FROM RESEARCH TO INDUSTRY

cea tech

PAPYRUS ROUND-TRIP ENGINEERING

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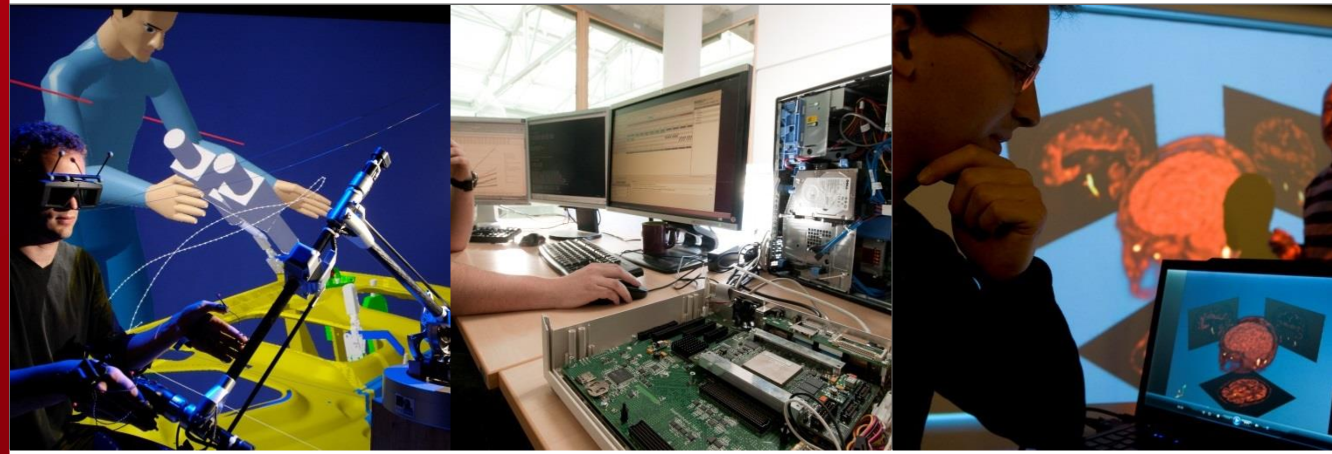

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What is round-trip engineering?

"The ability to automatically maintain the consistency of multiple, changing software artifacts, in software development environments/tools, is commonly referred to as round-trip engineering" [Sendall04]

- **Related to traditional software engineering disciplines:**
  - Forward engineering: creating software from specifications
  - Reverse engineering: creating specifications from existing software
- **Round-trip engineering adds synchronization of existing artifacts that evolved concurrently by incrementally updating each artifact to reflect changes made to the other artifact**
- **Round-trip generalizes both forward and reverse engineering**

[Sendall04] S. Sendall and J. Küster. Taming model round-trip engineering. In *Proceedings of Workshop on Best Practices for Model-Driven Software Development*, Vancouver, Canada, 2004.

A real need for round-trip engineering

- Previously, UML-RT runtime code was manually reversed to a Papyrus UML model and code was generated
- The task was “long” and “tedious”
- In the mean time model and code evolved concurrently

