Stairway to Heaven: An Architecture-Level Characterization of Cloud Migration Strategies

Nabor C. Mendonça

Programa de Pós-Graduação em Informática Aplicada (PPGIA)
Universidade de Fortaleza (UNIFOR)
Fortaleza, Ceará, Brazil
nabor@unifor.br, nabor.mendonca@gmail.com
https://sites.google.com/site/nabormendonca/

SEIF Brazil Workshop 2013, November 25-26 | Rio de Janeiro

Talk Outline

- **Cloud computing (quick) overview**
- Cloud migration strategies
- Concluding remarks

Cloud Computing

- Essential characteristics

Ref: The NIST Definition of Cloud Computing
http://csrc.nist.gov/publications/nistpubs/800-145/SP800-145.pdf

On-demand self-service

Ubiquitous network access

Location transparent resource pooling

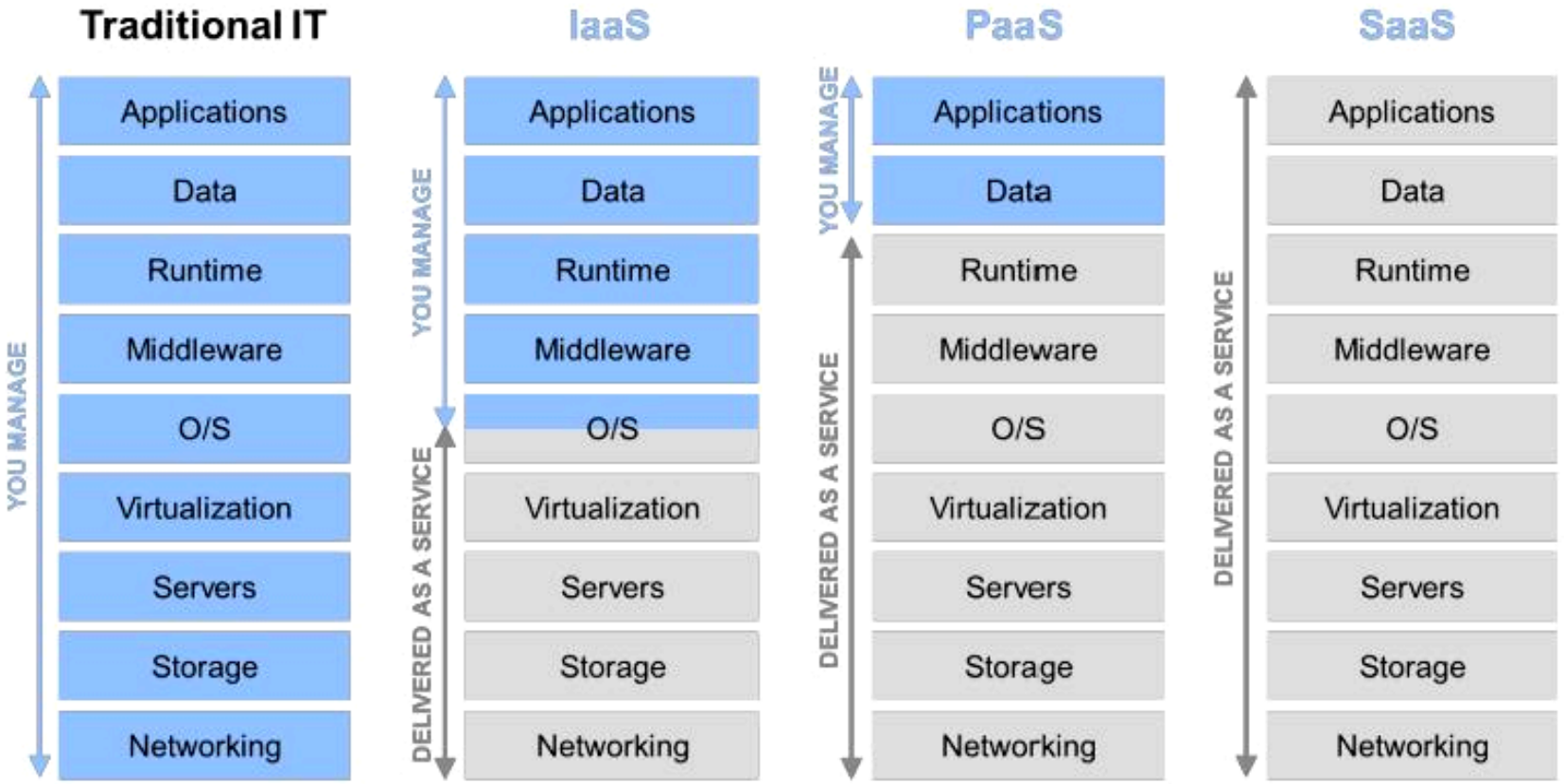
Rapid elasticity

Measured service with pay per use

Source: http://aka.ms/532/

Cloud Computing

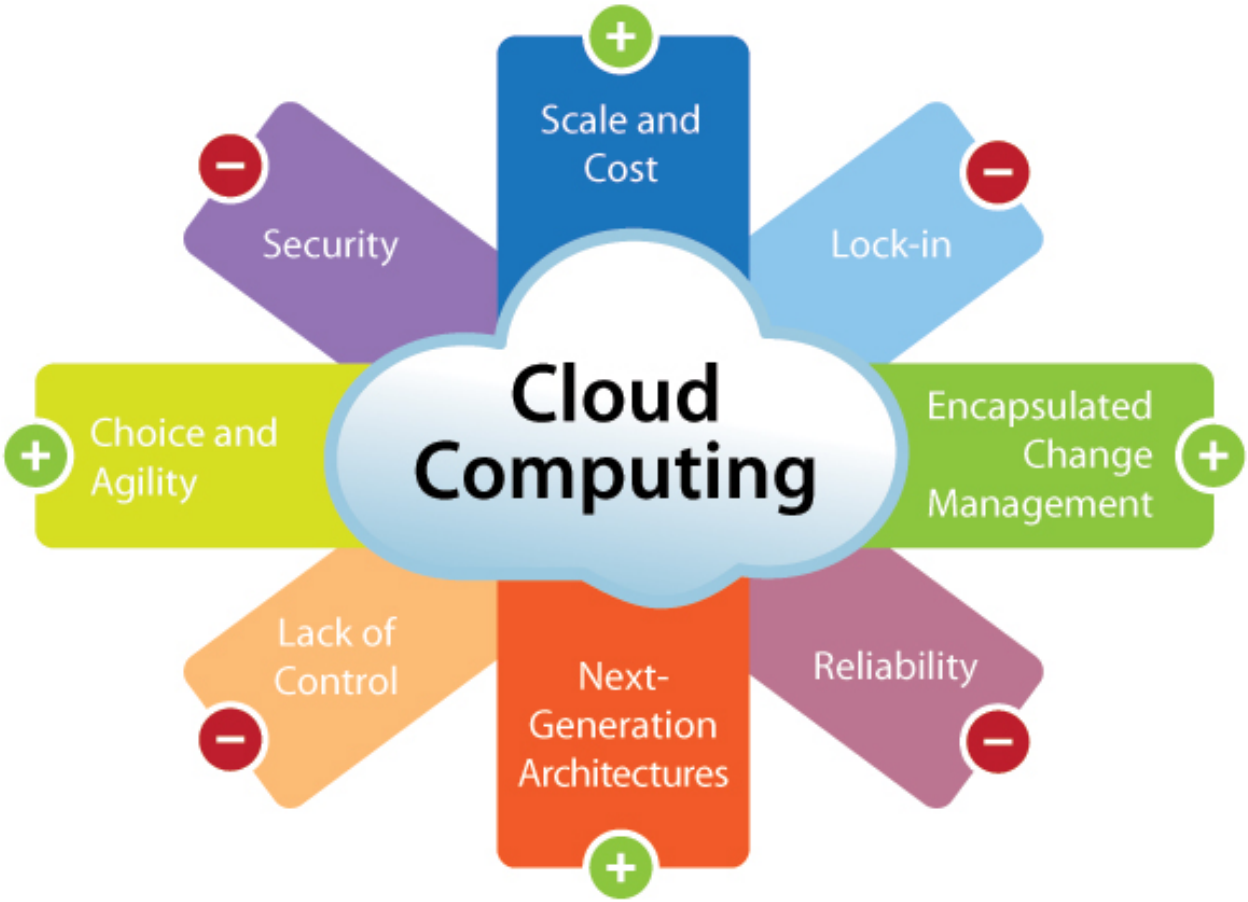
- Delivery models (vs. traditional IT)



Source: Microsoft presentation.

