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Towards Predictive Self-optimization by Situation Recognition

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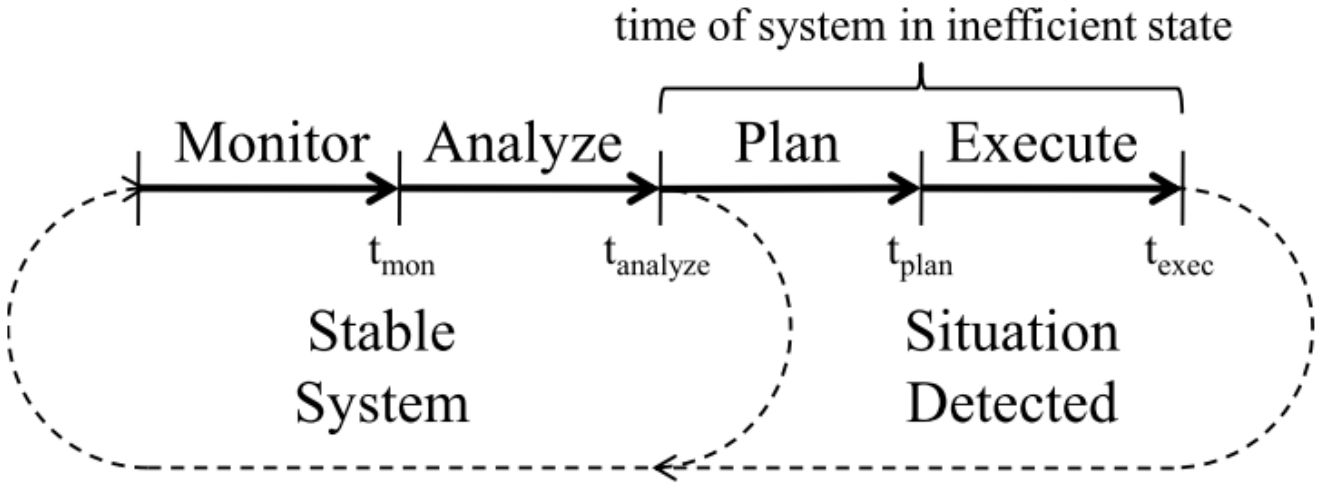
General goal

- **Energy efficiency** by automatic reconfiguration
- Goal of self-optimizing systems = Best configuration w.r.t. specified objectives (e.g., energy) [ST09]

  → Measure efficiency as ratio between user utility/satisfaction and energy consumption