! A real problem of synchronization

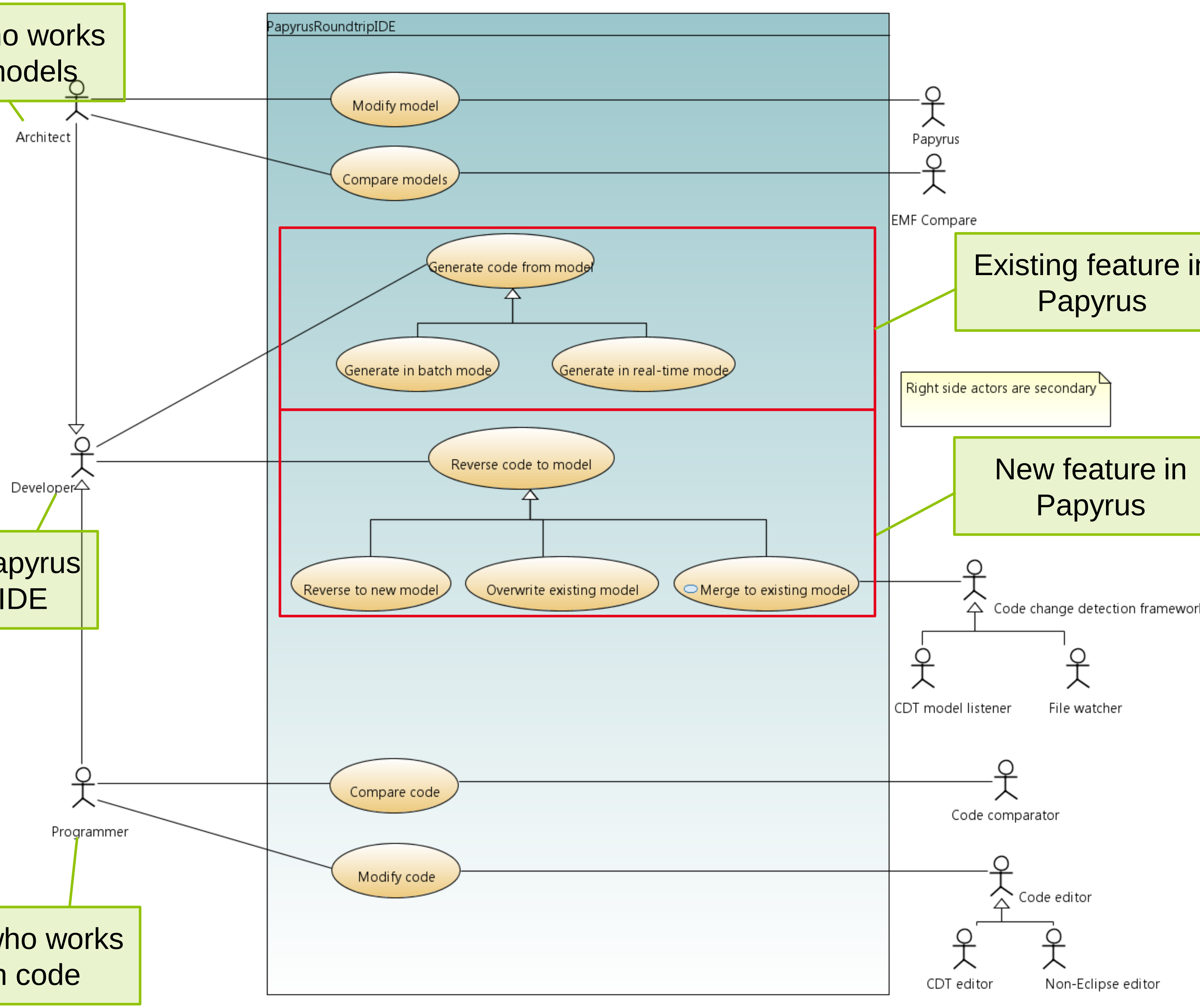
Papyrus offer for round-trip engineering

- UML modeler and C++ code generator are released…
- …but reverse and incremental update tool are still in development