Cloud Computing

- Risks and benefits



Source: http://www.tridens.si/

Talk Outline

- Cloud computing
- **Cloud migration strategies**
- Concluding remarks

Motivation

- Cloud migration is still a difficult process for many organizations

Source: http://www.cloudtweaks.com

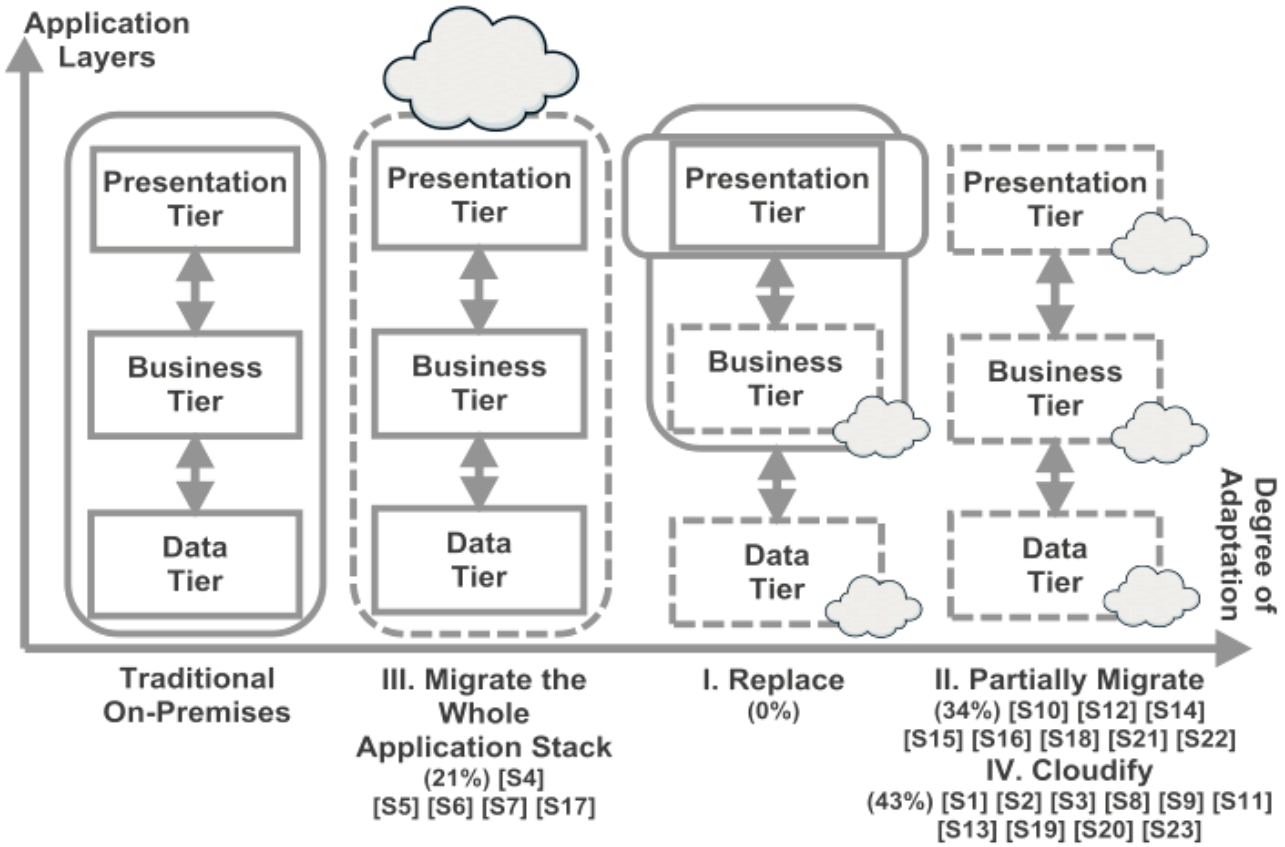
Motivation

- Existing approaches are either too broad in scope…

Source: http://www.neevtech.com/

Motivation

- ... or too narrow in terms of architectural alternatives



Source: Jamshidi *et al.*, Cloud Migration Research: A Systematic Review, IEEE TCC, 2013.

Goal (and Non-Goal)

- Identify and characterize useful cloud migration strategies from an architectural perspective
- Specific focus on **application components** and their **service dependencies**
- How each strategy would affect (or be affected by) other factors, both technical and non-technical, is beyond the scope of our present work

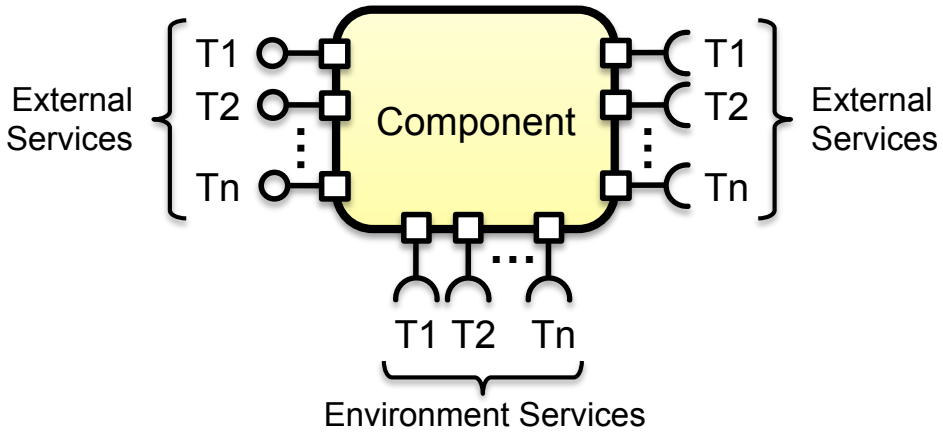
Basic Assumptions

- Components as the unit of migration
- Cloud migration means that a component will benefit from the cloud somehow, not necessarily run on it
- After migration the target component must be able to resolve all its (original) services dependencies, including those to other external components and the underlying execution environment

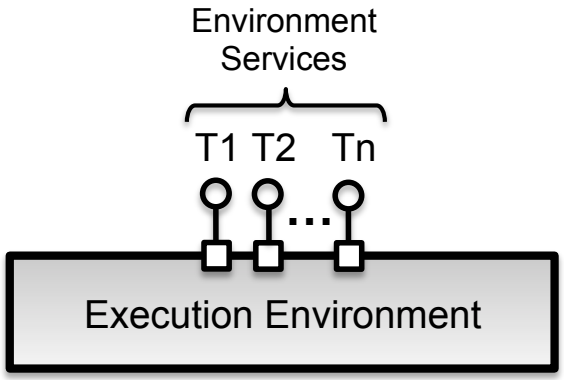
Architectural Notation and Model

- We use a simple graphical notation (loosely based on UML component diagrams) to illustrate our cloud migration strategies in terms of key architectural elements:
  - Component
  - Service dependencies
  - Execution environment
  - Cloud environment

