Software Development II
Unit 6: *Specification notations*

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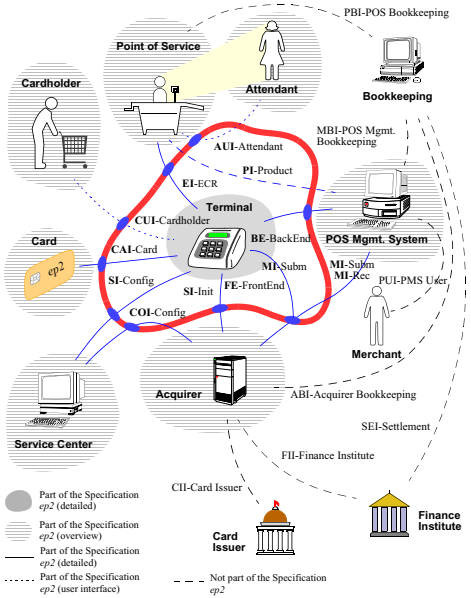
You will learn

- there exists a plethora of specification formalisms
- some of which you know already, e.g., propositional logic
- one important one is the UML

Specification notations

Informal notations

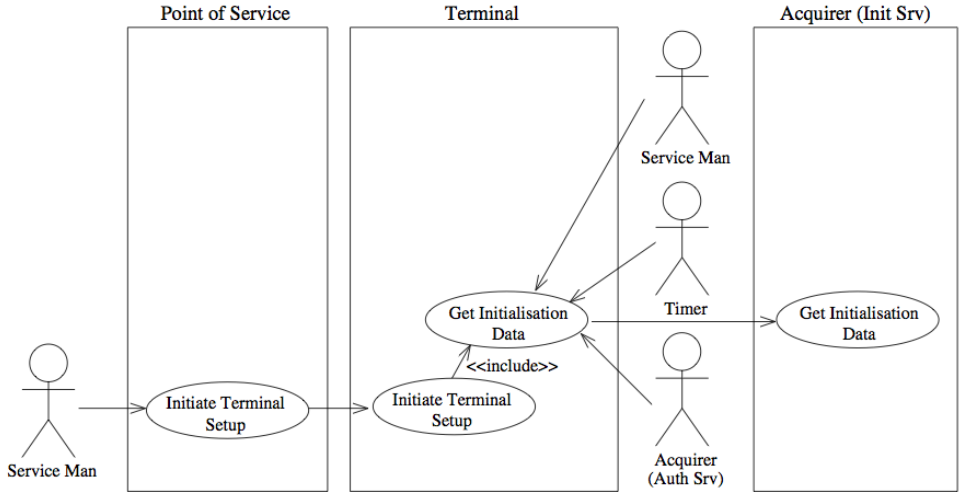
Diagram:



Plain English: *'The interface is used to download configuration data, terminal software and some initialisation data'.* (From the ep2 standard)

Semi formal notations

UML use case diagram:



Formal notations I

Propositional Logic:

$$SingleAspect \equiv (tla\_g \vee tla\_r) \wedge \neg(tla\_g \wedge tla\_r).$$

"For traffic light tla the following holds:
either its signal is green g or its signal is red r."

Process algebra: $VM = button \rightarrow coin \rightarrow candy \rightarrow VM$

Formal notations II

Formal Specification Language CASL:

```
spec Arithmetic [op k:Nat] given Nat =
  sort I = { n: Nat . n  < k }
  ops __add__, __sub__ : I * I -> I
  forall n,m:    . n add m = (n + m) mod k
                 . n sub m = (n -? m) mod k
```

And many many more!

Our specification notation: "Computational Problem"

Multiplication:

Input: natural numbers a, b

Output: the natural number $a * b$

UML

Basic Facts

What The Unified Modelling Language (UML) is a general-purpose, developmental, modelling language.