Propose a IDE for **C++** round-trip engineering

ROUND-TRIP USE-CASES AND SCENARIOS

A developer who works mostly with models



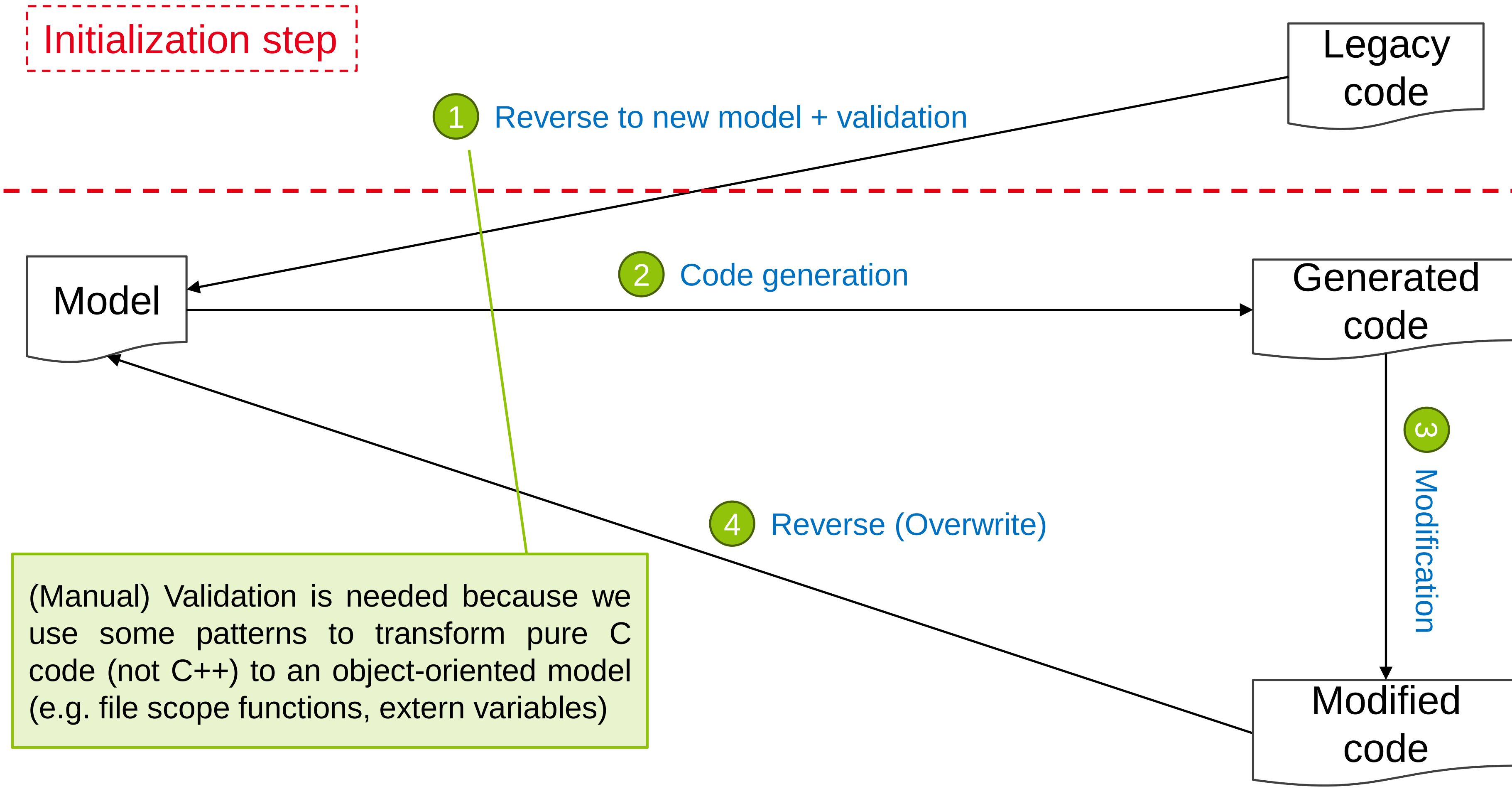
Existing feature in Papyrus

New feature in Papyrus