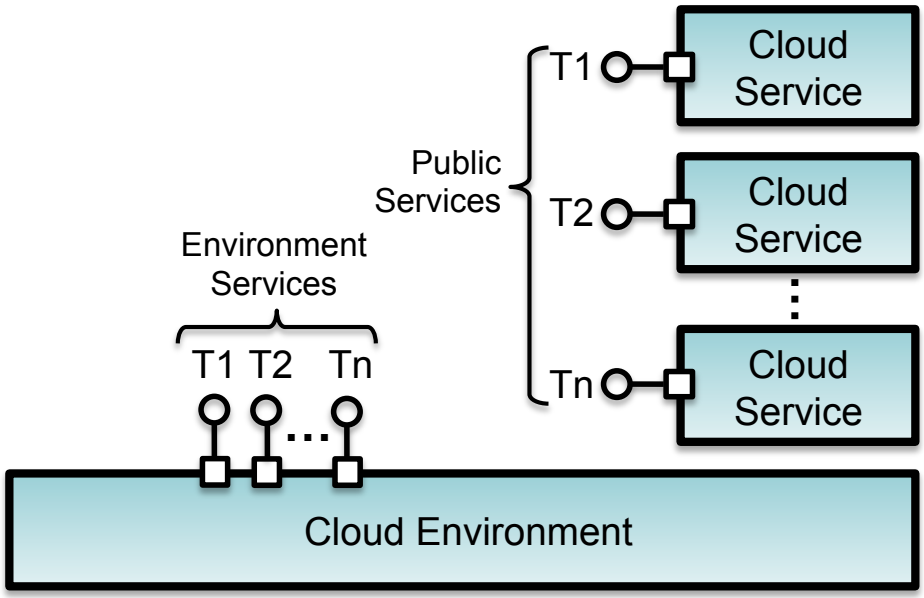
Component and Service Dependencies



Execution Environment



Cloud Environment

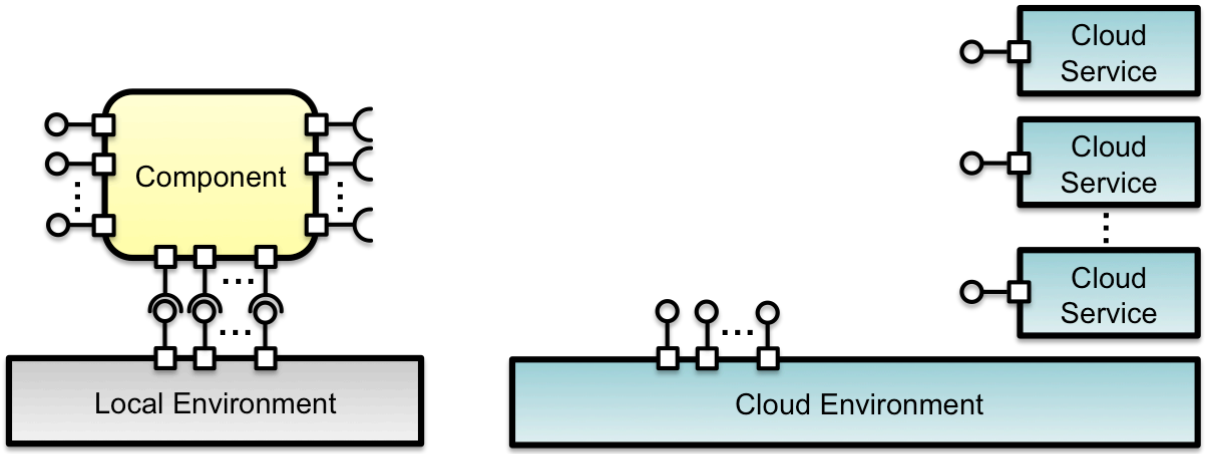


Cloud Migration Characterization

- Relocation
- Cloudification
- Compensation

Cloud Migration Characterization

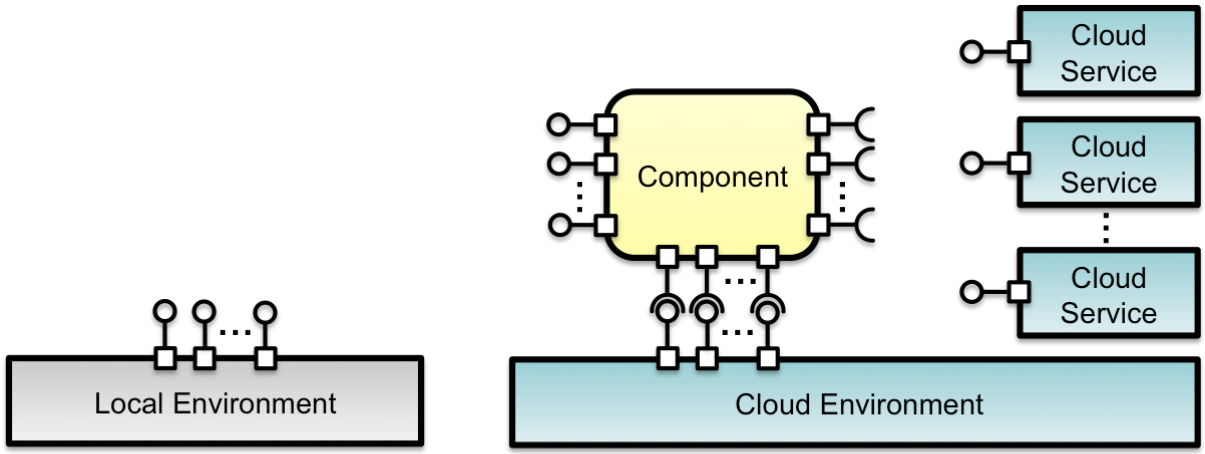
- Relocation
- Cloudification
- Compensation



Before migration

Cloud Migration Characterization

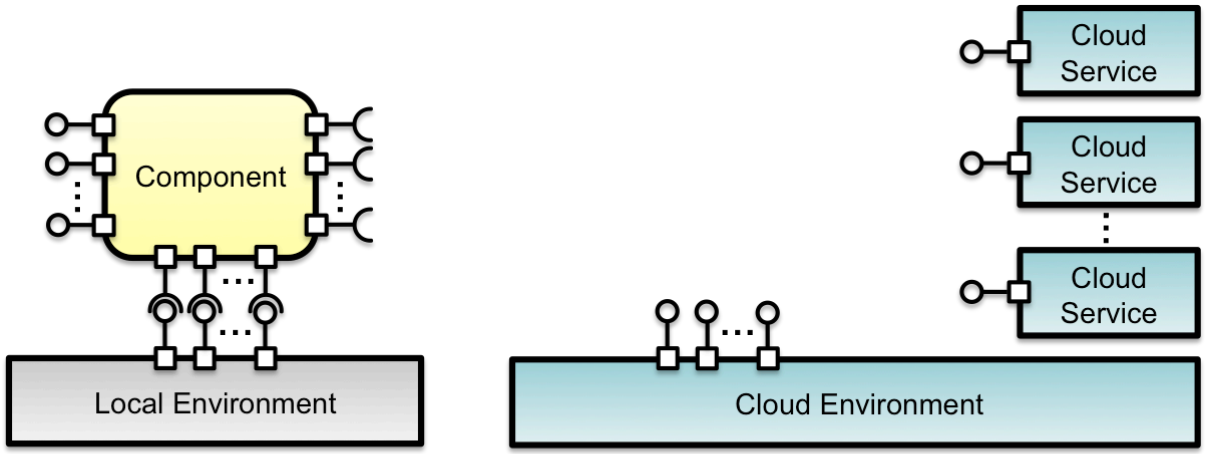
- Relocation
- Cloudification
- Compensation



After migration

Cloud Migration Characterization

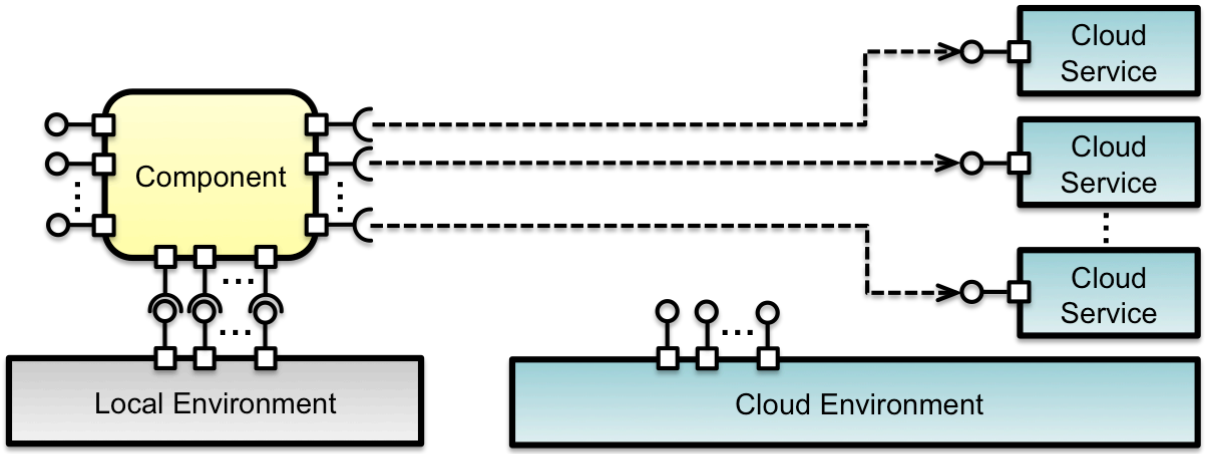
- Relocation
- Cloudification
- Compensation



