GDC

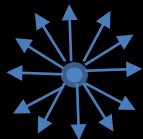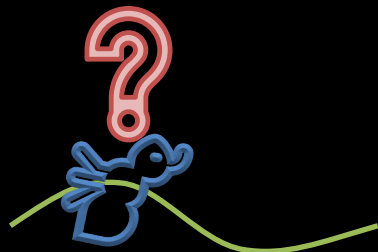# Final Fantasy VII Remake: Automating Quality Assurance and the Tools for the Future

Fabien Gravot

AI Lead Engineer / SQUARE ENIX

GAME DEVELOPERS CONFERENCE | July 19-23, 2021

Overview

- Game QA

- Replay
  - System overview
  - Replay data and synchronization
  - Workflow and results

- Exploration

- Conclusion

Game QA: Common Issues

Game development is evolving:

- More content and interactions

- Greater freedom of play styles

- Increasing post-release content, services, and support

All these improvements lead to:

Growing QA costs

ADVANCED
TECHNOLOGY
DIVISION

SQUARE ENIX

Tools of QA

Reporting Tools:
- Automatic data entry of bug reports
- Automatic crash/assert reports
- Telemetry data reports

Automated-Play Tools:
- Scripting
- Replay
- Exploration

Examining Replay

Replay	Without game code change	With Game code change
Input	Time, screenshot	Game state (code access)
Output	Game Pad driver	Game Pad emulator (debug command possible)
Build	All including Master	Test
Supports non-deterministic action	No (beside image recognition)	Yes
Support for change in level	No	Partial
Start usage in game development cycle	Master	First playable level

ADVANCED TECHNOLOGY DIVISION

SQUARE ENIX

Replay Example:
FINAL FANTASY VII REMAKE

Replay system

Supervise and control the game

Generic game state

UI Command

Auto QA server

Runner / Launcher（UI）

User program

Start process

Start/end game

request

Game

Auto QA SDK

Game specific Auto QA code

Communication Default behaviors

Game state Bots (game control)

Watchdog

ping

Platform dependent code start and monitor game

Start game process

ADVANCED TECHNOLOGY DIVISION

SQUARE ENIX

Replay System: Game Specific
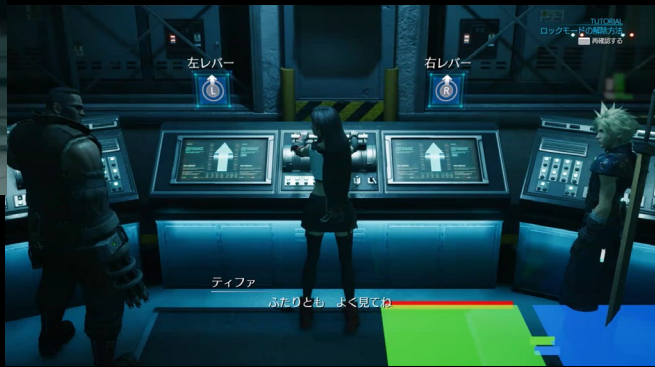
ADVANCED
TECHNOLOGY
DIVISION

SQUARE ENIX

Replay: server/game

Supervise and control
the game

Generic
game
state

Game

UI Command

Auto QA server

request

Auto QA SDK

Game specific
Auto QA code

Runner /
Launcher（UI）

Start
process

Start/end
game

Communication
Default behaviors

Game state
Bots (game control)