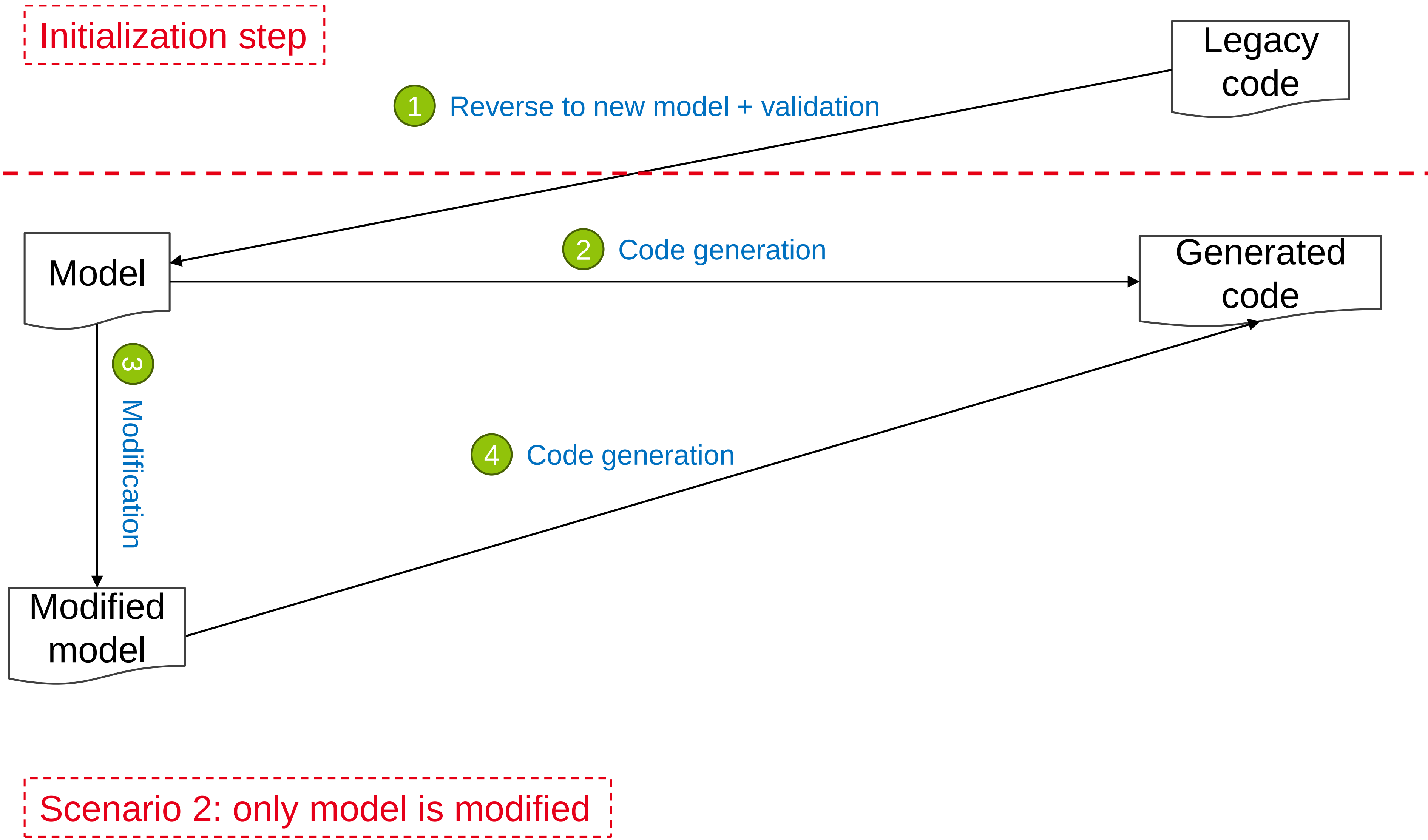
User of the Papyrus Round-trip IDE

A developer who works mostly with code

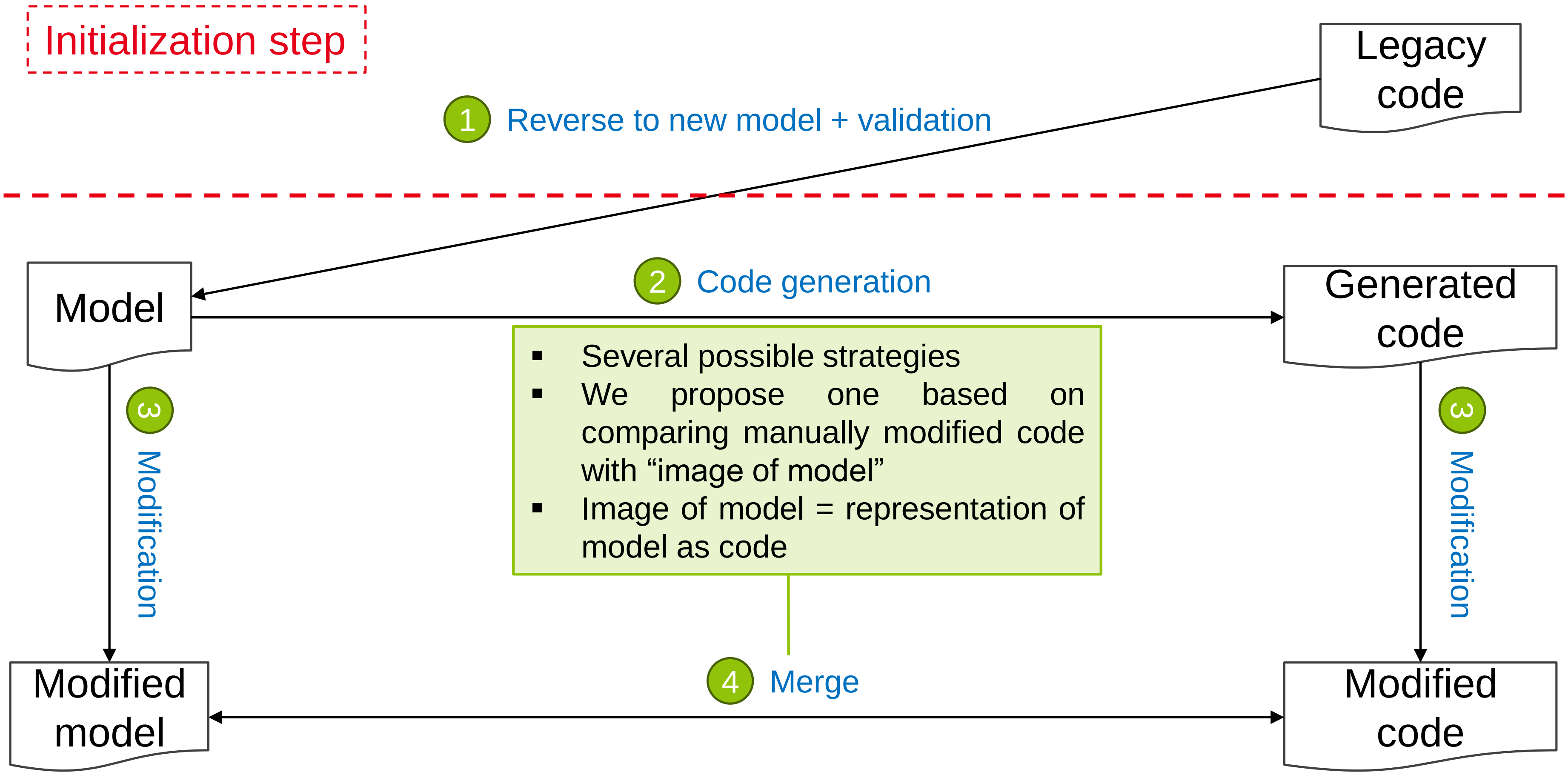
ROUND-TRIP USE-CASES AND SCENARIOS



Scenario 1: only code is modified


Initialization step
Legacy code
1 Reverse to new model + validation
Model
2 Code generation
Generated code
3 Modification
4 Code generation
Modified model
Scenario 2: only model is modified