Before migration

Cloud Migration Characterization

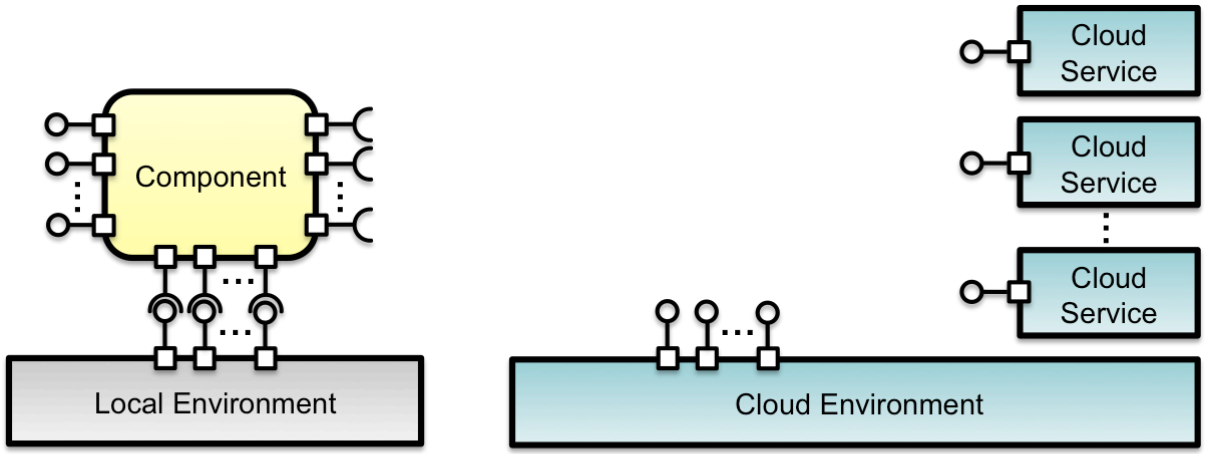
- Relocation
- Cloudification
- Compensation



After migration

Cloud Migration Characterization

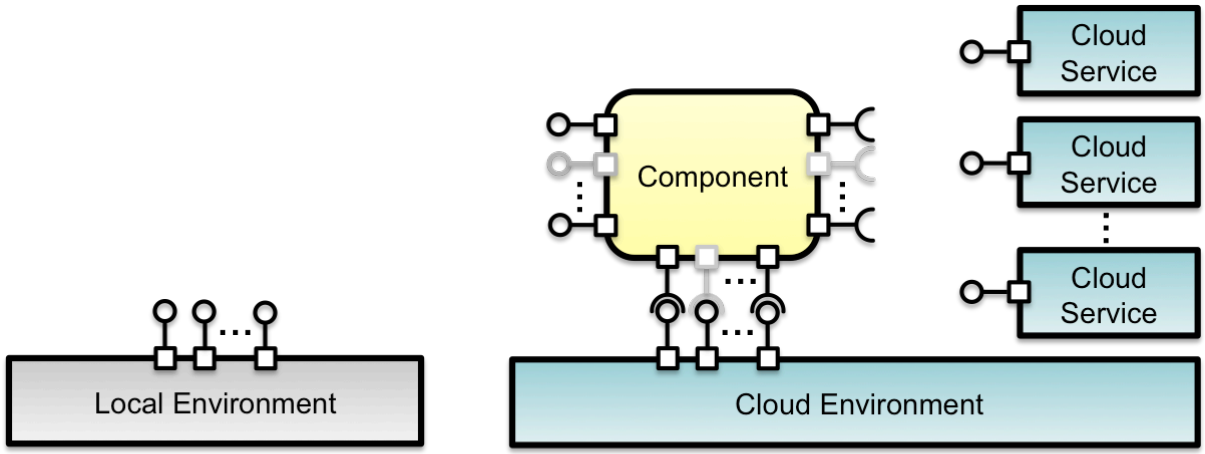
- Relocation
- Cloudification
- Compensation



Before migration

Cloud Migration Characterization

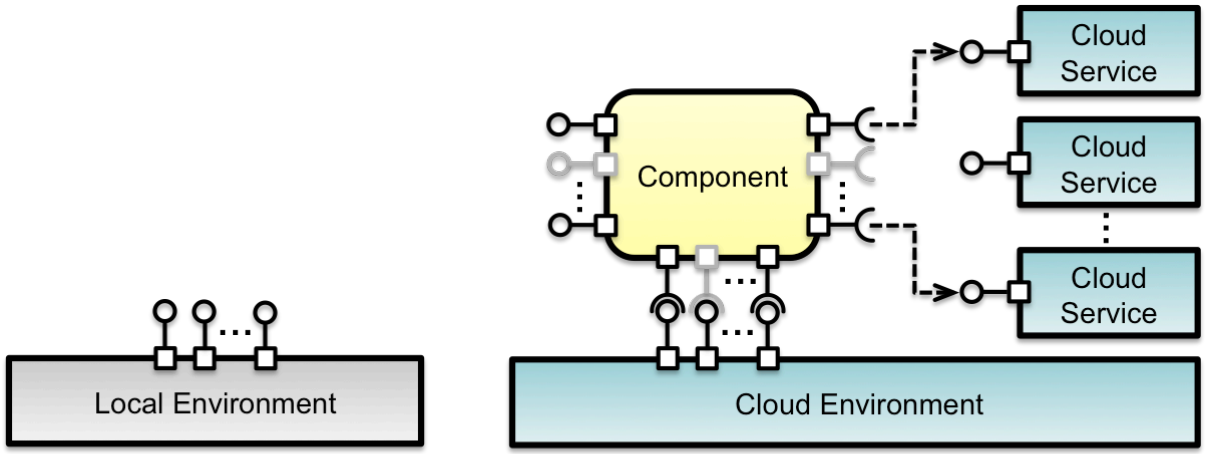
- Relocation
- Cloudification
- Compensation



After migration

Cloud Migration Characterization

- Relocation
- Cloudification
- Compensation



After migration

Strategies Classification

- Each of those strategies are further classified according to the following criteria:
  - Implementation mechanisms
  - Service compatibility requirements
  - Migration effort

