OPENSCENARIO:
A REGULATOR'S PERSPECTIVE ON THE REQUIREMENTS

ZEYN SAIGOL
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caTAPULT
Transport Systems

OUTLINE

1. Overview of MUSICC project

2. Scenario-based regulatory approval: Use cases

3. Regulator's perspective on requirements

4. Technical points relating to OSC 1.0 / 2.0 compatibility
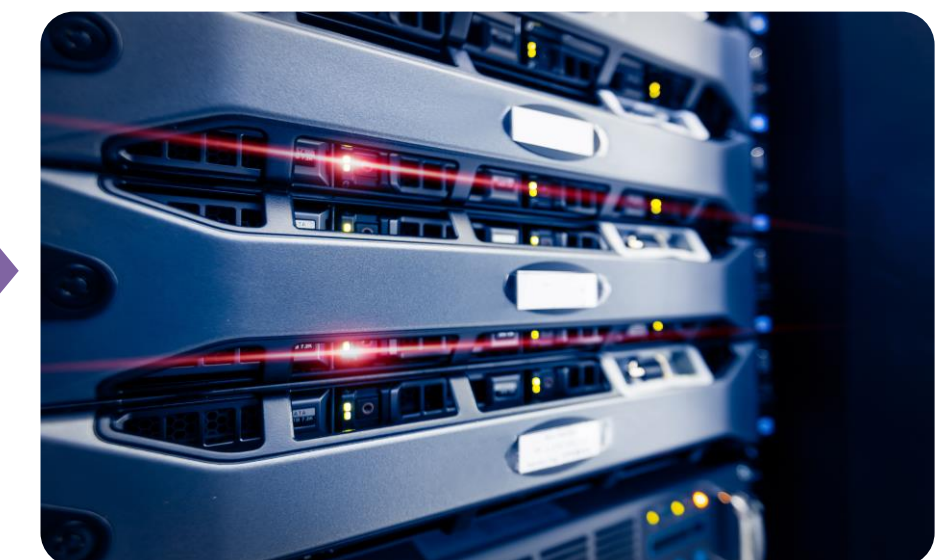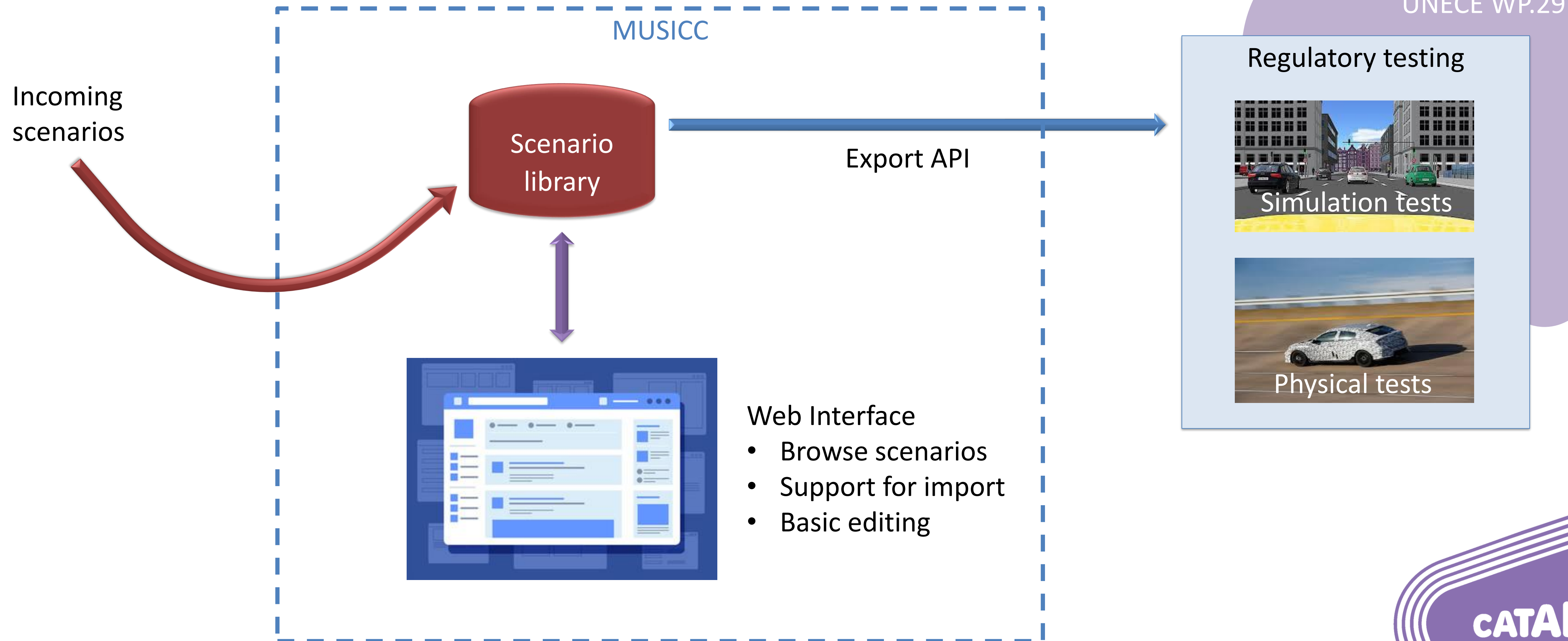
OBJECTIVES AND APPROACH