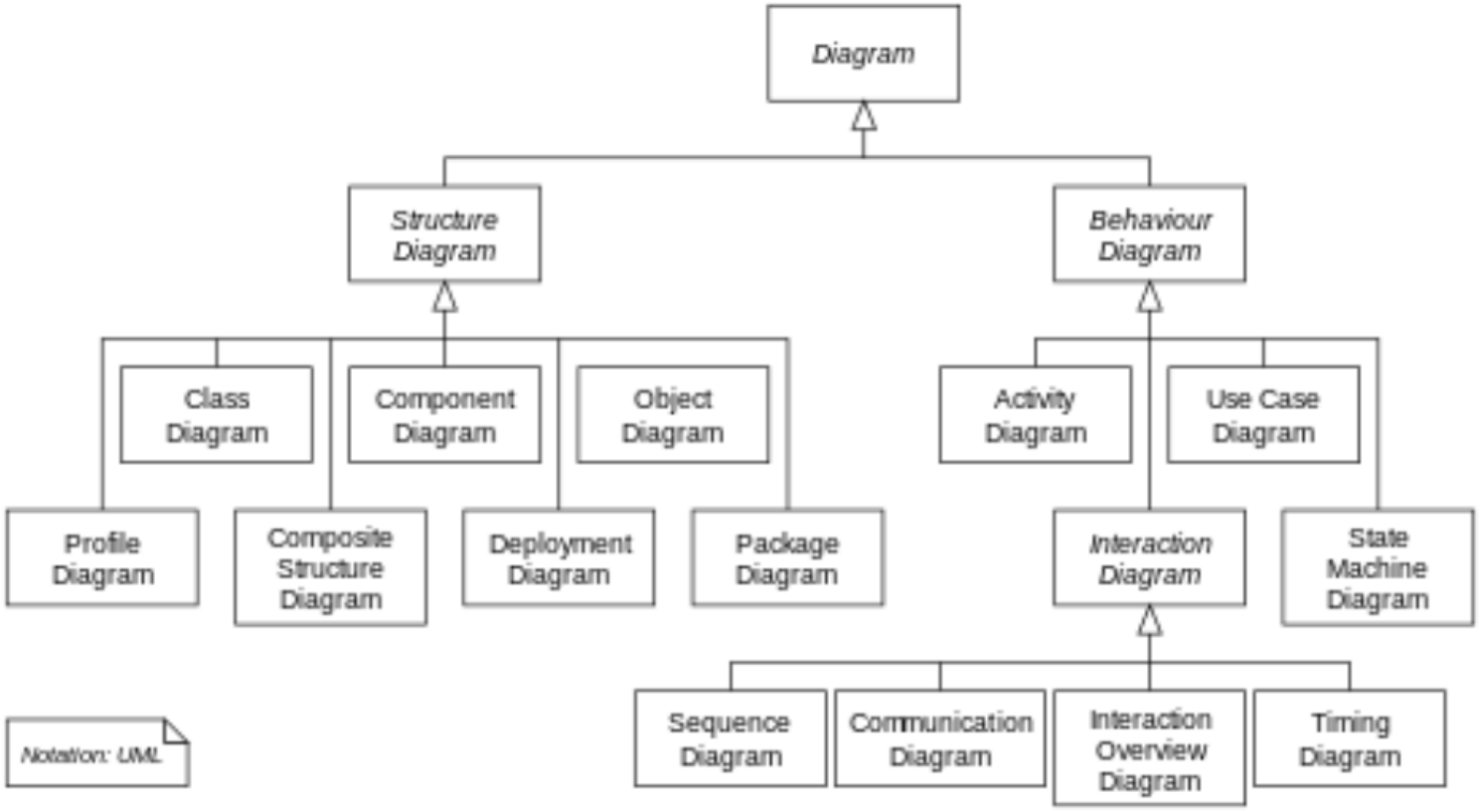
Standardisation In 1997 UML was adopted as a standard by the Object Management Group (OMG).

Current version Version 2.5.1, December 2017.

Diagrams UML 2 has many types of diagrams which are divided into two categories. Some types represent structural information, and the rest represent general types of behaviour.