User program

ping

Watchdog

Start game process

Platform dependent code
start and monitor game

ADVANCED
TECHNOLOGY
DIVISION

SQUARE ENIX
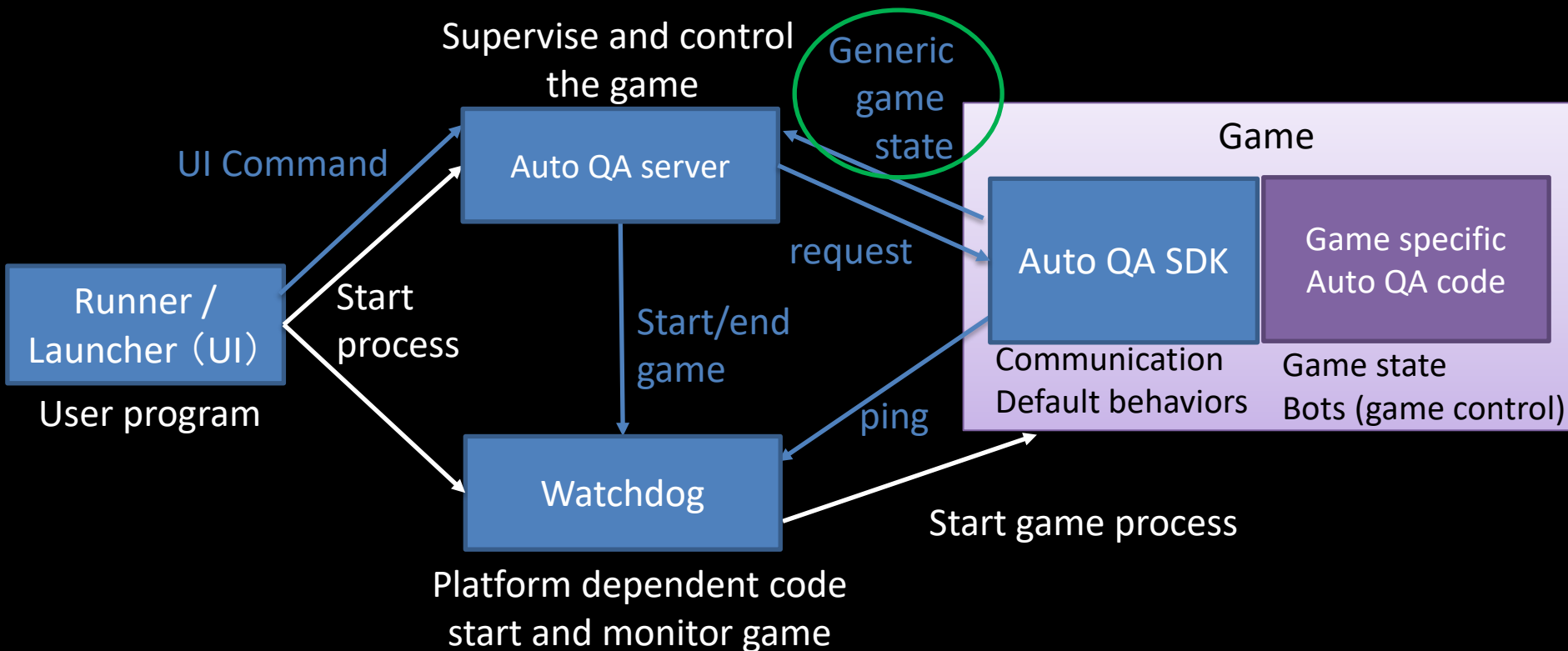
Replay: server/game

- Generic game state:

Where
  - Position, level id
  - Velocity / orientation

When
  - Time: game time, UTC time, real time, frames count
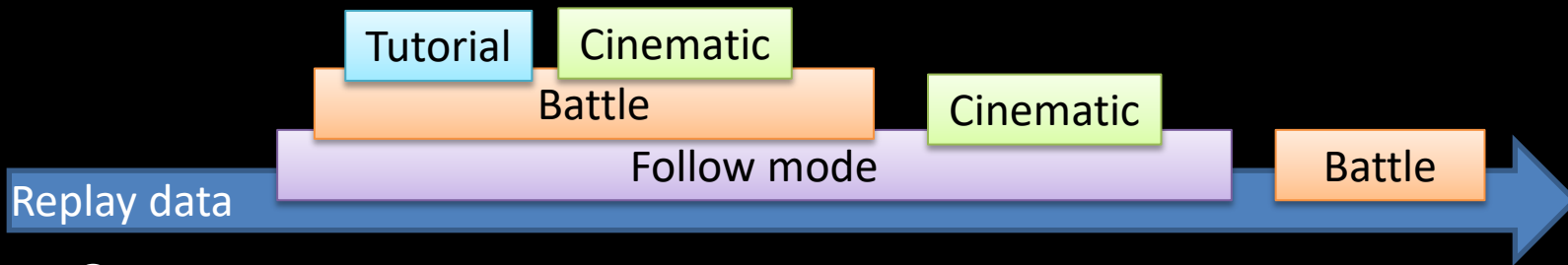
What
  - Action/event: key press, pad input