Objectives:
- Create a standard language to describe scenarios
- Build an open and extensible library of scenarios for CAV certification
- Focus on simulation testing environments

Approach:
- 12-month proof-of-concept demonstration project
- Close collaboration with vehicle manufacturers, developers, organisations with expertise in CAV validation and international regulators
- Define a scenario format based on a wide consultation
- Enable openly-accessible scenario platform

MUSICC SCOPE AND CONTEXT

MUSICC

Incoming scenarios

Scenario library

Export API

Web Interface
- Browse scenarios
- Support for import
- Basic editing

UNECE WP.29

Regulatory testing

Simulation tests

Physical tests

MUSICC SYSTEM PREVIEW

(With apologies for dummy data)

MUSICC SYSTEM PREVIEW

MUSICC NEXT STEPS

- Open beta phase, commencing late April
  - Interim scenario language: OSC 0.9.1 with some additions
  - Will align with OSC transfer and concept project outputs in future
- Proof-of-concept integrations with tool providers

Please get in touch if you'd like to be involved

zeyn.saigol@ts.catapult.org.uk

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REGULATORY CERTIFICATION – NEAR-TERM SUGGESTION
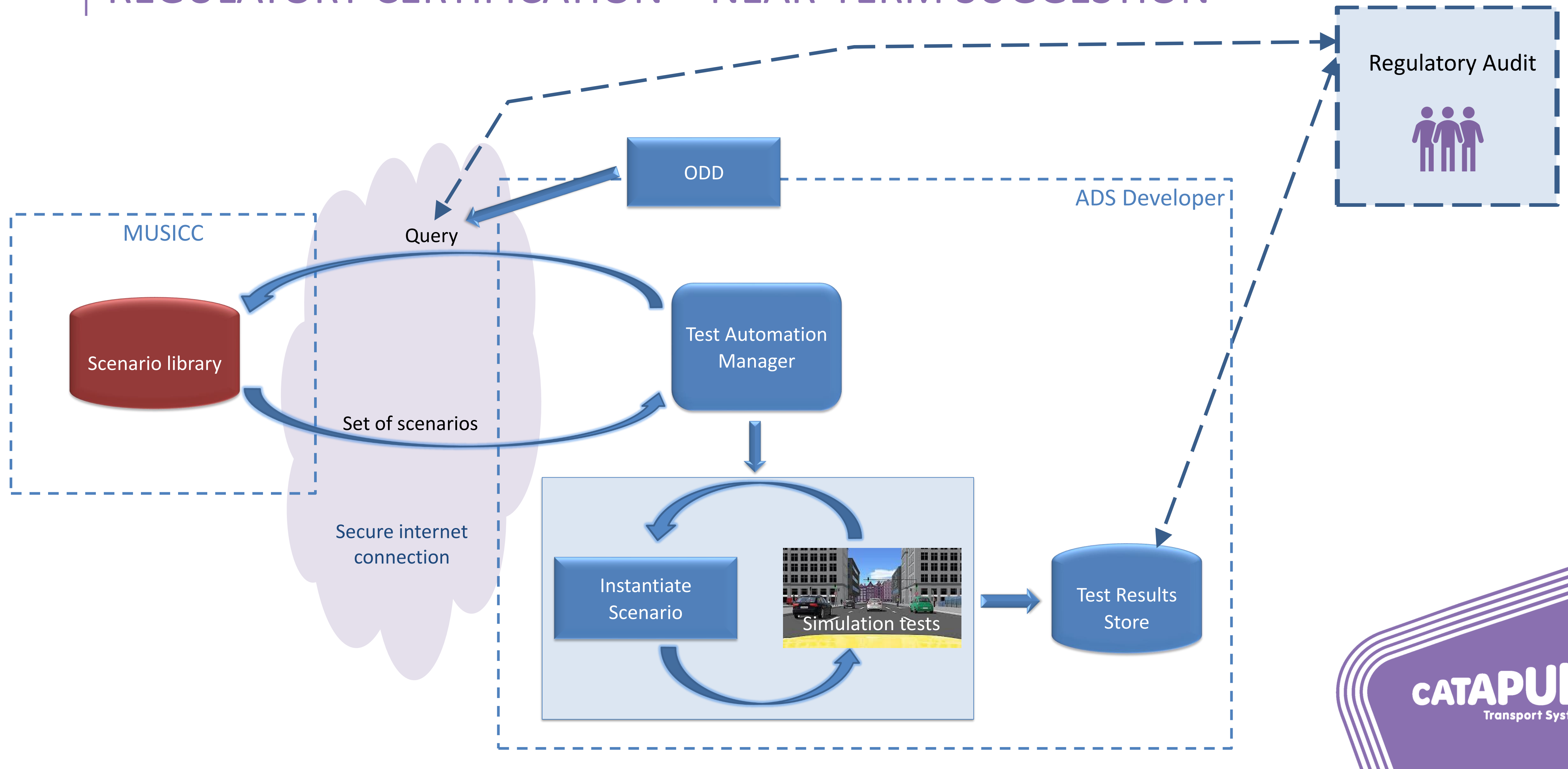
FIVE.AI* REGULATORY CERTIFICATION SUGGESTION

MUSICC
Multi User Scenario Catalogue for
Connected Autonomous Vehicles

Approved by regulatory body

Independent Test Organisation(s)

ADS Developer

Some scenarios kept private, accommodate commercial considerations

Scenario library

Contribute selected scenarios

Internal Scenario DB

Filter by

ODD

Test Automation Manager

Simulation tests

Provide access to

ADS

DHC (Digital Highway Code)

Certification Result

Abstracted feedback on any failures

* Five.AI are a new-entrant ADS developer based in the UK
https://five.ai/certificationpaper/

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TRADITIONAL APPROACH OF EU & UNECE REGULATIONS