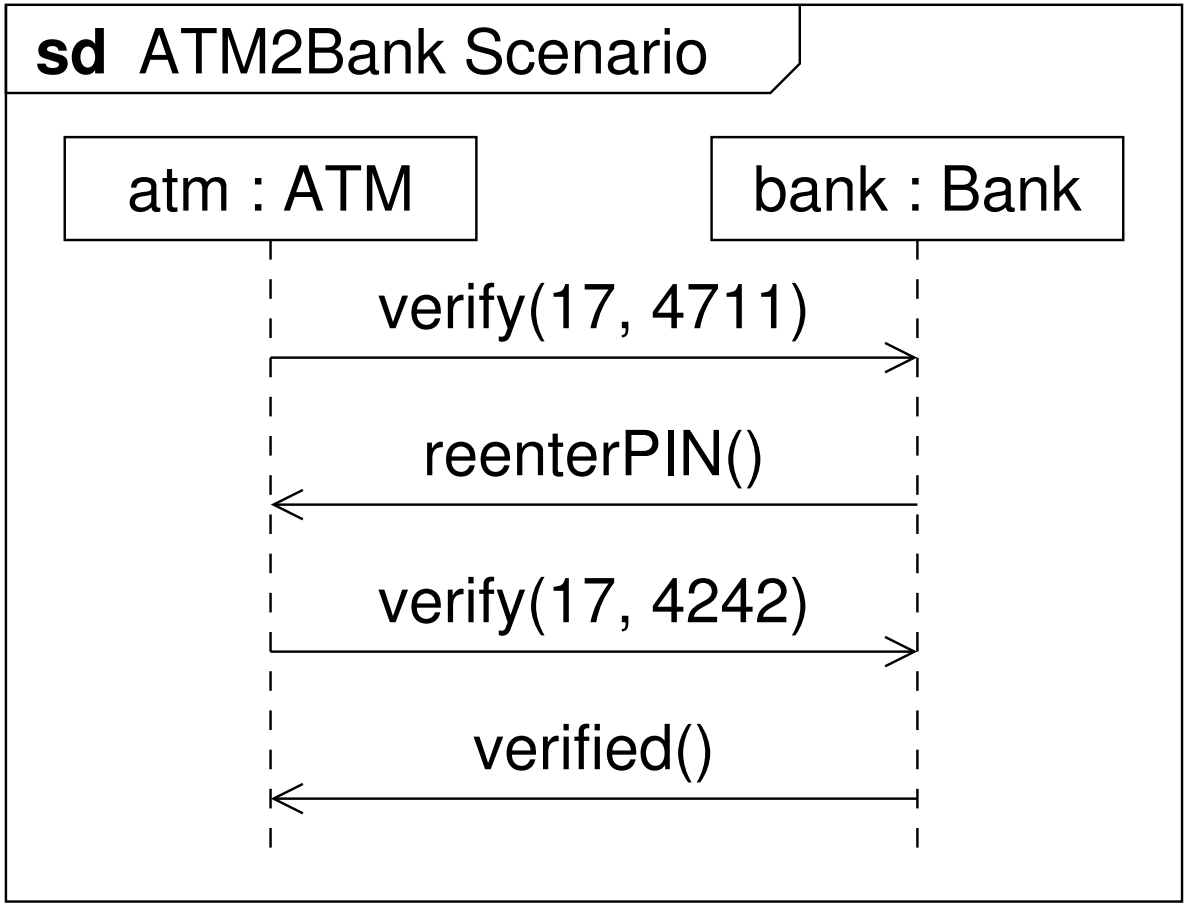
Source: Wikipedia.

UML Diagram types

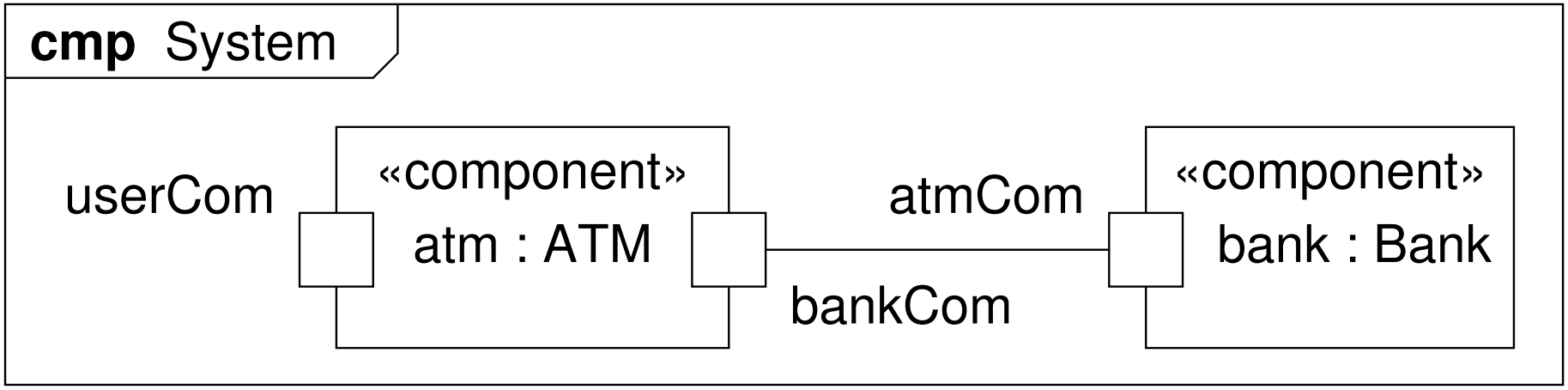


Source: Wikipedia.