Why
  - Game state stack

ADVANCED TECHNOLOGY DIVISION

SQUARE ENIX
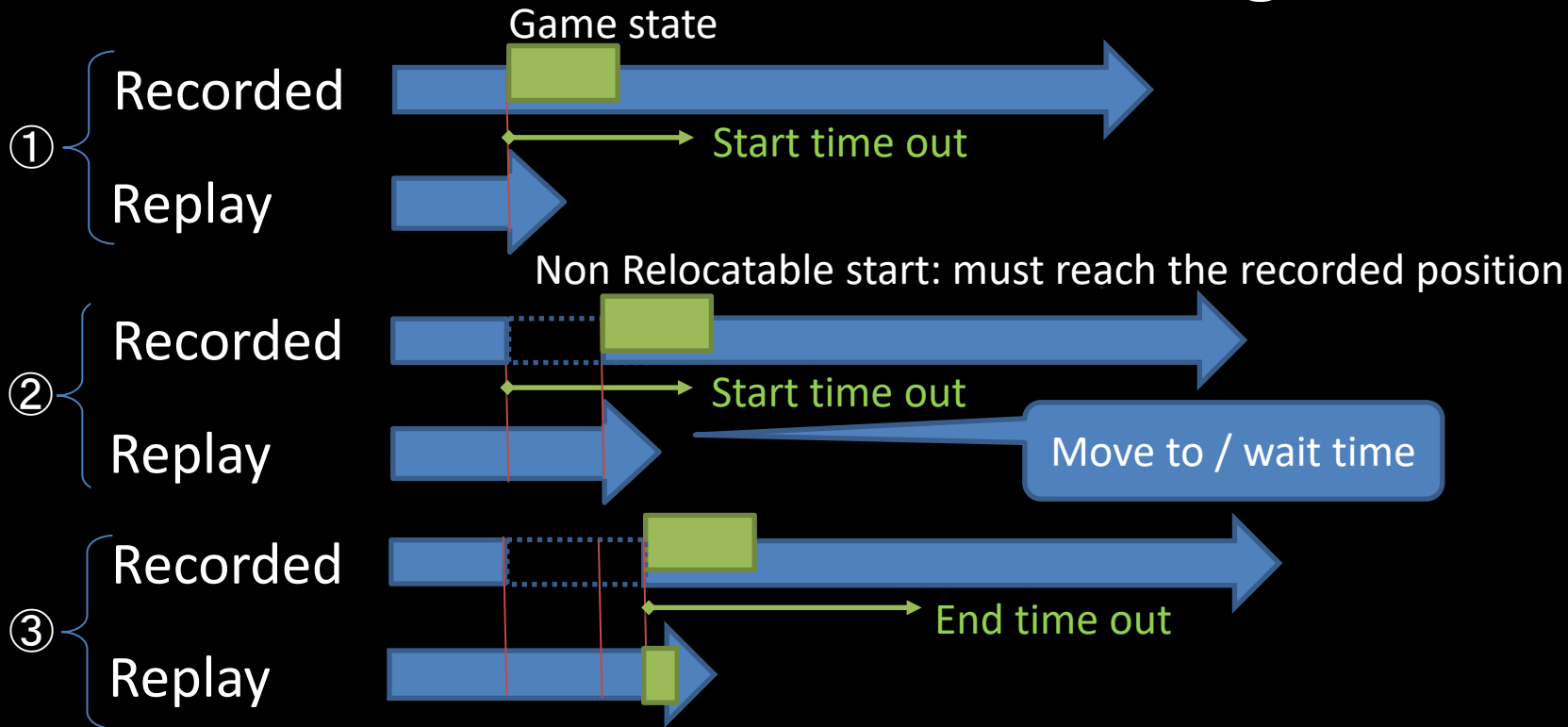
Replay: server/game

- Game state stack:

- State:
  - Id (type id/game id)
  - User data