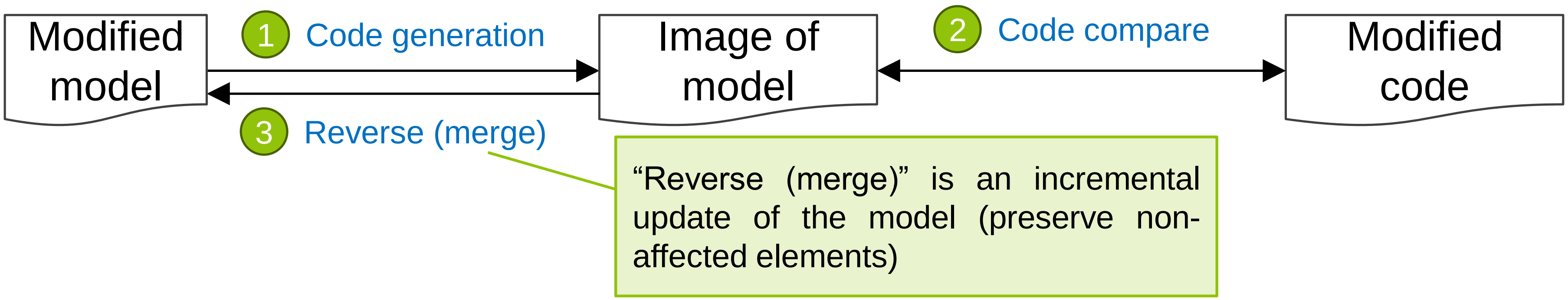
ROUND-TRIP USE-CASES AND SCENARIOS



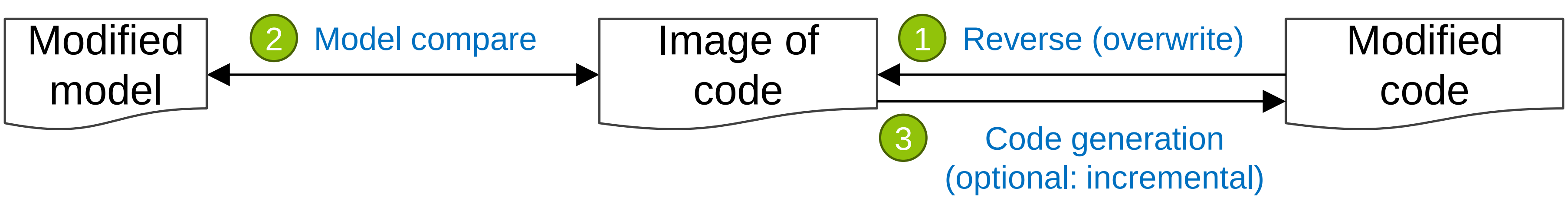
Scenario 3: model and code are both modified

ROUND-TRIP USE-CASES AND SCENARIOS

Scenario 3.1: merge by creating an image of the model as code



Scenario 3.2: merge by creating an image of the code as model



ROUND-TRIP USE-CASES AND SCENARIOS

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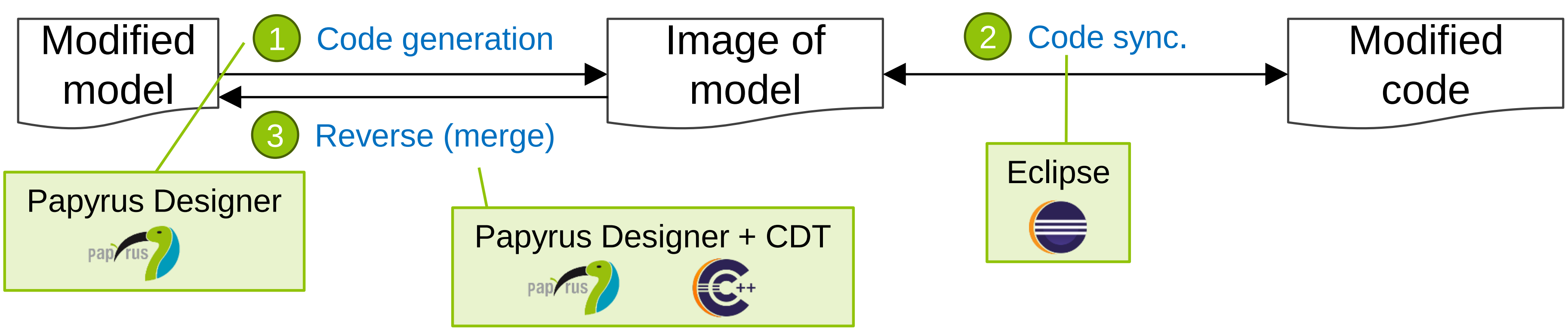

