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MSC-2000

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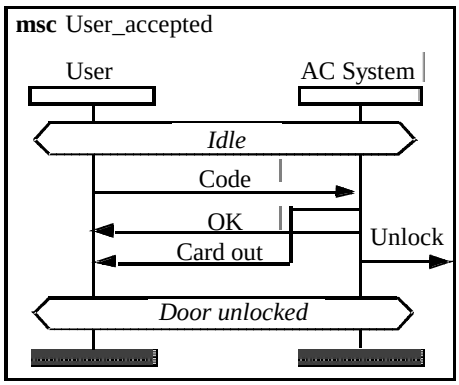
Message Sequence Charts

- **Language to describe the interaction between a number of independent message-passing instances**
- **ITU-T Z.120**



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Objectives

- **MSC**
  - **is a scenario language**
  - **supports complete and incomplete specifications**
  - **is a graphical language**
  - **is widely applicable**
  - **can be used throughout the engineering process**
  - **supports structured design**
  - **is often used in conjunction with other methods and languages**

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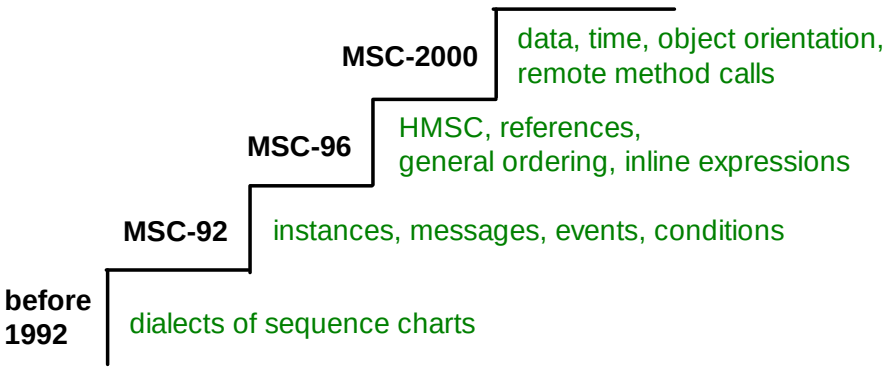
The Development of MSC



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Add-on 1 in MSC-2000

- Improved structural concepts and object orientation

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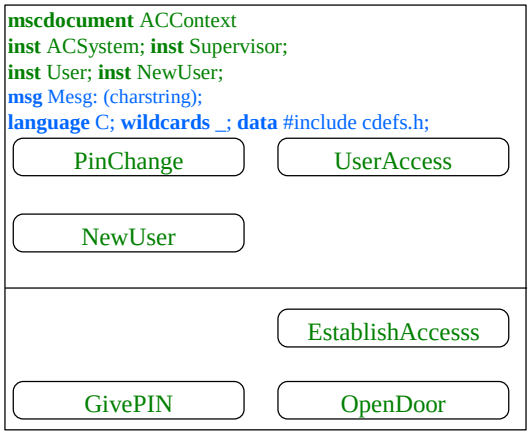
MSC document

- Defines instance kinds which
  - declare
    - instances
    - messages
    - data
    - timer
- contain defining and utility parts
- may inherit from other instance kind
- may use MSC libs



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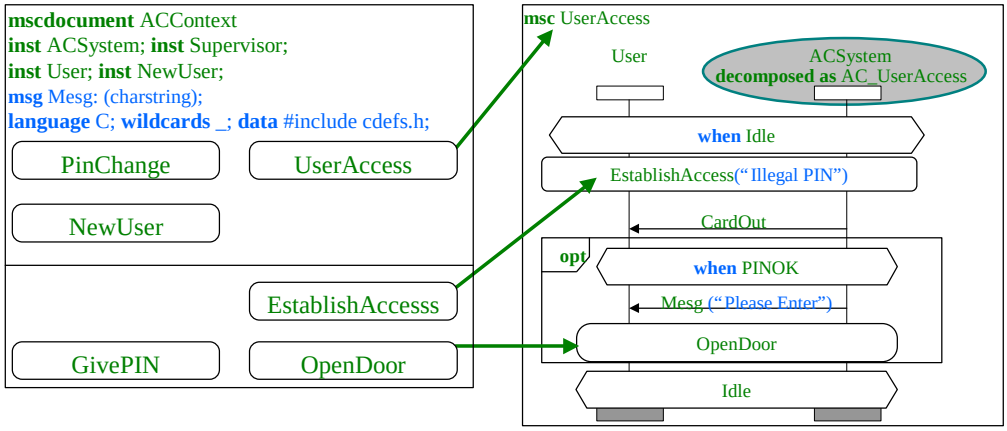
MSC document (cont'd)