  - Synchronization flags: unique, client controlled, …
  - Timeout override
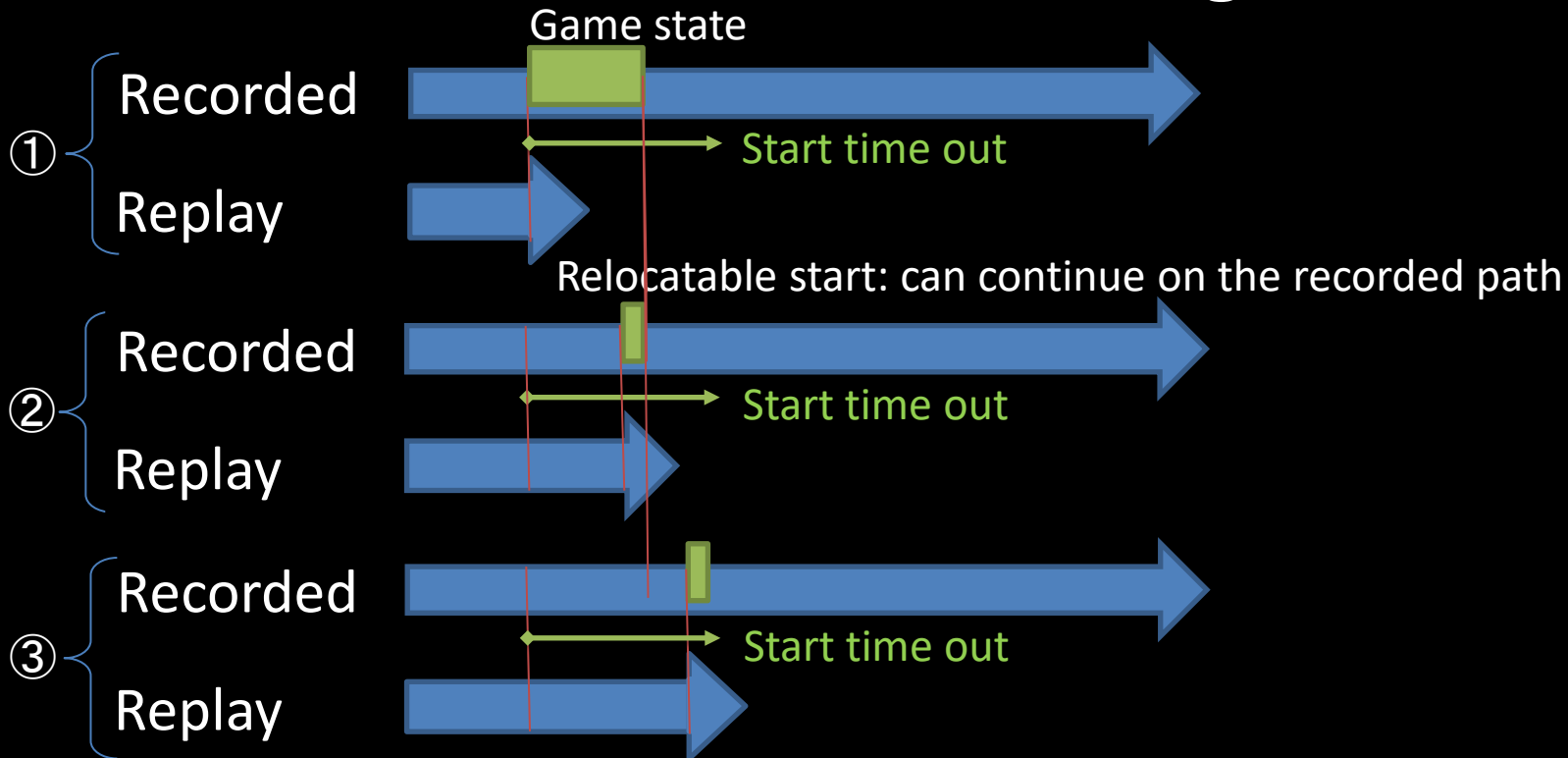
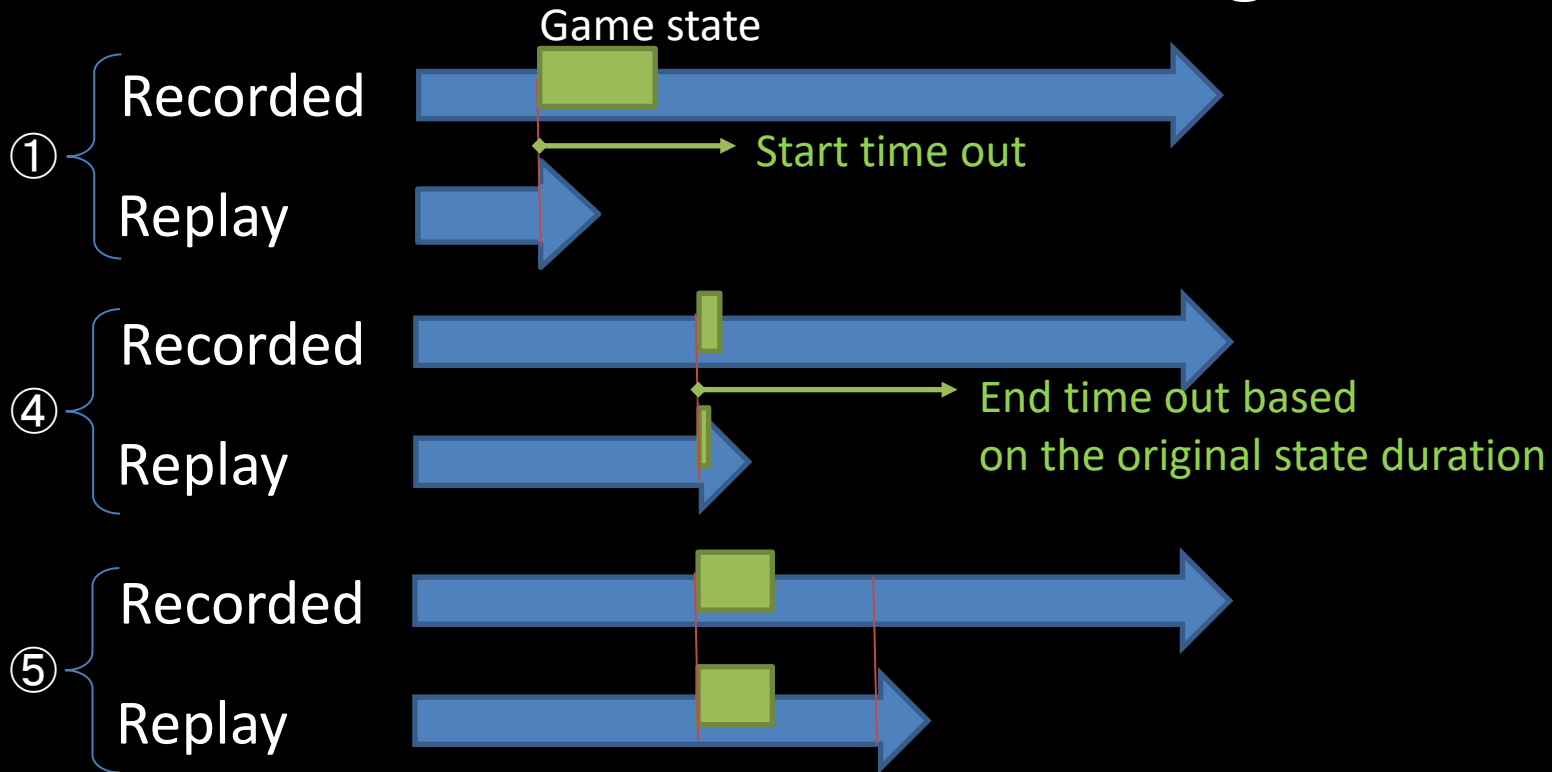# Replay: synchronization
Non Relocatable flag