- Approval Authority led process
- Pre-market assessments & testing
- Defined tests & test conditions
- Defined pass/fail criteria (performance based and technology neutral)
- Based upon mutual recognition
- New types and new registration dates

These procedures can be transferred to CAV certification, given a carefully thought-out methodology with sufficient industry buy-in. This methodology is likely to make significant use of scenarios and simulation.

GENERAL REGULATORY REQUIREMENTS

Neutrality / Fairness

- Work with all ADS architectures and implementations
- Work with all sensor types
- Not be influenced by commercial goals
- Shouldn't constrain OEM USP features

May not require the full scope of development testing

- Different objectives & targets (safety focus)
- Results presented for different users
- Should support both randomisation and repeatability

Must work within the wider regulatory regime

Must work equally well across different regions

- For example, the UK drives on the left.   Signage etc

Manageable database

- Vital to keep a high-relevancy, high-integrity set of certification scenarios
- Tight human oversight implies a limited number of scenarios (implies stochastics?)

Work easily with any simulation toolchain

- Different tools may use different internal representations
- Should support HIL and road tests

Able to select scenarios according to ODD

- Scenarios should have metadata tags to identify the ODD-elements they contain

Compatible with an ID-based storage system

- When scenarios go into a database, cannot use filenames to reference other entities
- Applies to scenarios and child/related documents (OpenDRIVEs + Catalogs especially)

May be specified per-scenario, or globally

- Globally => Digital Highway Code?
- Would need significantly more detail than existing rules of the road

May be encoded into the scenario, or elsewhere (test specification?)

