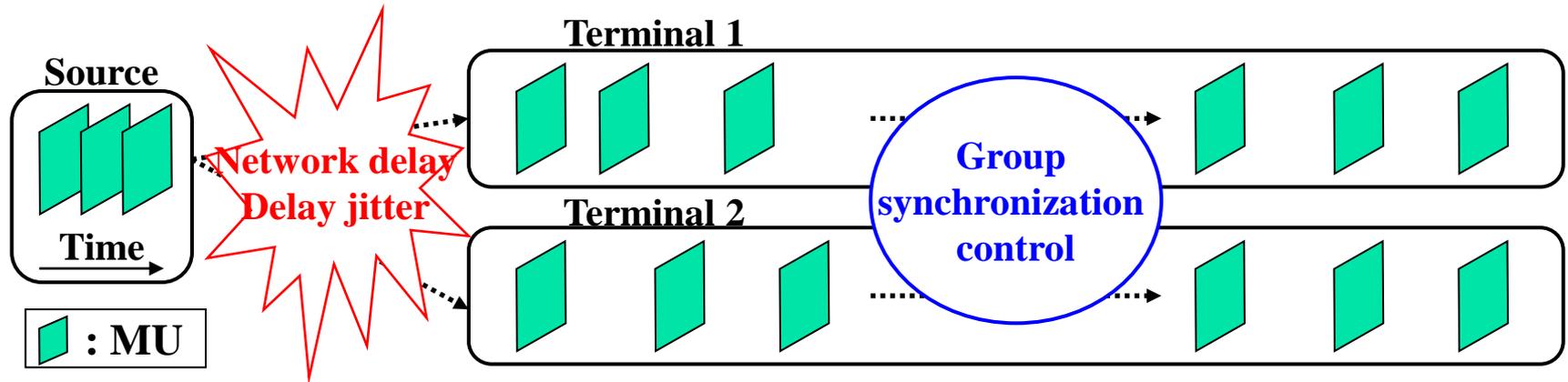
Hit of a bullet is shown by raising an arm



FPS screen and view of player's character

- The game is based on a **client-server model**, which is consisted of the server, client1, and client2

Group Synchronization Control



- The group synchronization control adjusts the output timing for media units (MUs) among multiple terminals.
(MU: Information unit for media synchronization)
- To adjust the output timing among all the clients
➔ When each client outputs an MU which has been generated at the client, the client outputs the MU after having buffered it for Δ ms.
- The value of Δ is dynamically changed **between $\Delta_L (\geq 0)$ ms and $\Delta_H (\geq \Delta_L)$ ms** according to the network delay.

Assessment Method

▪ In the QoE assessment,

▪ The five-grade impairment scale

Score	Description
5	Imperceptible
4	Perceptible, but not annoying
3	Slightly annoying
2	Annoying
1	Very annoying