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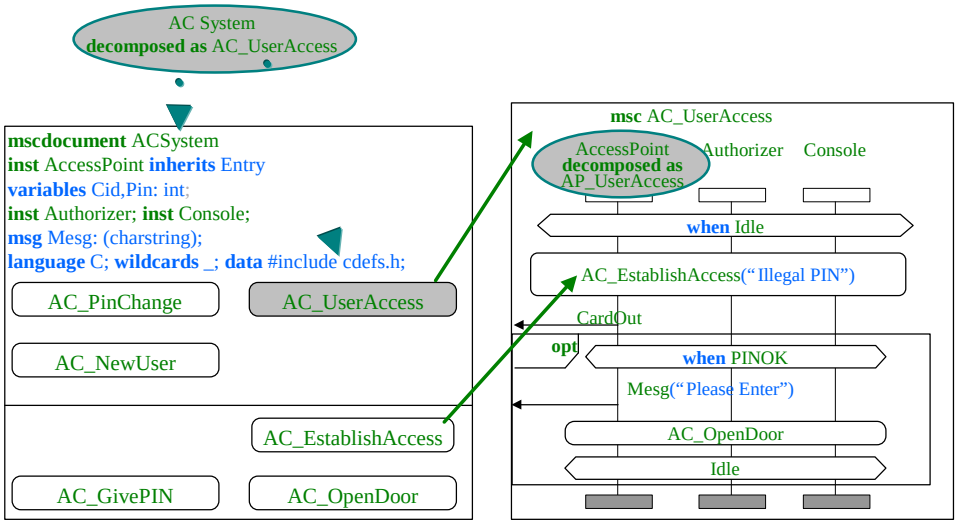
MSC Decomposition



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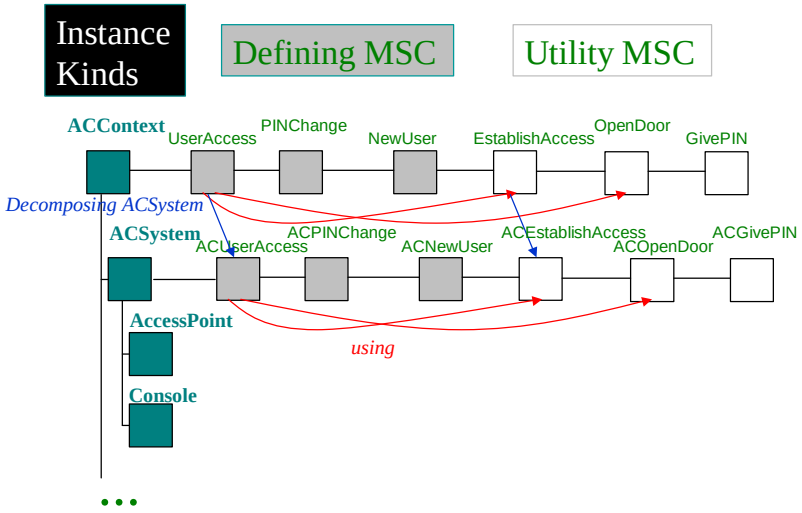
The Aggregate Hierarchy



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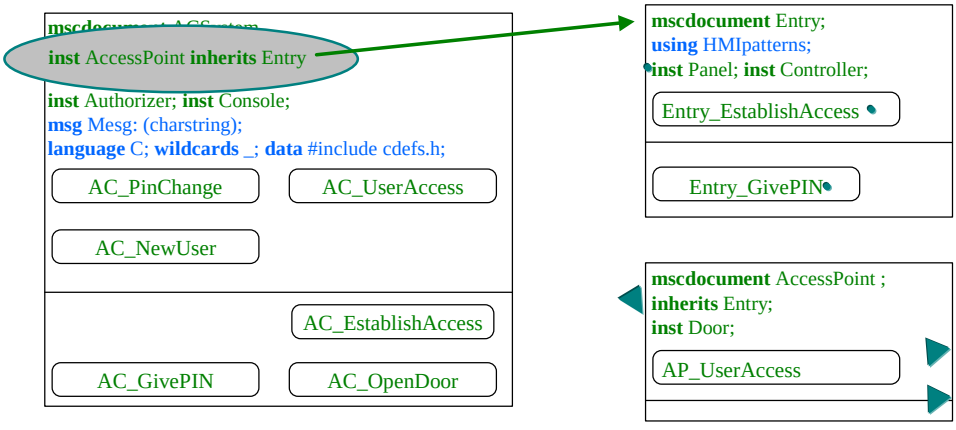
MSC Inheritance