Game state

① Recorded

Start time out

Replay

Non Relocatable start: must reach the recorded position

② Recorded

Start time out

Replay

Move to / wait time

③ Recorded

End time out

Replay

ADVANCED
TECHNOLOGY
DIVISION

SQUARE ENIX

Replay: synchronization
Relocatable flag

Game state

① Recorded

Start time out

Replay

Relocatable start: can continue on the recorded path

② Recorded

Start time out

Replay

③ Recorded

Start time out

Replay

Replay: synchronization
Relocatable flag

Game state

① Recorded / Replay — Start time out

④ Recorded / Replay — End time out based on the original state duration

⑤ Recorded / Replay

Replay: synchronization
Skippable/Startable

Game state

Recorded

Skip request

End time out

Replay

Skippable
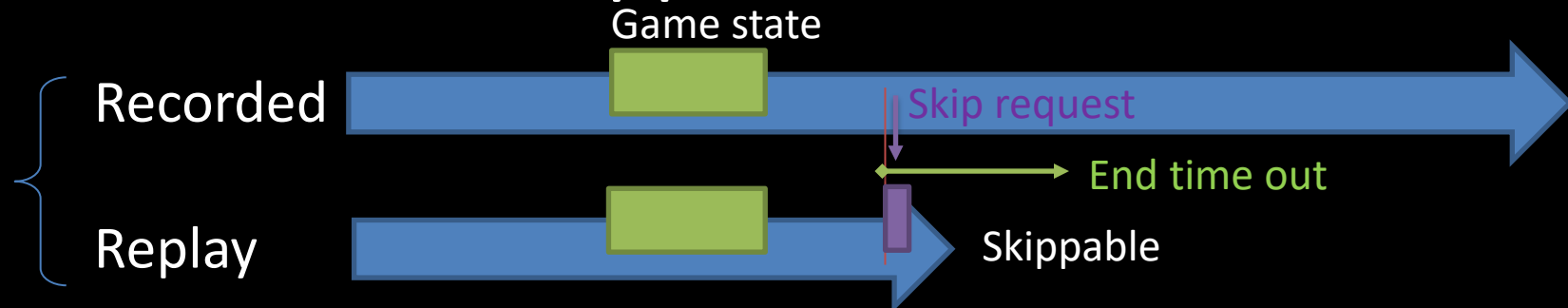
Skip request can trigger client update, for example close tutorial menu