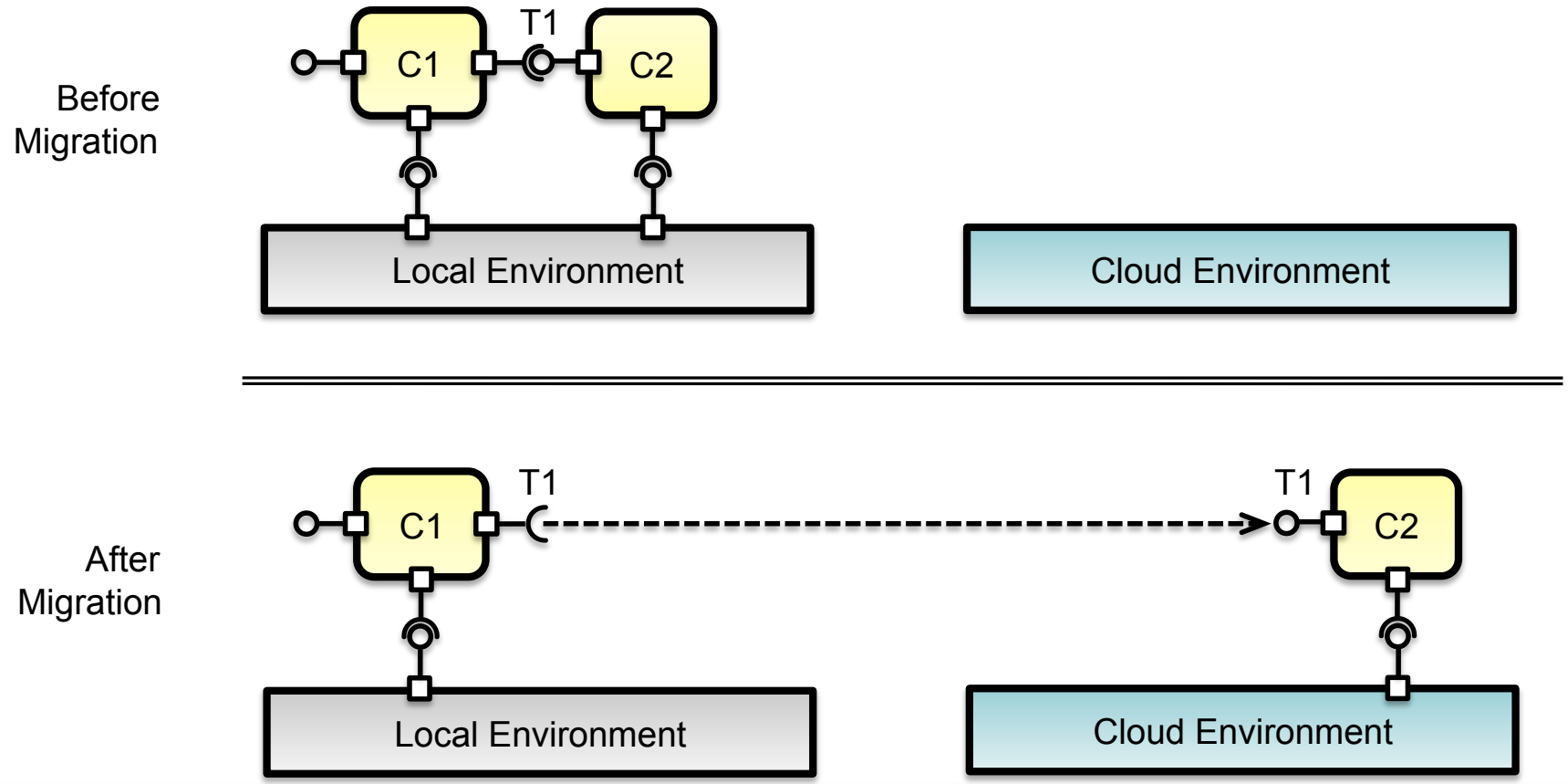
Strategies Classification

Strategy	Implementation Mechanisms	Compatibility Requirements		Migration Effort
		ID	Type	
Relocation	Re-binding	☑	☑	CM, AR
	Adaptation	☑	☒	CM, AR,
	Transformation	☑	☒	CC, CM, AR
Cloudification	Replacement	☒	☑	DM, SC, AR
	Adaptation	☒	☒	DM, SC, AR
	Transformation	☒	☒	CC, DM, SC, AR
Compensation	Incorporation	☒	☑	CC, CM
	Suppression	☐	☐	CC, CM

Legend: **CC** (Component Change), **CM** (Component Migration), **DM** (Data Migration), **SC** (Cloud Service Configuration), **AR** (Architecture Reconfiguration)