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Object Orientation

- MSC documents define instance kinds
  - instance kinds are types suited for object orientation
- Inheritance
  - inheritance of instance kinds means inheriting all contained instances and MSCs
- Virtuality
  - Virtual MSCs means that MSCs may be redefined in specialized instance kinds
- Close correspondance with object orientation in SDL and other object-oriented languages such as Java

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Add-on 2 in MSC-2000

- Data with the data language of your choice

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Data in MSC-2000

- MSC has no data language of its own!
- MSC can make use of data languages such that
  - fragments of your favorite (data) language can be used (C, C++, SDL, Java, ...)
  - MSC can be parsed without knowing the details of the chosen data language
  - the data language strings have no unnecessary extra delimiters
- Mappings to data languages have not yet been made
  - up to any user
  - could be standardized in the future

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Data Definitions

- Type declarations
- Dynamic variables have instances as homes
- Parameterized Messages

```
mscdocument Controller

inst User variables CID;
inst AccessPoint variables cardid, access: int;
inst Authorizer variables cid, pin: int;

msg Card,AccLev: (int);
msg Get_AccLev: (int,int);

language C; wildcards _; data #include cdefs.h;

...
```


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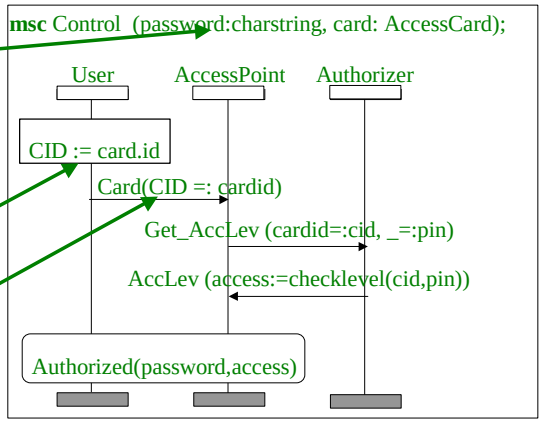
Use of Data

- **Static variables have MSCs as homes (cannot change binding within the MSC)**
- **Binding**
  - **Left-hand or right-hand**
  - **in actions**
  - **with messages**



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Interface to a Data Language

- **Syntactically:**
  - **parenthesis delimiters and escape characters to make data strings in the data language recognizable within an MSC specification**
- **Semantically:**
  - **Well-formedness functions for variables, data definitions, type refs, and expressions**
  - **Type-checking functions**
  - **Function to compare variable names**
  - **Type conformance for data strings**

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Conditions

- Setting
  - associates a set of labels (condition names) with a set of (covered) instances
- Guarding (when, evaluated dynamically)
  - State-like guard
    - checks whether the set of labels associated with the covered set of instances has a non-empty intersection with the set of labels given in the guard
  - Data-oriented guard
    - checks whether the Boolean expression evaluates to true

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Add-on 3 in MSC-2000

- Time observations and time constraints

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Time in MSC-2000

- Supports the notion of quantified time for the description of real-time systems
- Precise meaning of the sequence of events in time
- MSC events are instantaneous
- Time constraints can be specified in order to define the time at which events may occur
- Time measurements can be specified in order to observe the time at which events occured

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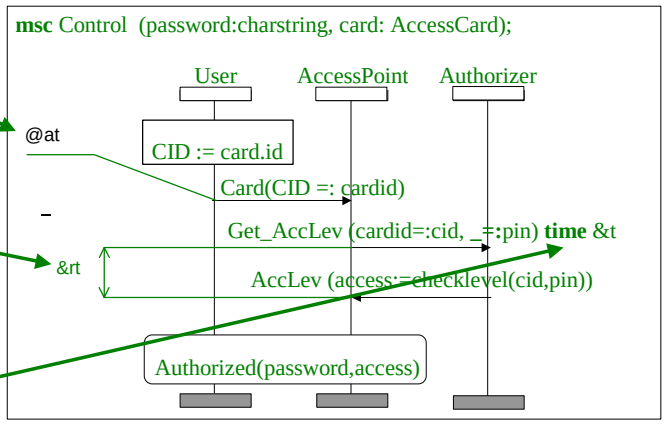
Time Observation