- Not clear if this belongs in a scenario description language

- This is a complex topic
- Perhaps not realistic to resolve within OpenSCENARIO project

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- Important for us, as we're building MUSICC using current OpenSCENARIO, but we're aware of significant stakeholder demand for a high-level language

- Therefore we hope to transfer the existing scenarios in MUSICC to the OSC high-level language as soon as possible

- An automated way of doing this will be highly desirable

- Here I would simply like to articulate the key questions

- Assume OSC 1.0 is concrete, 2.0 is logical
- Normally, expect to use a random-number-generator to create concrete scenarios from logical:

$Logical_A$ → $Concrete_A$

f_{rand} $Concrete_B$

$Concrete_C$
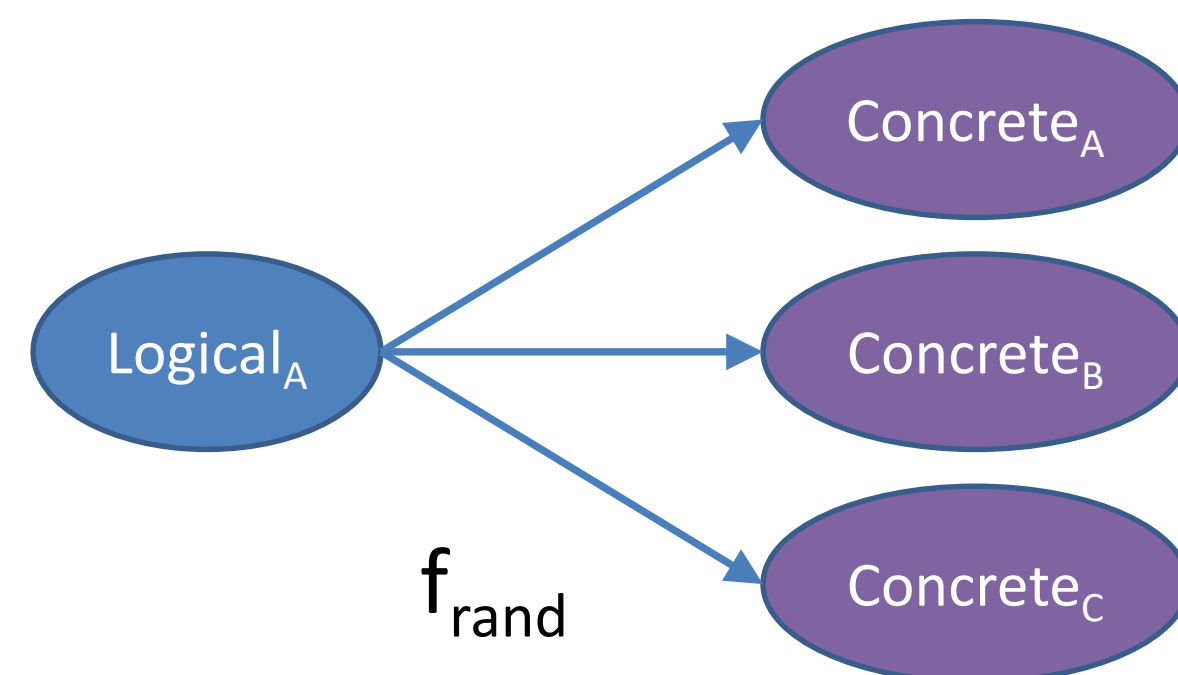
- This is clearly neither deterministic nor invertible