Recorded

Startable

End time out
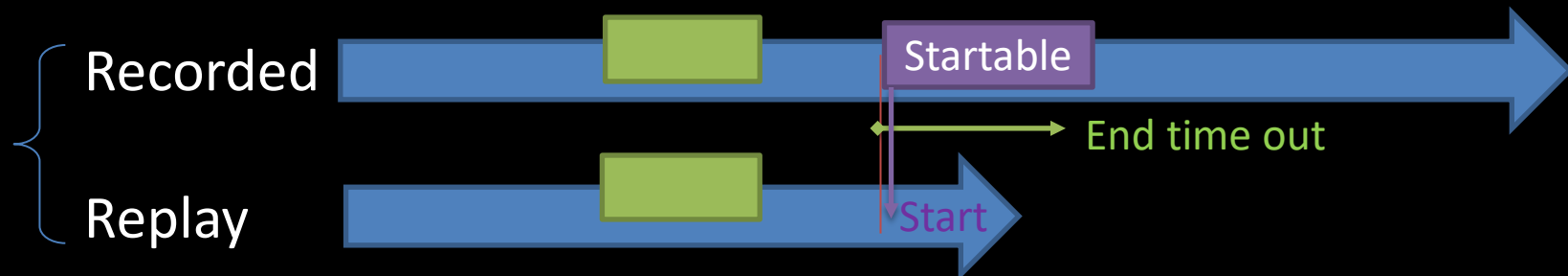
Replay

Start

Start request can trigger client update, for example start interaction

ADVANCED
TECHNOLOGY
DIVISION

SQUARE ENIX

Replay: synchronization
Optional flag

Recorded / Replay — ①

Optional Optional

Recorded / Replay — ②

Optional Optional

Ignore Optional states

End time out
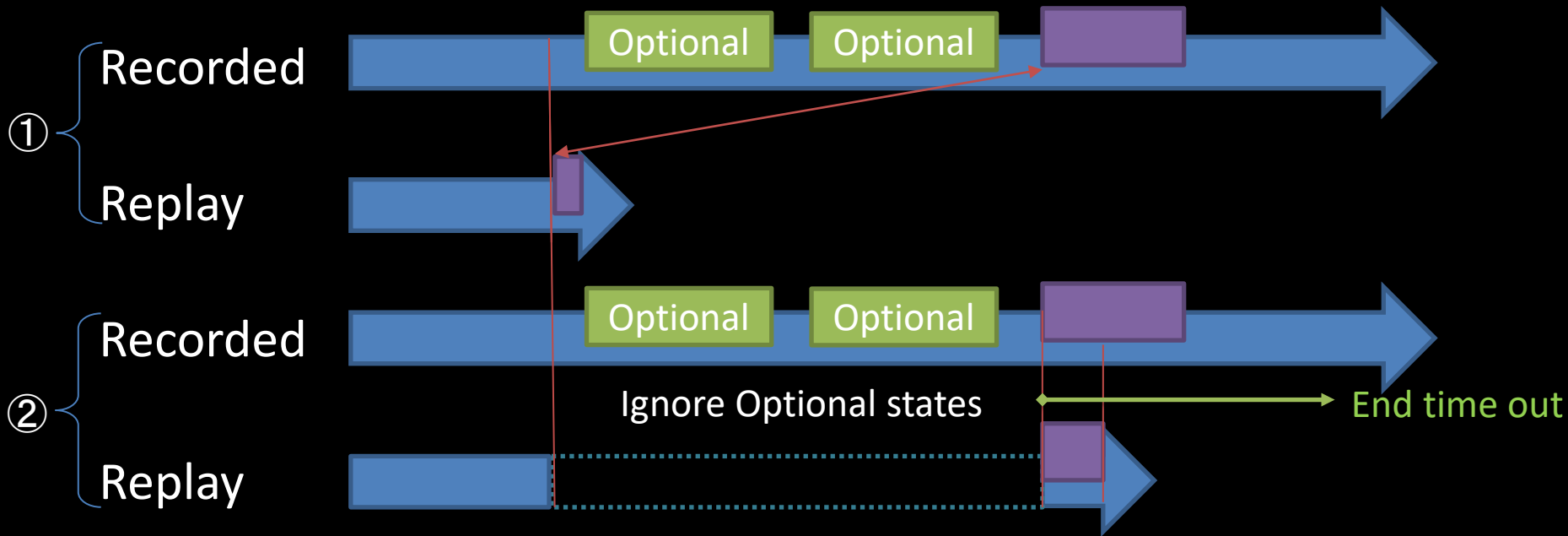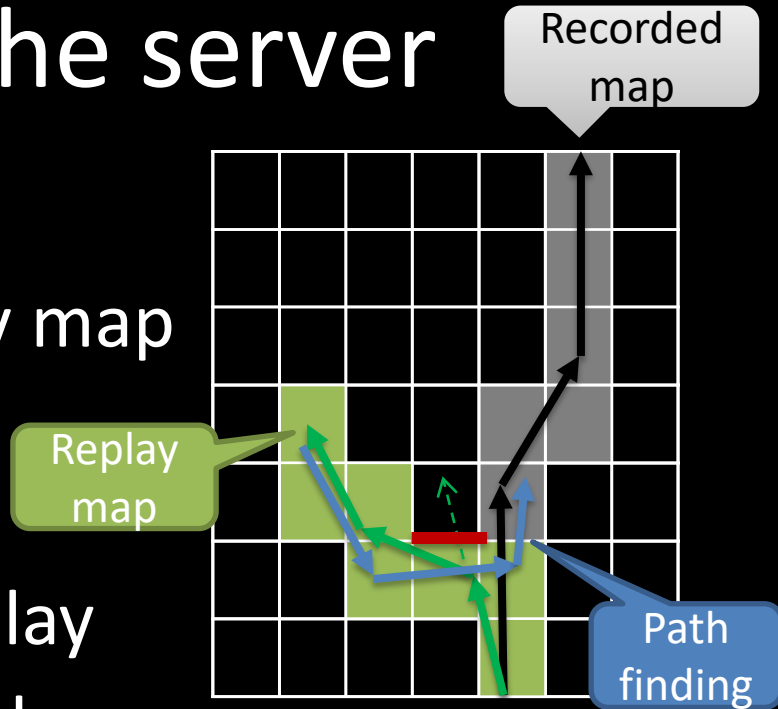
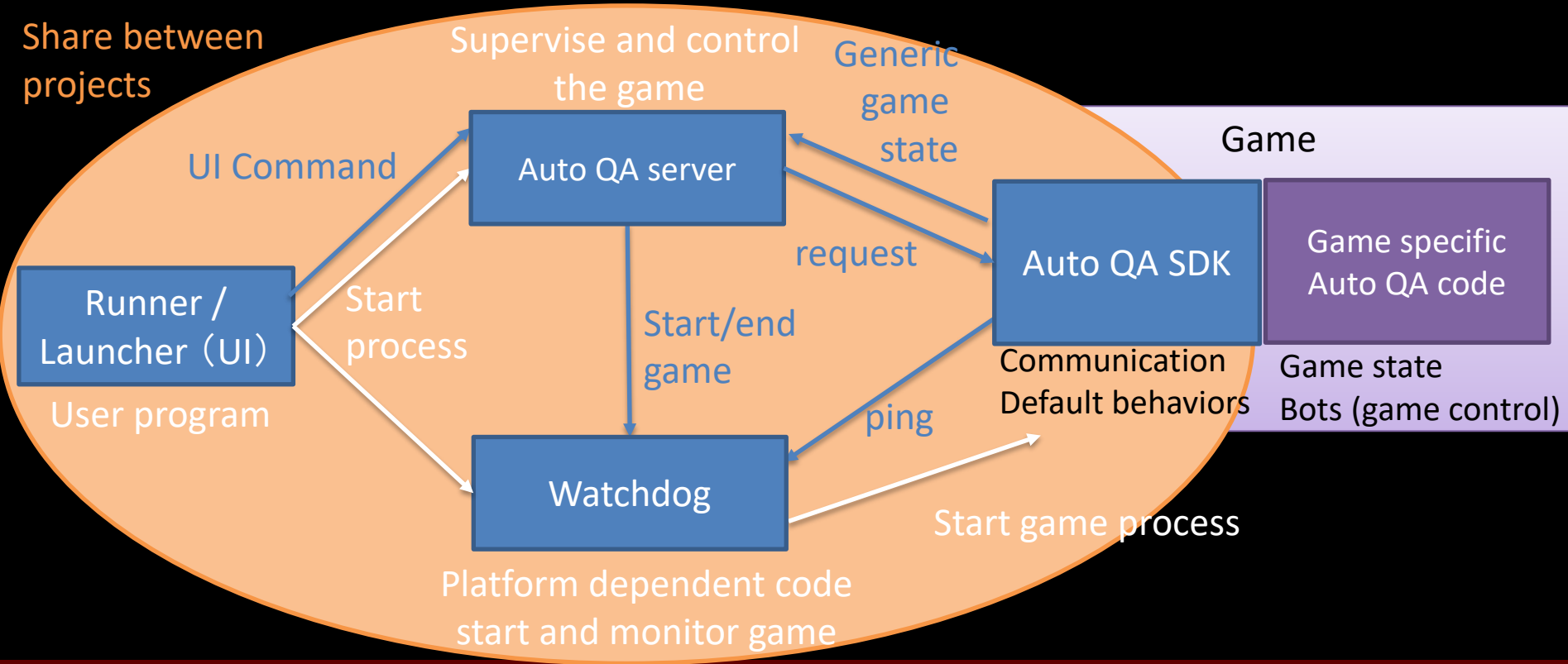# Path finding: in the server