Observing absolute time

Observing relative time

Observing a message duration



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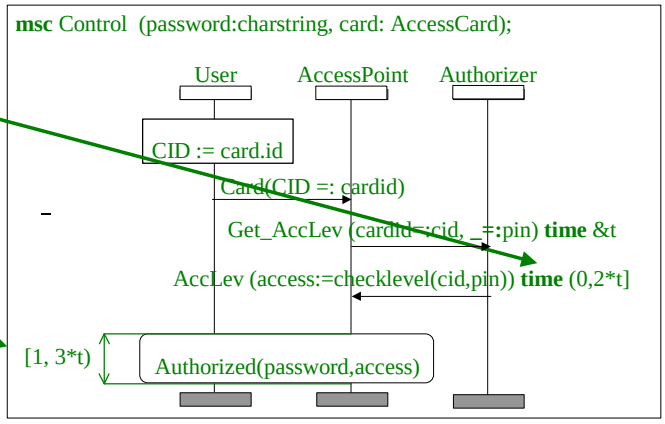
Time Constraints

Constraint for a message duration

Constraint for the execution of an MSC



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Add-on 4 in MSC-2000

- **Method calls for more synchronizing communication**

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Method Calls

- **Method Calls**
  - **Blocking (with reply)**
  - **Non-Blocking**
- **Method calls can be super-imposed**
- **Used to describe the control flow between instances**

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Method Calls

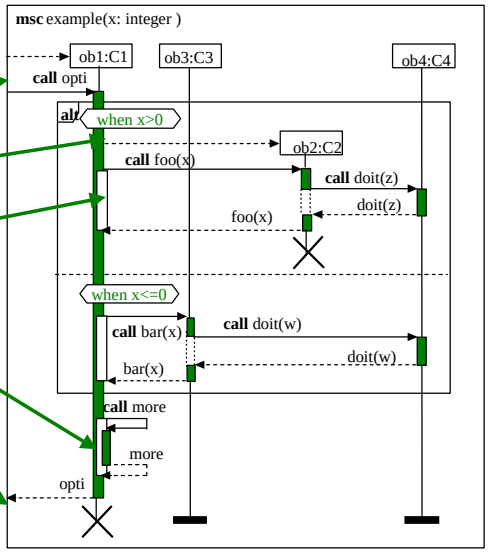
Method call at a gate

Method area

Suspension area

Call on suspension

Reply at a gate



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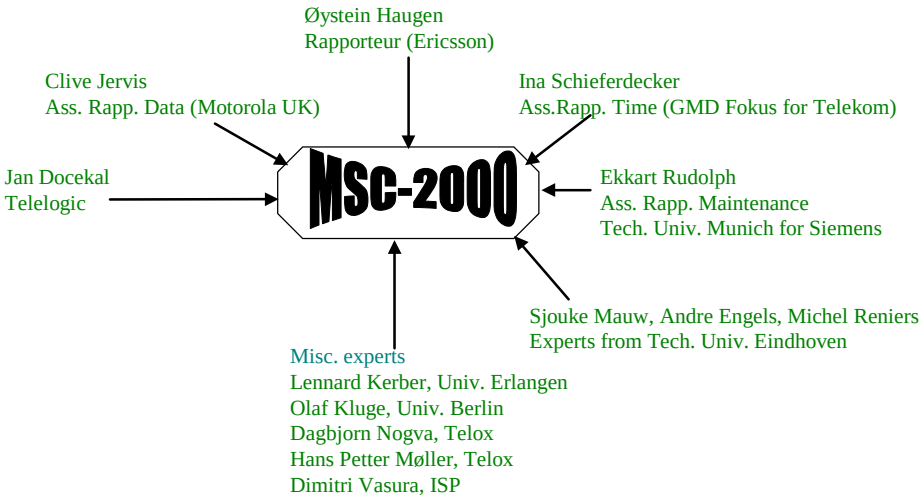
Who made MSC-2000?



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Future of MSC

- MSC-2000 is accepted by the ITU
- There should be
  - tools supporting the major parts of MSC-2000 in year 2000
  - learning material available for MSC-2000 available in the latter part of year 2000
- MSC-2000 will be input to the making of UML 2.0 and hopefully UML 2.0 will be influenced
- MSC will be maintained in the next study period
  - updated formal semantics
  - more on Quality of Service
  - improvements on grammar and meta-grammar
  - and more ....