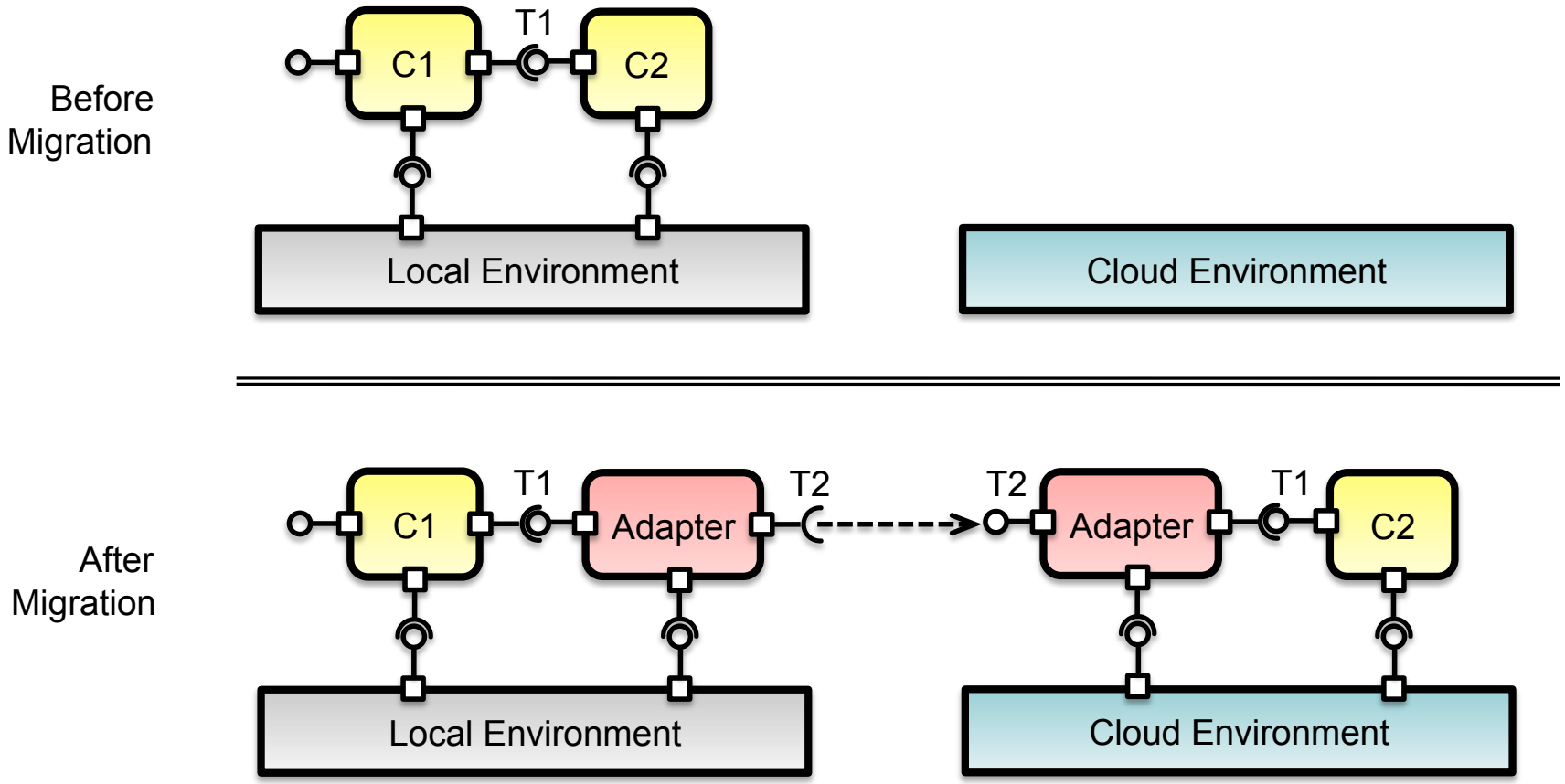
Relocation Mechanisms

- Re-binding



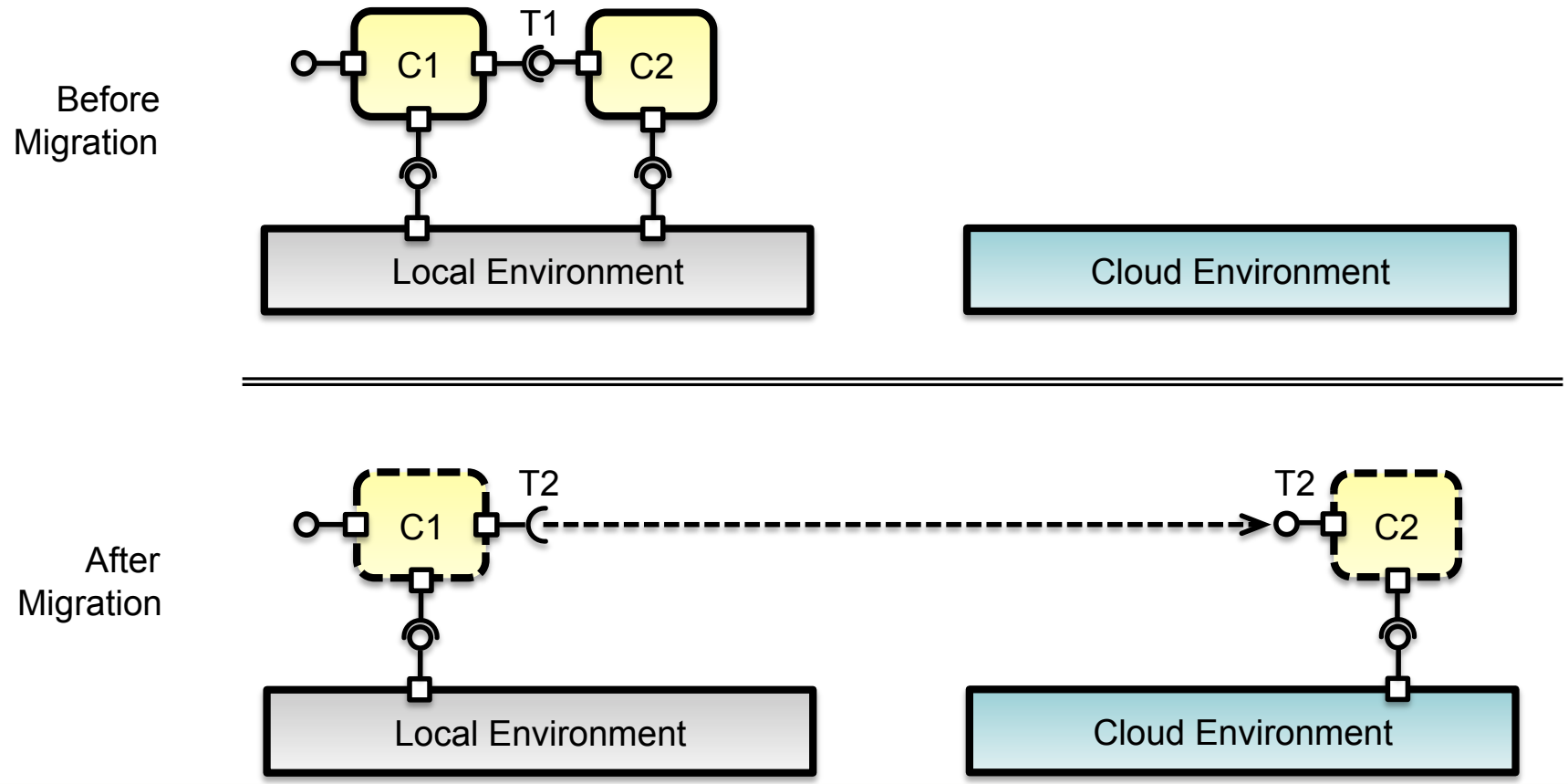
Relocation Mechanisms

- Adaptation



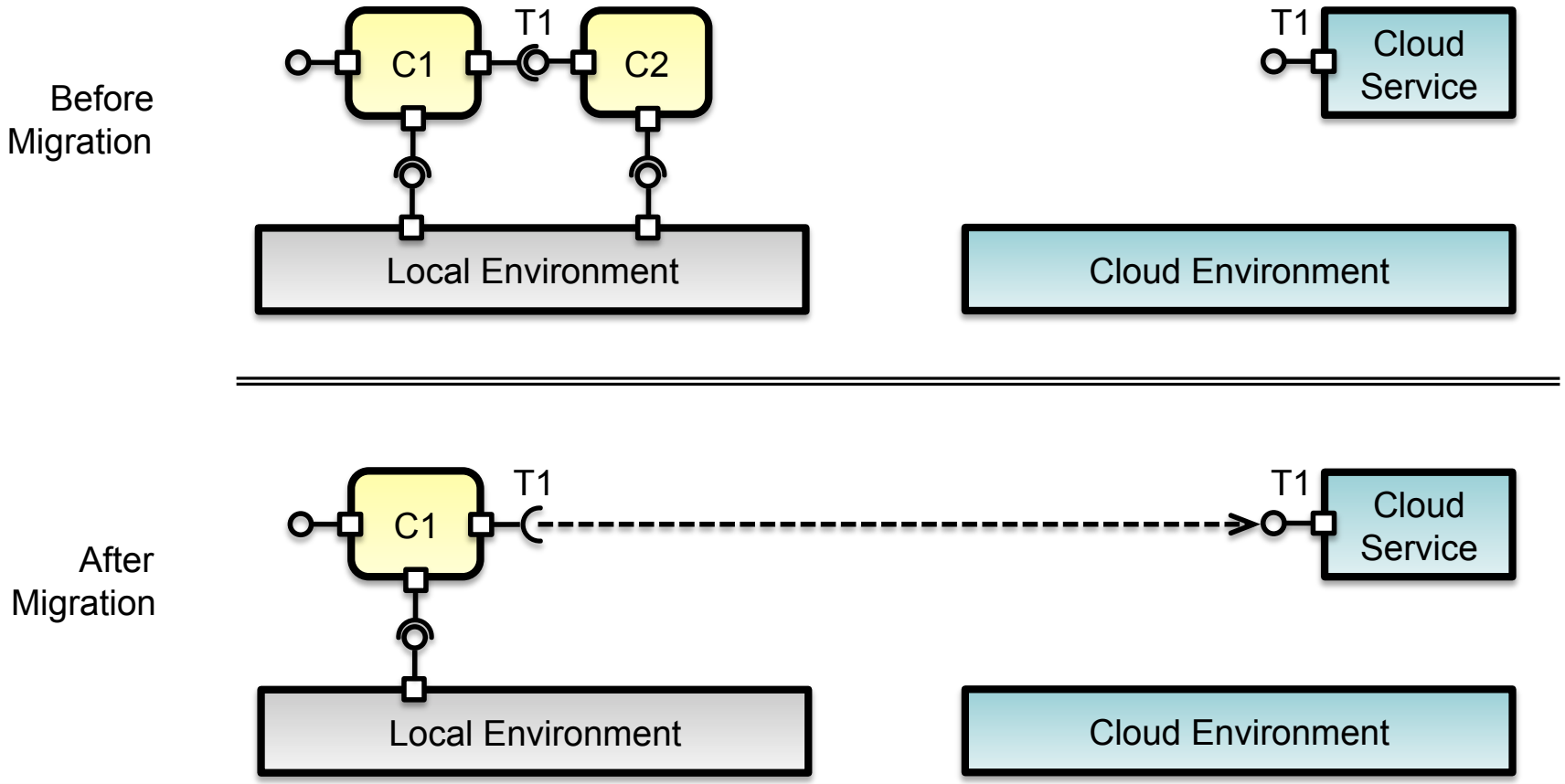
Relocation Mechanisms

- Transformation



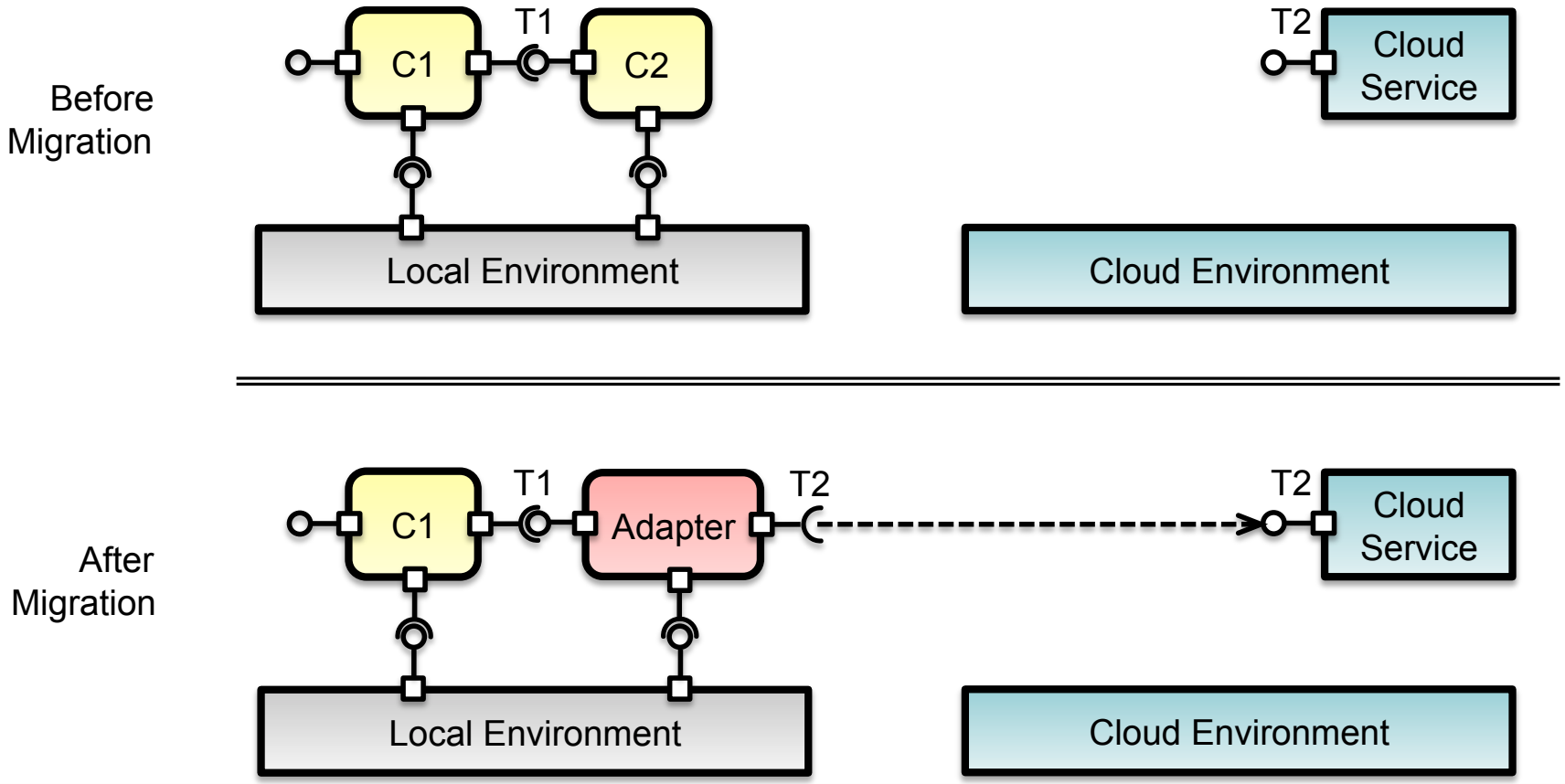