- Create a 3D grid map

- Use both recorded and replay map

- Detect wall when the motion doesn't match commands

- Path finding to go back to replay

- Use simple heuristic to extend the map if blocked (can use in game path finding)
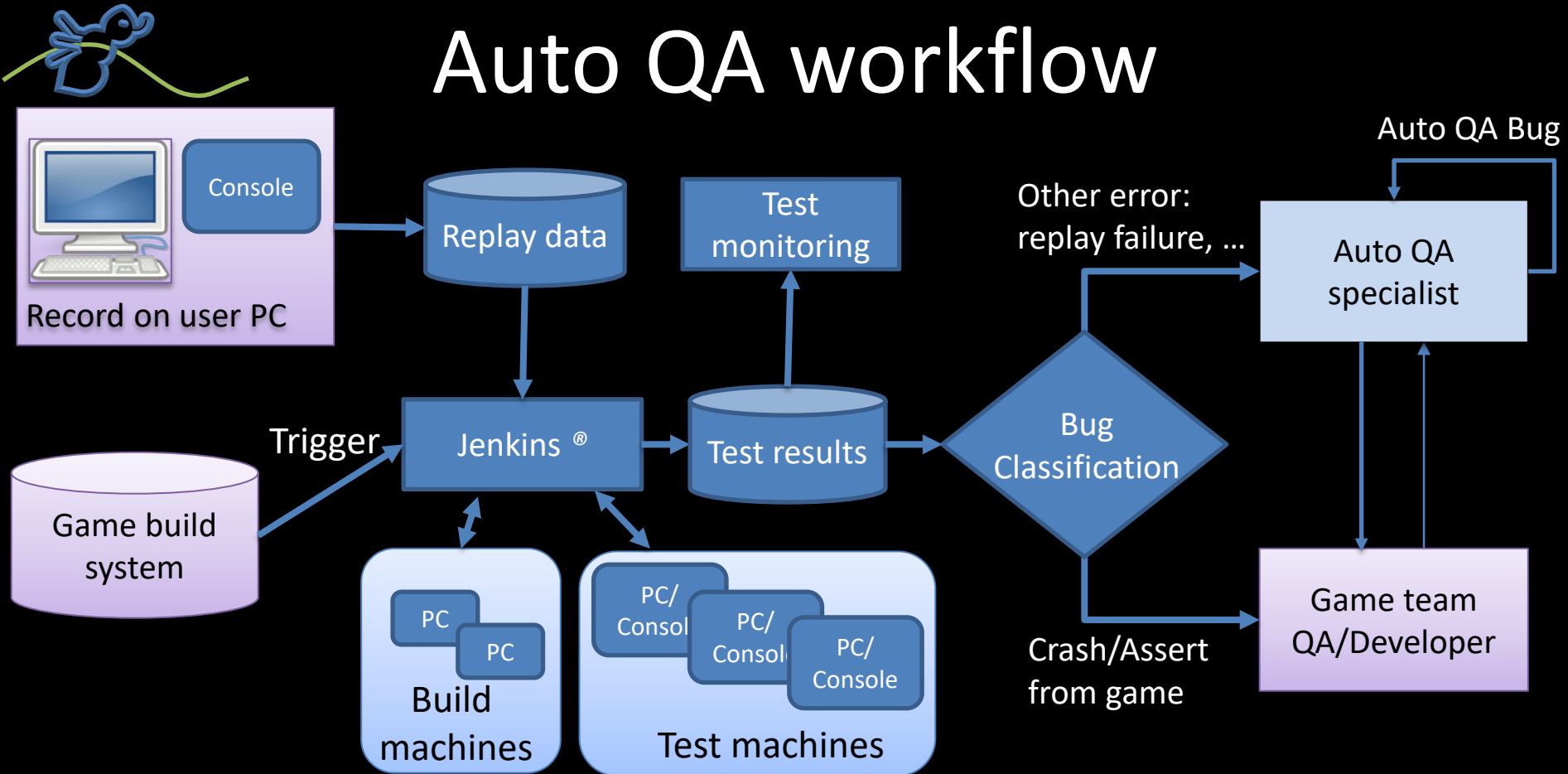
Recorded map

Replay map

Path finding

ADVANCED TECHNOLOGY DIVISION

SQUARE ENIX

Replay: server/game

Auto QA workflow

Evaluating Replay

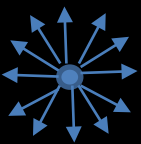- Advantages：
  - Finds rare bugs (logic, multi-thread, etc.)：0.3%
  - Tests for level-traversal issues: 300 tests per day
  - Tests large code changes for crashes, etc.
  - Tests games with bad frame rates (debug options)
  - Able to perform tests 24/7 (Aging test)
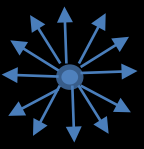
- Disadvantages:
  - Mostly tests a recorded path

SQUARE ENIX
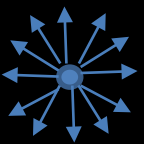
Exploration Example
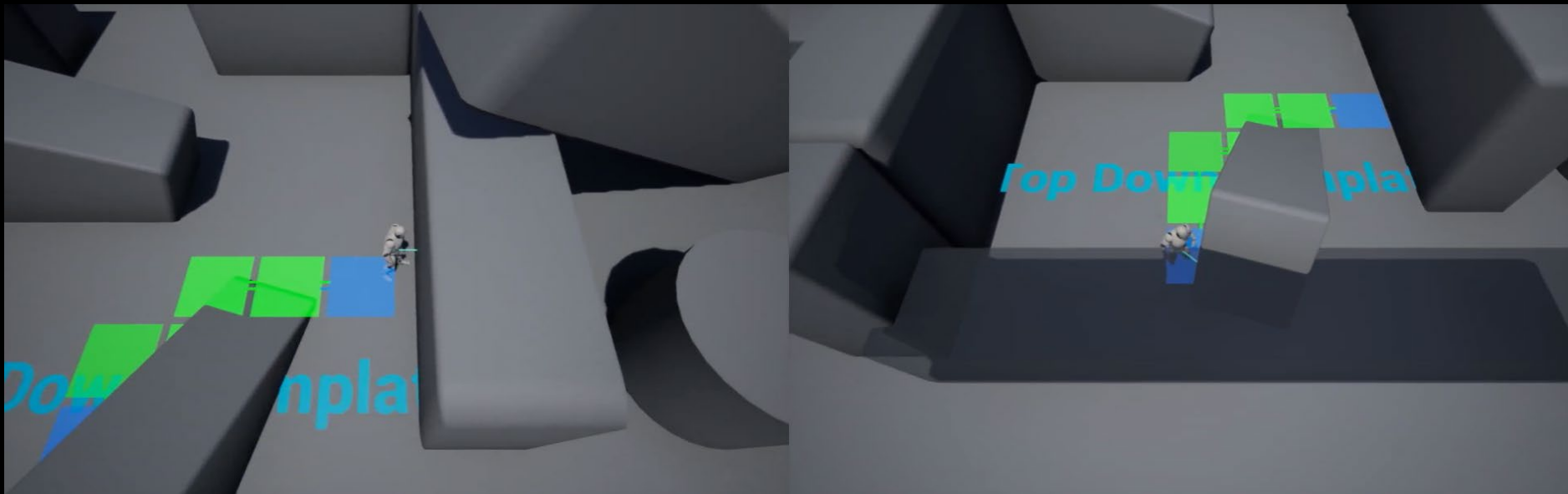
Epic Games. (2020). *Unreal Engine*. Retrieved from https://www.unrealengine.com