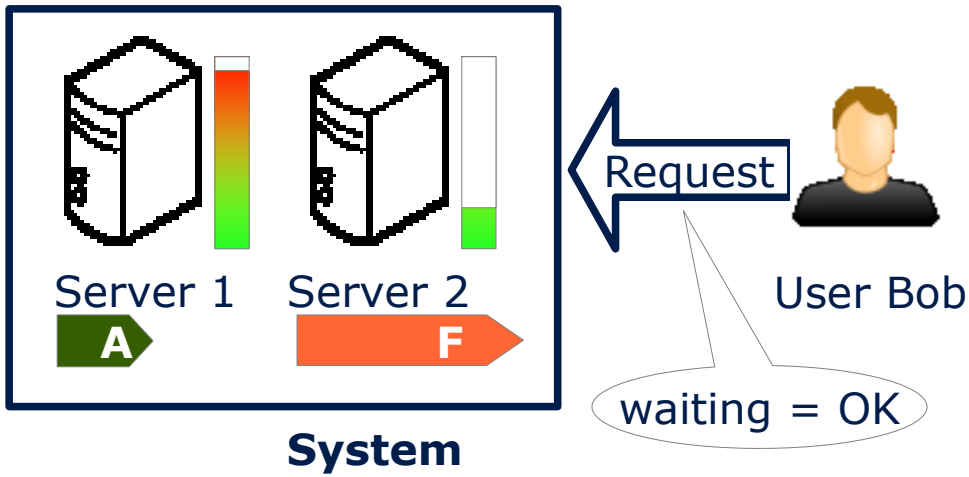
Basic principle

- Principle of self-adaptive systems: loop with 4 steps



Example 1

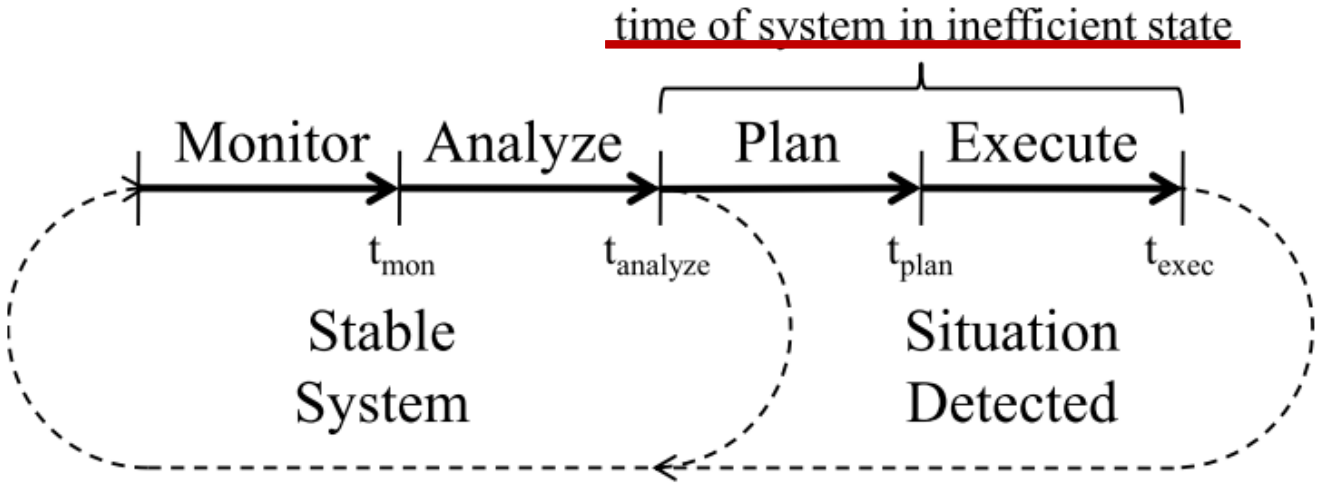
- Audio processing system



- Optimal: wait until execution on Server 1 is possible

Problem

- Planning begins at arrival of user request
- Inefficient state of system in last two steps



Idea

- Shift from reactive to **proactive adaptation**
- Recognize situations implying a need for reconfiguration of the system (i.e., inefficiencies) **in advance**

User Alice

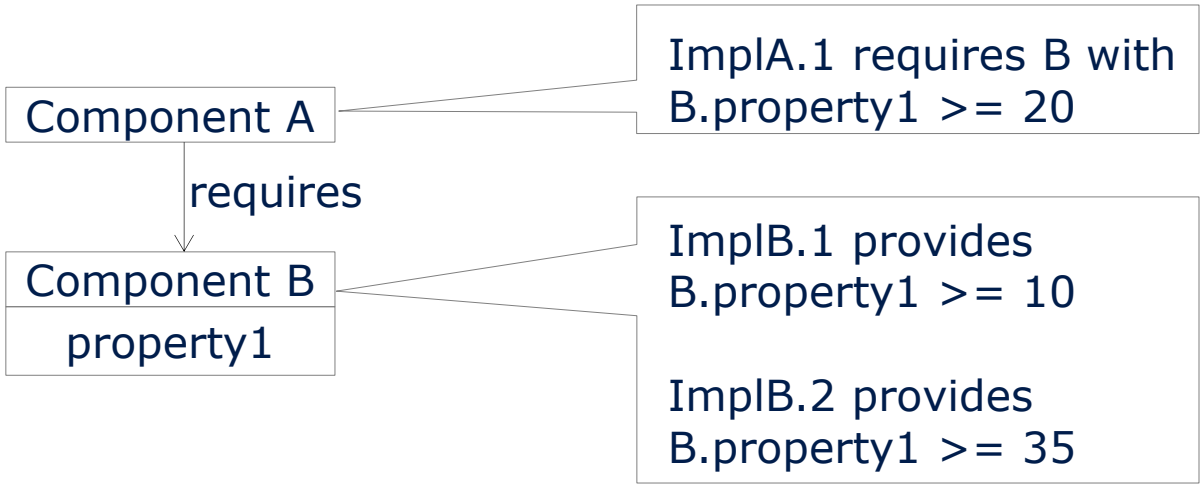
- Alice likes to hear podcasts in specific format f
- ∃Podcast p unheard by Alice
- Alice logs in