- Can probably make this deterministic by defining rules
  - e.g., given a uniform distribution between X and Y, use the value (X+Y)/2
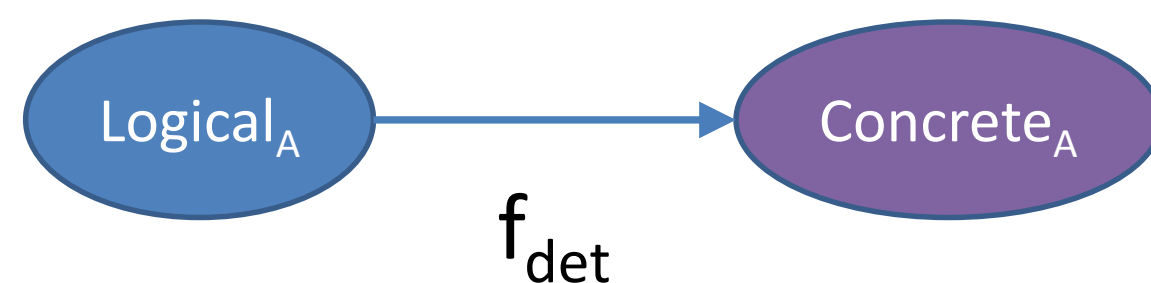
- Still not invertible, as cannot recover the range from a single value (e.g. values X and Y)
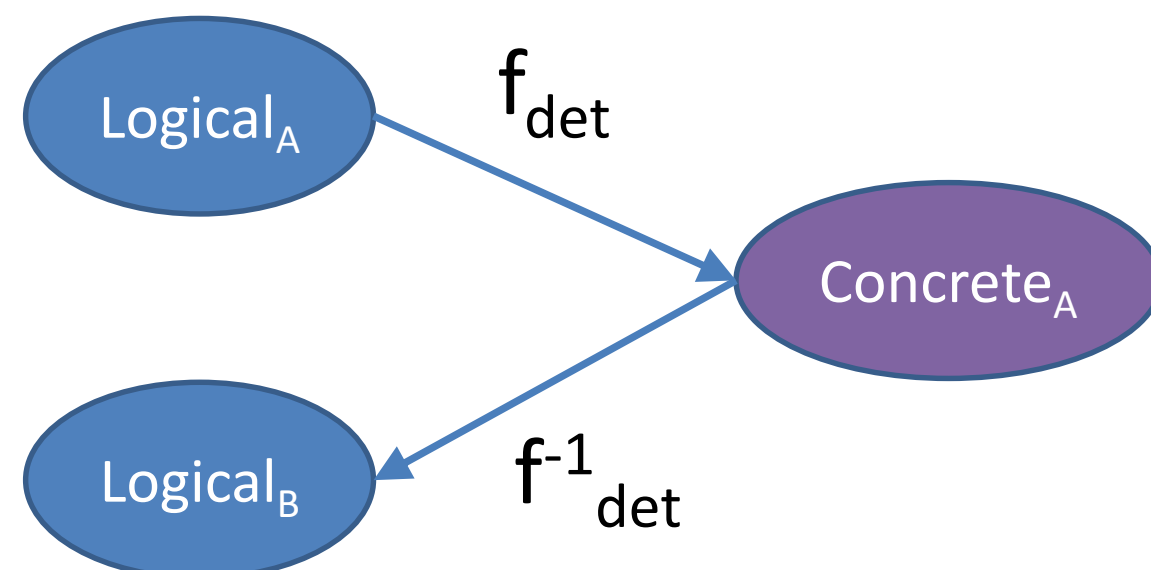
- If we can define the concrete format, could include ranges as comments? …
- Is invertibility an important requirement?

EXECUTION INFORMATION VS. PARAMETERISATION

- Going from 2.0 to 1.x, there are two kinds of information lost:
  - Execution information: concepts that cannot be represented in 1.x
    - For example, perhaps you can't represent "adjust the speed of vehicle X to meet the ego vehicle at point P" in 1.x
  - Parameterisation information: lost through randomisation
    - As discussed, converting from logical to concrete scenarios requires selecting values according to specified distributions and ranges
    - As well as simple parameters like the speed of a traffic vehicle, this could cover trajectories; potentially many different low-level trajectories could satisfy a maneuver specified in OSC 2.0

- Siddartha Khastgir from WMG has some interesting suggestions relating to this in his presentation
- For MUSICC, the key thing is an easy migration path for scenarios stored in OSC 1.x

CATAPULT
Transport Systems

Transport Systems Catapult
The Pinnacle
170 Midsummer Boulevard
Milton Keynes
MK9 1BP
T   +44 (0)1908 359 999
E   marketing@ts.catapult.org.uk
W   ts.catapult.org.uk

Thank you

zeyn.saigol@ts.catapult.org.uk