Cloudification Mechanisms

- Replacement



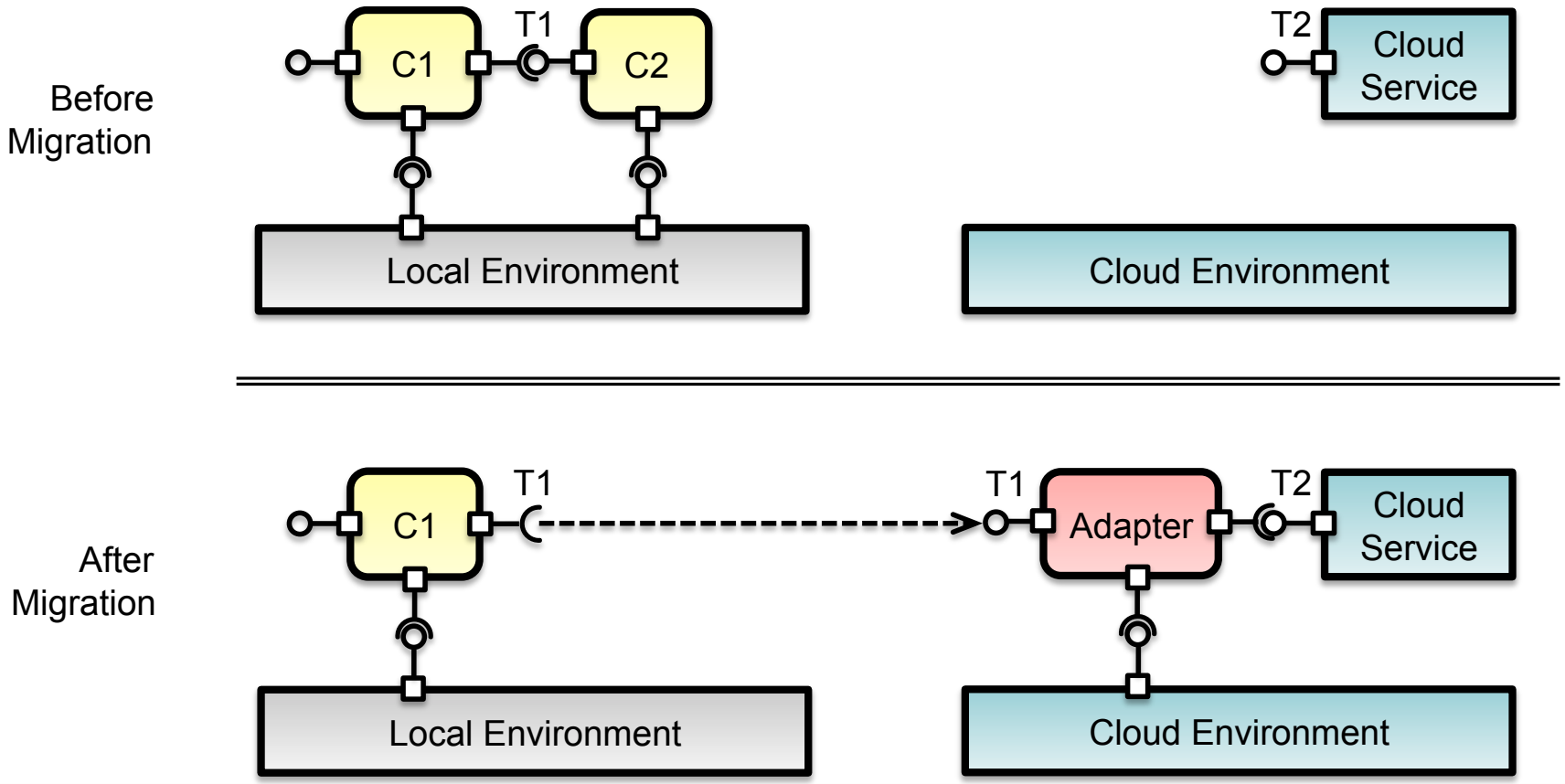
Cloudification Mechanisms

- Adaptation (with local adapter)



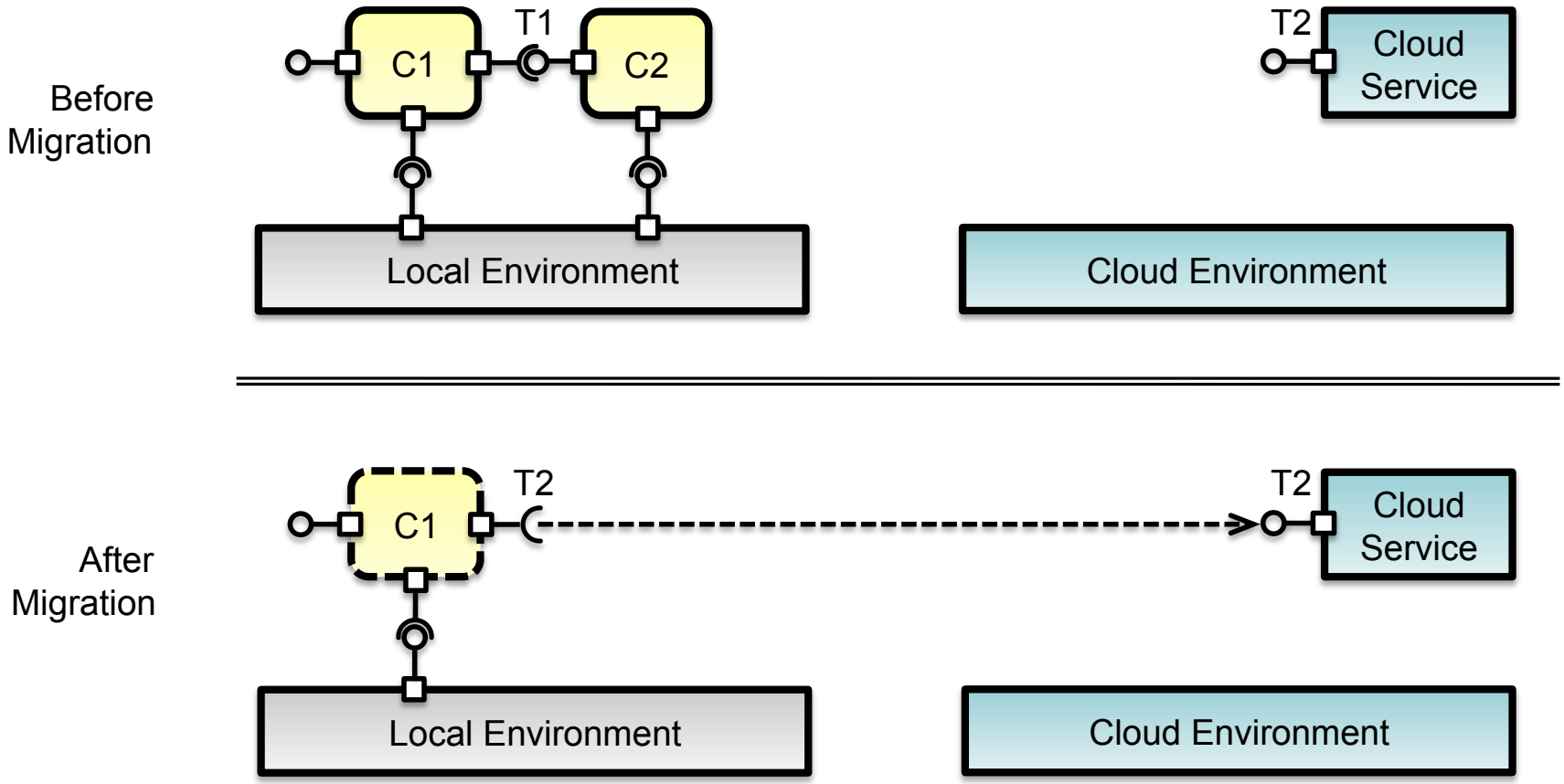
Cloudification Mechanisms

- Adaptation (with cloud adapter)