⇩ Reasoning

- Likely, that Alice will request podcast p in format f
- Compute optimal configuration for transcoding podcast p into format f

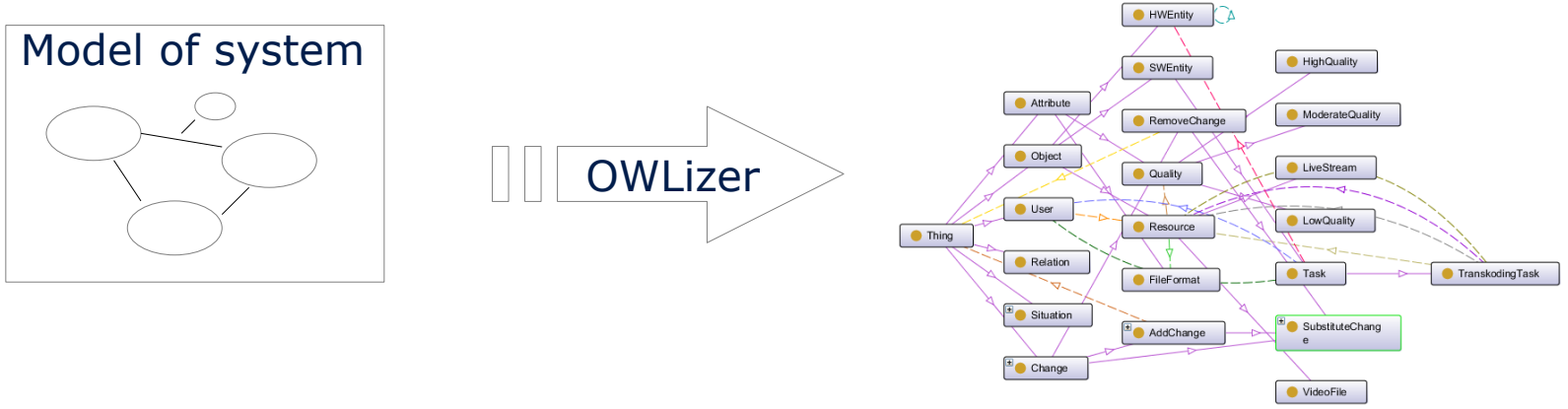
Current system

- Models@run.time paradigm [MBJ+09], CCM [GWS+10]
- Ability to specify non-functional properties for implementations in terms of **quality contracts**



Envisioned Approach

- Use OWLizer [WPGW10] to transform model of system into ontology
- Reason about ontology to identify present and upcoming situations
- Execute appropriate actions



Situations

- Contract-concerned
  - Contract violation
  - Contract enablement

- User-concerned
  - New request
  - User logging in or out

Example 2

- Contract „Transcoding“
  - Requires 10% CPU load
  - Provides processing time linear to file size