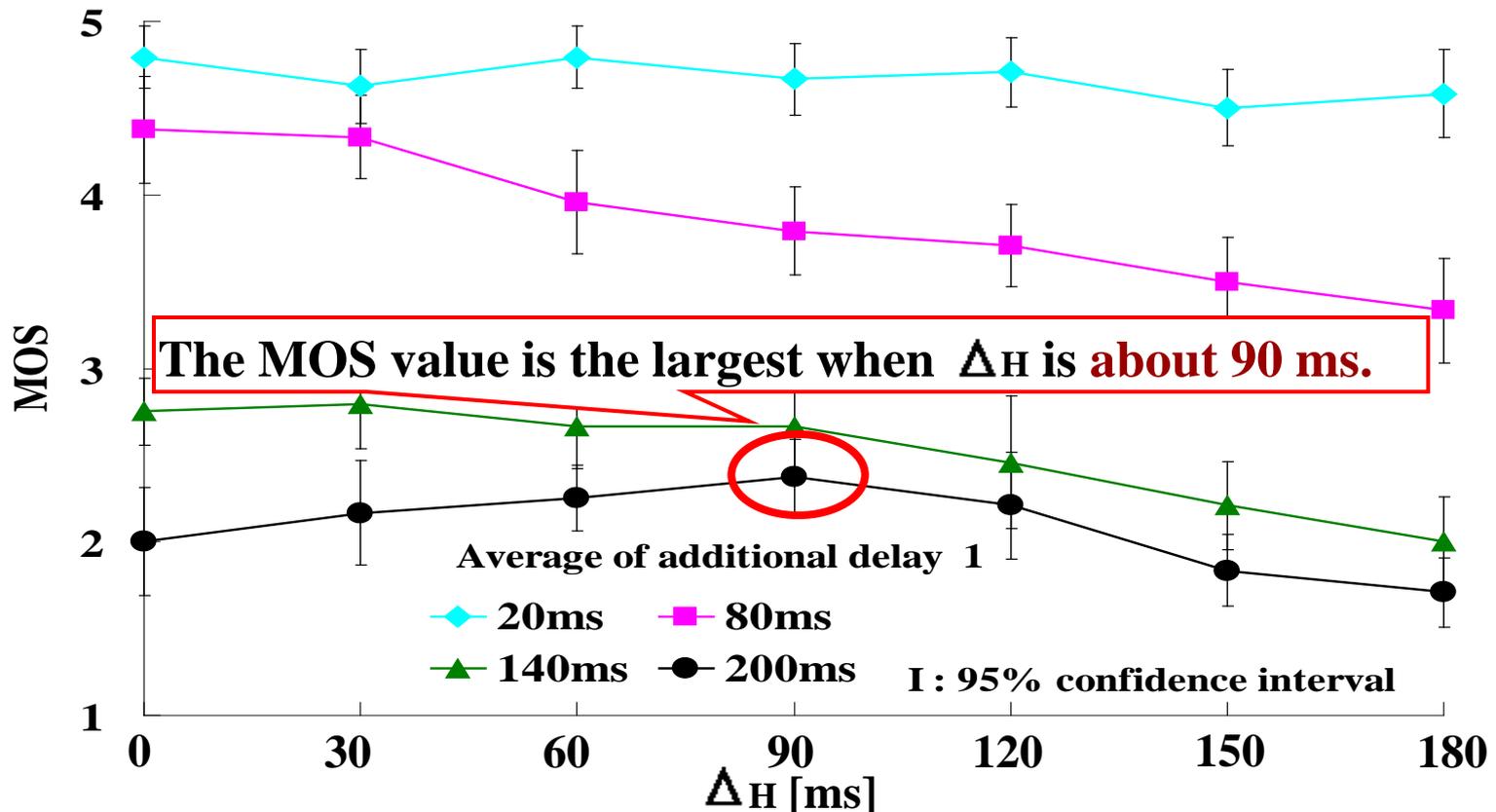
➔ the mean opinion score (MOS)

- Each subject as the attacker assessed
 - (1) The interactivity of firing a bullet.
 - (2) The interactivity of movement of the defender.
- Each subject as the defender assessed
 - (3) The interactivity of avoiding a bullet.
- Each subject assessed
 - (4) Whether he/she feels that hit judgments are unfair or not.
 - (5) **The comprehensive quality.**

(The comprehensive quality is a synthesis of the interactivity and fairness.)

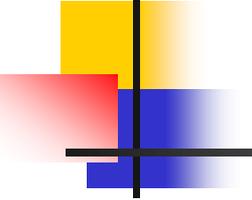
Assessment Results

- The MOS value of the comprehensive Quality at client 1



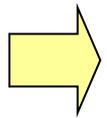
[The additional delay 1 is additional delay between the server and client1.]

To keep consistency high, the value of Δ_H should be as large as possible. Therefore, we can say that the value of Δ_H should be set to **about 90 ms** if we take account of interactivity, fairness, and consistency.



Conclusions

- We applied the group synchronization control to FPS.
- We investigated the influence of network delay and a parameter of the control by QoE Assessment.



The value of Δ_H should be set to **about 90 ms** if we take account of interactivity, fairness, and consistency.

Future Work

- We plan to investigate the influences of parameters (e.g., the speed of a bullet) in FPS and other parameters in the group synchronization control.
- We will also carry out the control in FPS which is based on a Peer-to-Peer (P2P) model and examine the influence of network delay.