Evaluating Exploration

- Advantages :
  - Finds bugs outside of traditionally tested paths
  - Captures performance analysis (FPS, memory usage, etc.)
  - Checks collision

- Disadvantages:
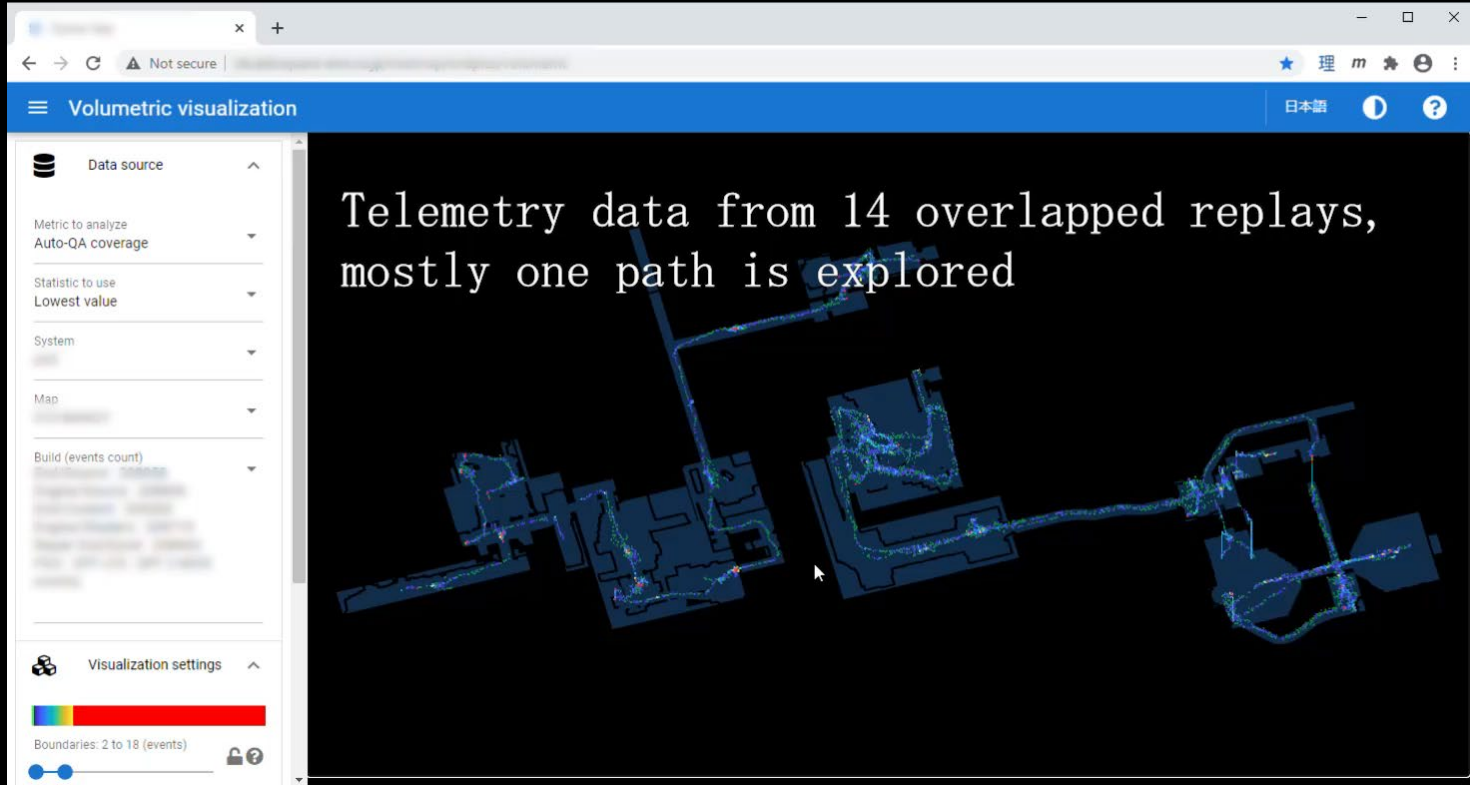 - Cannot test all possibilities needed to finish levels of complex games

ADVANCED TECHNOLOGY DIVISION

SQUARE ENIX

Combining Replay and Exploration

ADVANCED
TECHNOLOGY
DIVISION

SQUARE ENIX
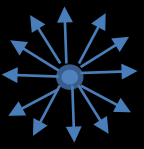
Combining Replay and Exploration

Conclusion

Advantages:

- Automating repetitive testing
- Sharing development cost through several projects

Disadvantages:

- Unable to perform qualitative QA (graphic issues, etc.)

Future works:

- Extract video/screenshot for QA check
- Exploration on other action: menu, mini-game
- Tools to find large change in level collisions

ADVANCED TECHNOLOGY DIVISION

SQUARE ENIX

Any Questions?

For more information, contact: gravfabi@square-enix.com

Thank you for listening.

Trademarks

- "PlayStation", "PS4" and "PS5" are registered trademarks or trademarks of Sony Interactive Entertainment Inc.

- *Jenkins® is a registered trademark of Software in the Public Interest, Inc.*