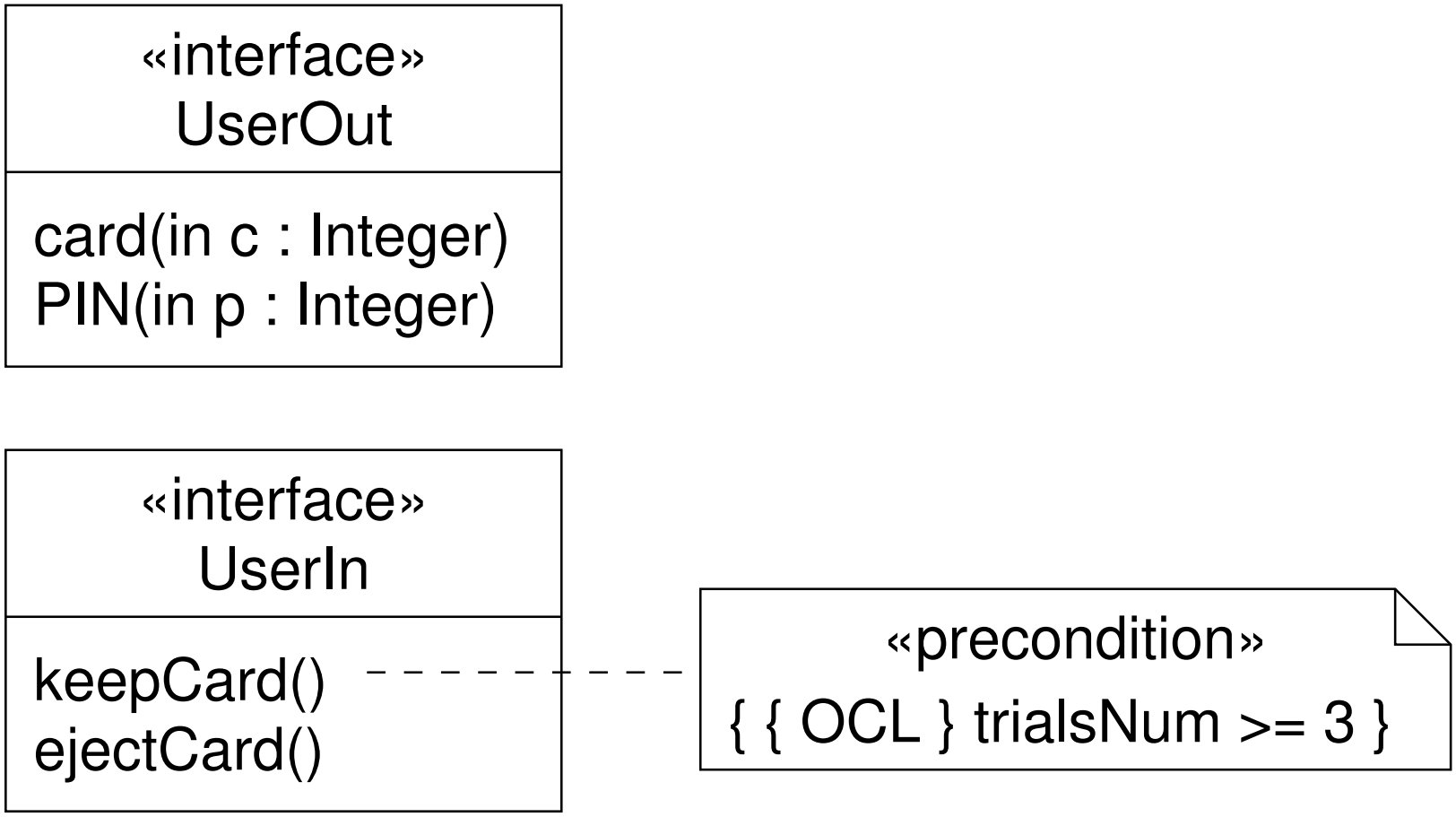
ATM modelling – Interaction



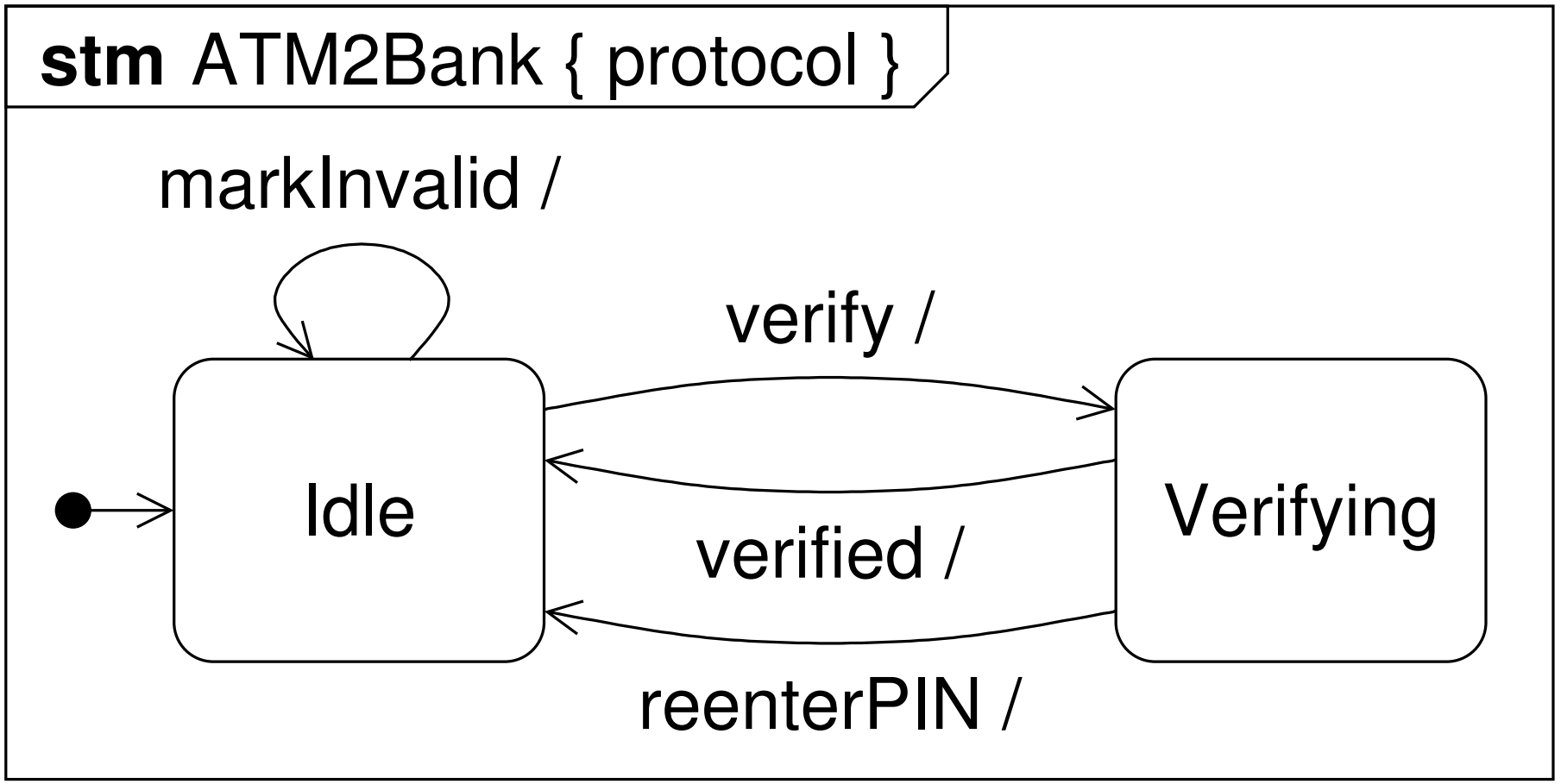
ATM modelling – Composite Structure



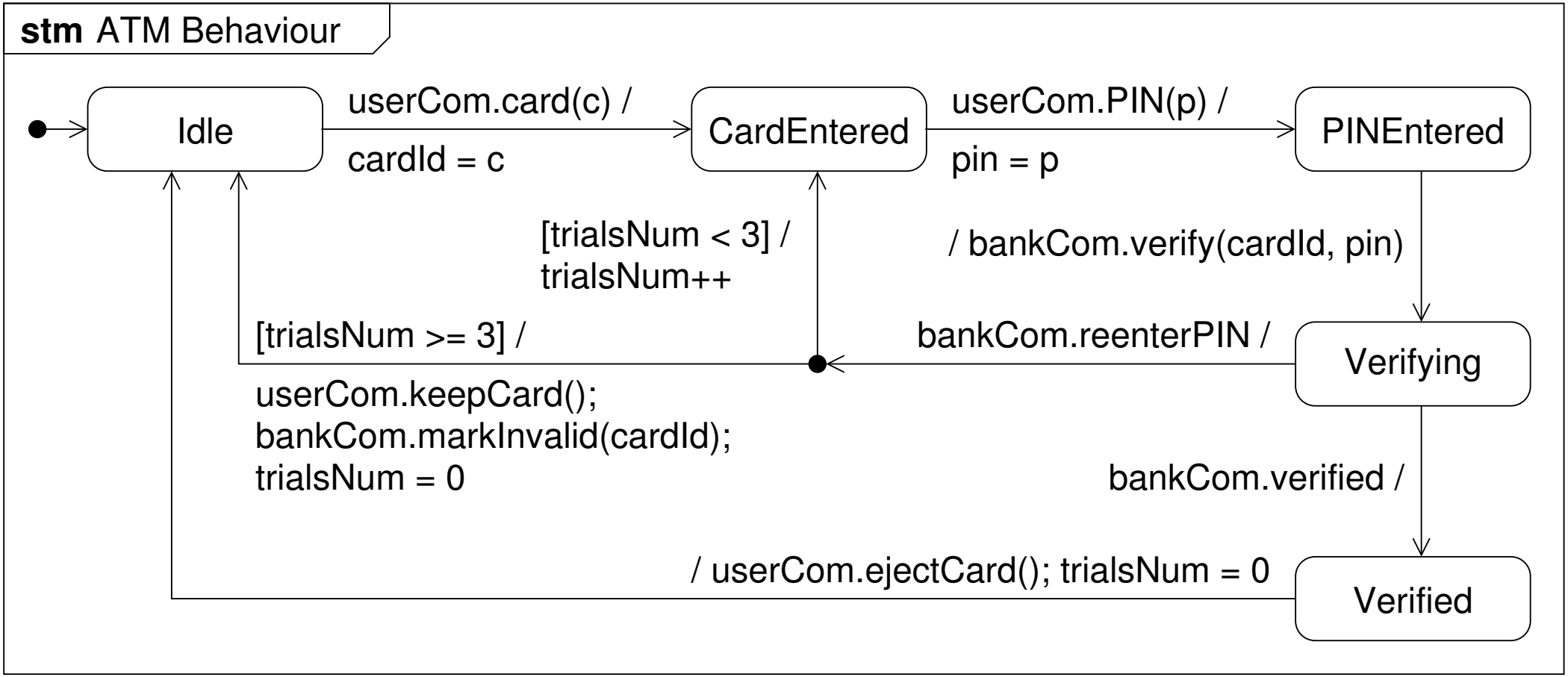
ATM modelling – Interfaces



ATM modelling – Protocol state machine



ATM modelling – State machine



ATM modelling – summary

one system – several models
different purposes – different UML diagram types
different diagrams – “share” information

Further reading on the ATM example

Alexander Knapp, Till Mossakowski, Markus Roggenbach: Towards an Institutional Framework for Heterogeneous Formal Development in UML – A Position Paper – pp. 215–230, LNCS 8950, Springer, 2015.

Further reading on UML

Jon Holt, Simon Perry:
SysML for Systems Engineering – A model-based approach.
IET Publishing, 2013.

SysML offers systems engineers several noteworthy improvements over UML. . . . SysML reduces UML's software-centric restrictions and adds two new diagram types, requirement and parametric diagrams. (Wikipedia)

What you have learned in this unit

Ideas

- different purposes ask for different formalisms
- the UML is a family of formalisms

You should be able to

- name at least three different UML diagrams