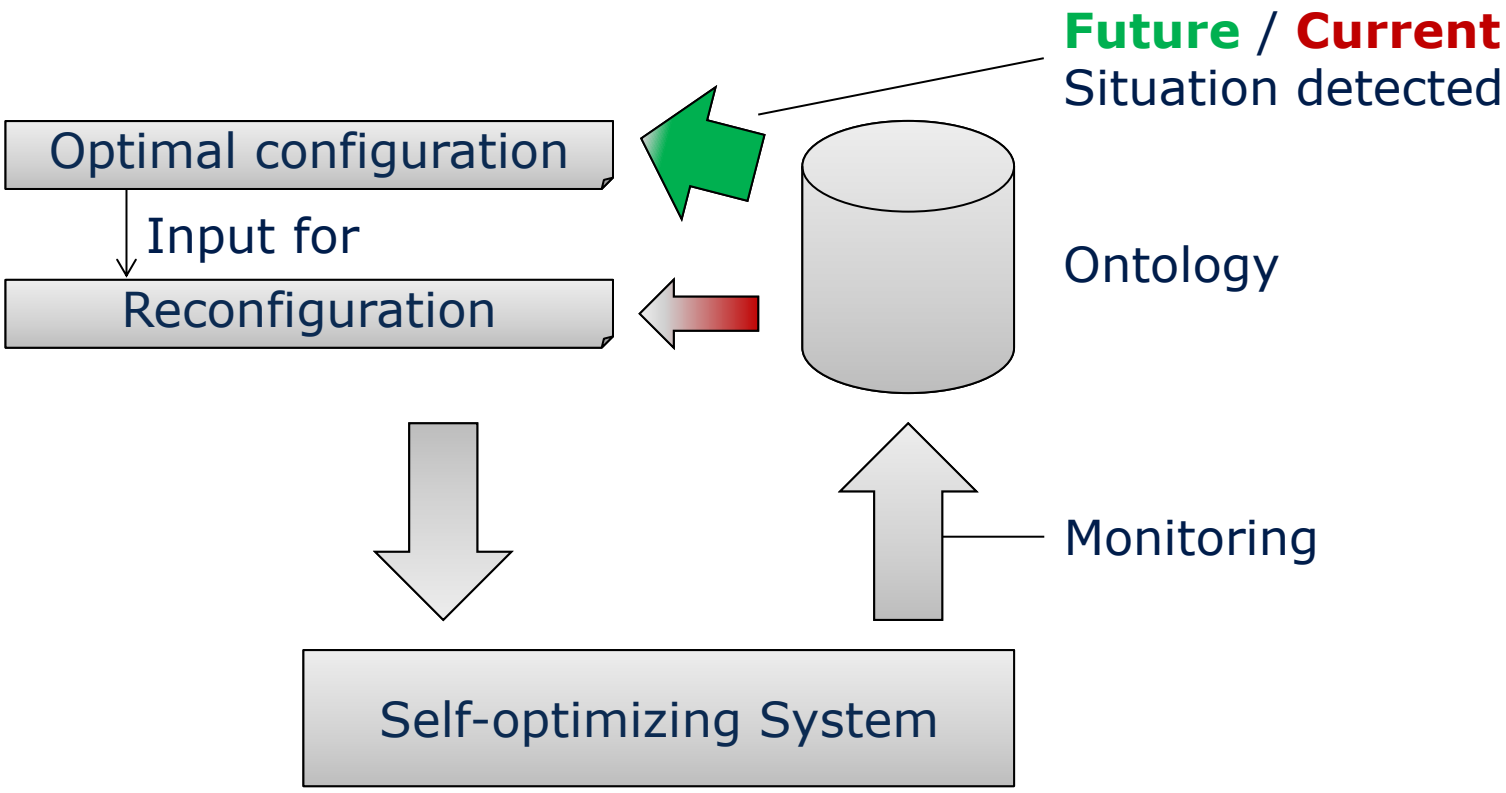
- Event: CPU fully utilized
- Transcoding contract violated
  → Processing time not guaranteed any more
  → New configuration required

- Goal: **Predict** such situations

Structure of the used ontology

- Various upper ontologies proposed:
  - CONON [WGZP04], SOUPA [CFJ05], SAWA [MKB+05], STO [KMB09]
- Currently used: SAWA
  - Situations as 1st class citizens
  - Events describing changes in context,
    e.g., CPU usage

Architecture of Envisioned Approach



Conclusion

- Current self-optimizing systems are reactive
- Time for planning and acting consumes energy
  - → Prepone planning to minimize this time by situation prediction
  - → **Proactive adaptation**
- Ontology used to reason over state of system

References

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