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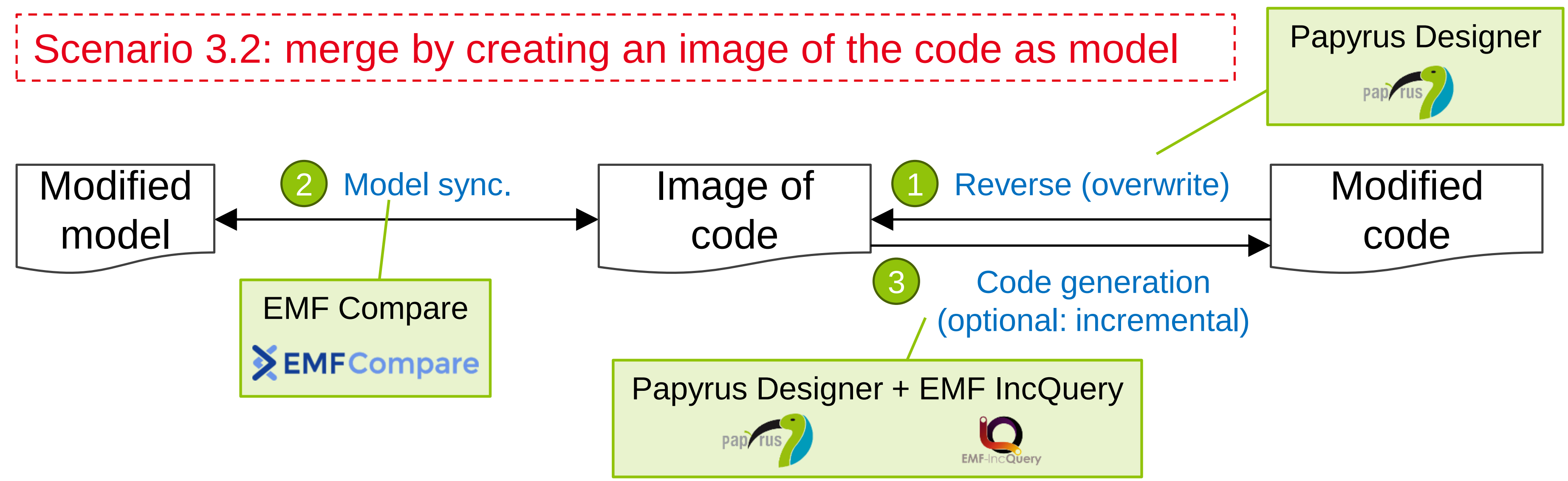

Technology comparison

Criteria	Merge using code	Merge using model	Winner
UI usability	Suited for algorithmic changes	Suited for architectural changes	Draw
Change detector	CDT listener is unreliable and not fine-grained	EMF IncQuery is reliable and fine-grained	Merge using model
Comparison tool	Many mature comparators (but basic can be messy)	EMF Compare comparison fine-grained in Papyrus, needs some UI work outside of Papyrus, xmi:id limitation needs to be leveraged	Merge using code
Overall robustness	“Reverse (merge)” operation is dependent on code changes detector and handling of changes, which in the current state is error-prone	Incremental code generation is based on more reliable EMF IncQuery AND it’s optional	Merge using model
Technology dependency	CDT	EMF technologies	Draw

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Video ▶

https://youtu.be/sudtoPvvyTA

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Summary

- **Papyrus round-trip engineering proof of concept**
- **Most limitations are on the implementation side due to technology issues**

Current and future work

- **Unitary testing and debugging of reverse tool for robustness**
- **Improvement of code generator**
- **Test on several real case studies:**
  - UML-RT runtime
  - Diversity
  - Embedded applications developed by CEA in C++
  - LEGO EV3 C++ library
- **Java version (integration of Cédric Dumoulin's work)**
- **Research work (thesis of Van Cam Pham): incremental code generation**

Roadmap and project

- **Target Eclipse Neon M6 milestone (end Q1 2016) for release of round-trip features**
- **European project on this subject being proposed?**