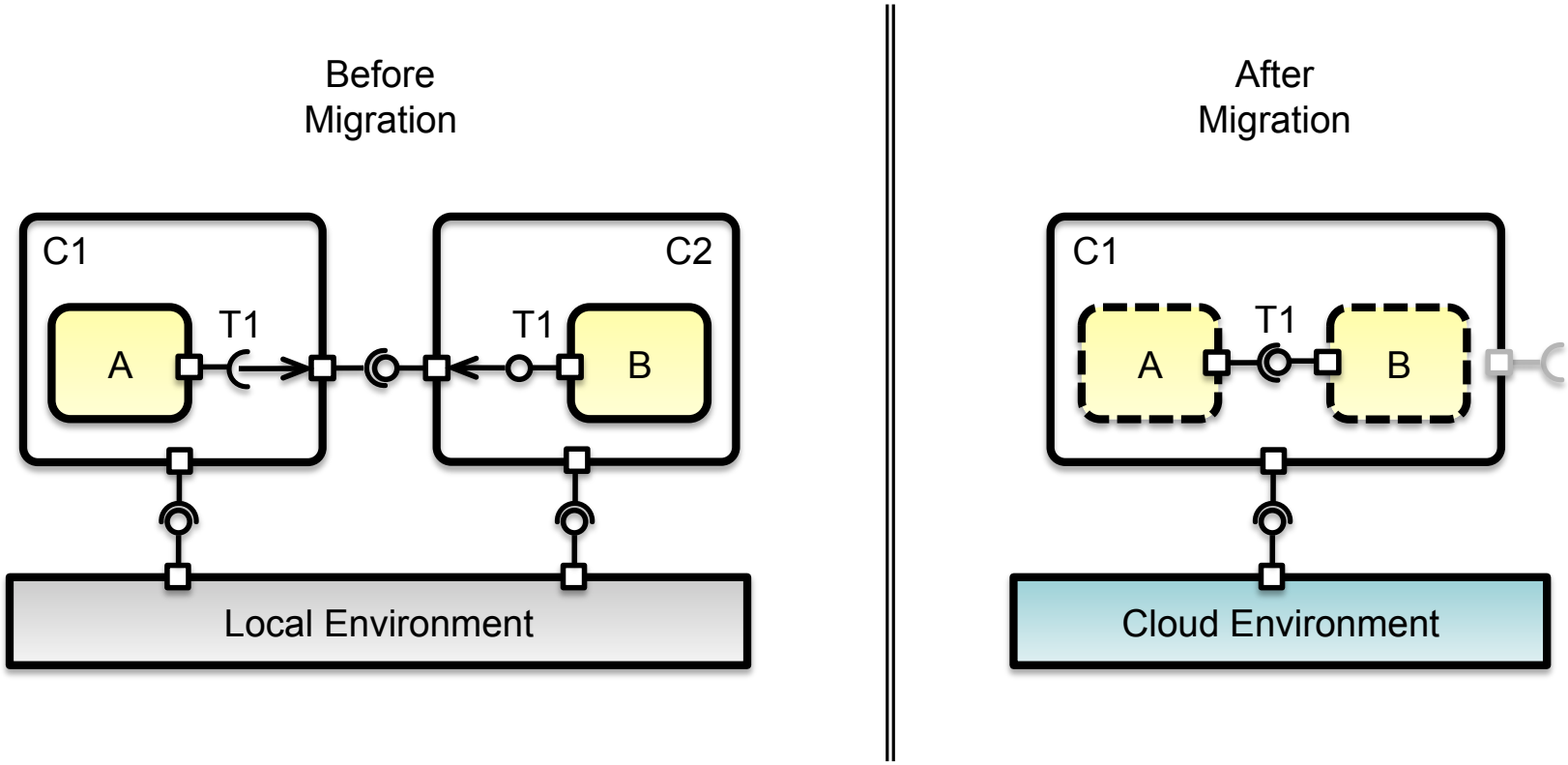
Cloudification Mechanisms

- Transformation



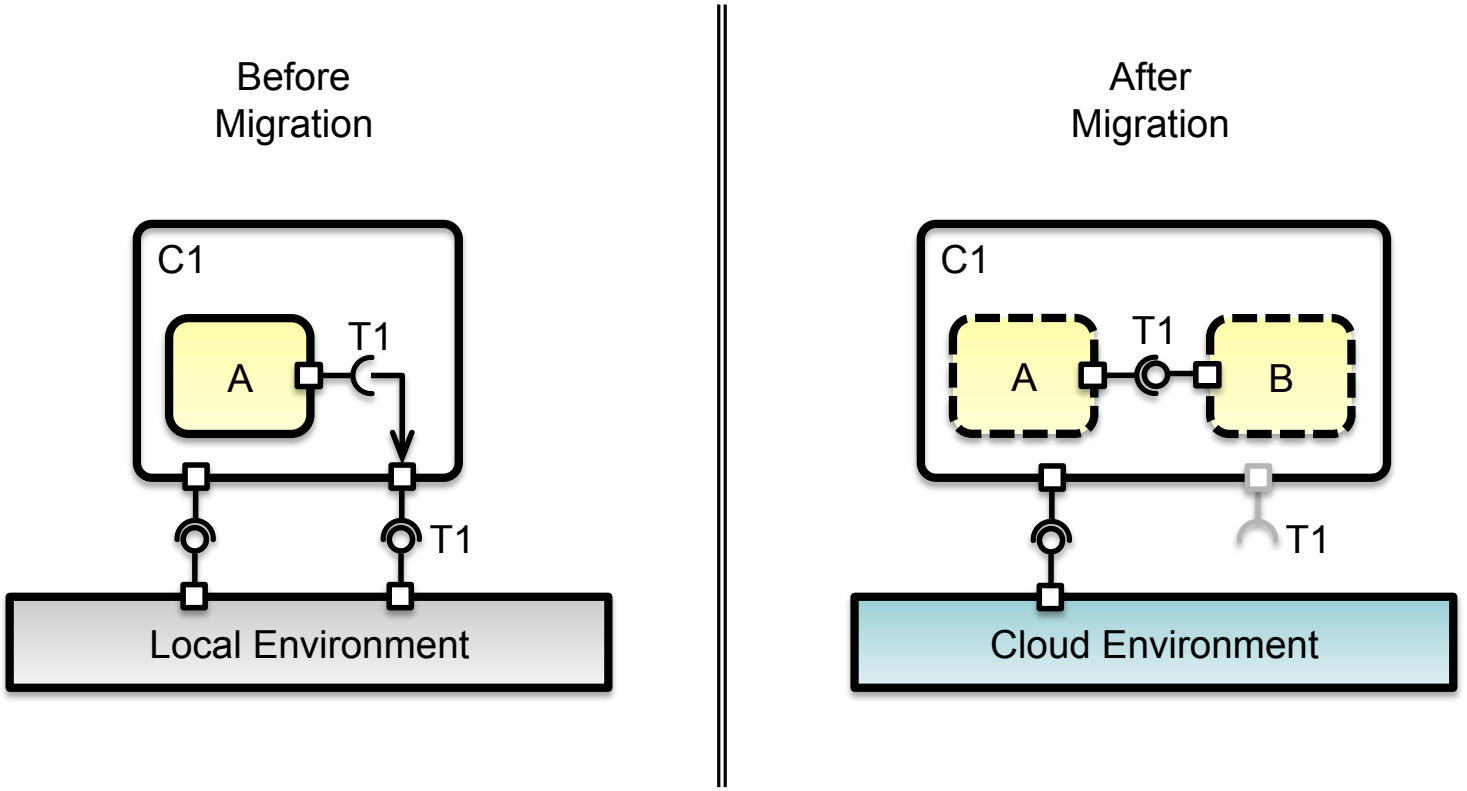
Compensation Mechanisms

- Incorporation (of external service)



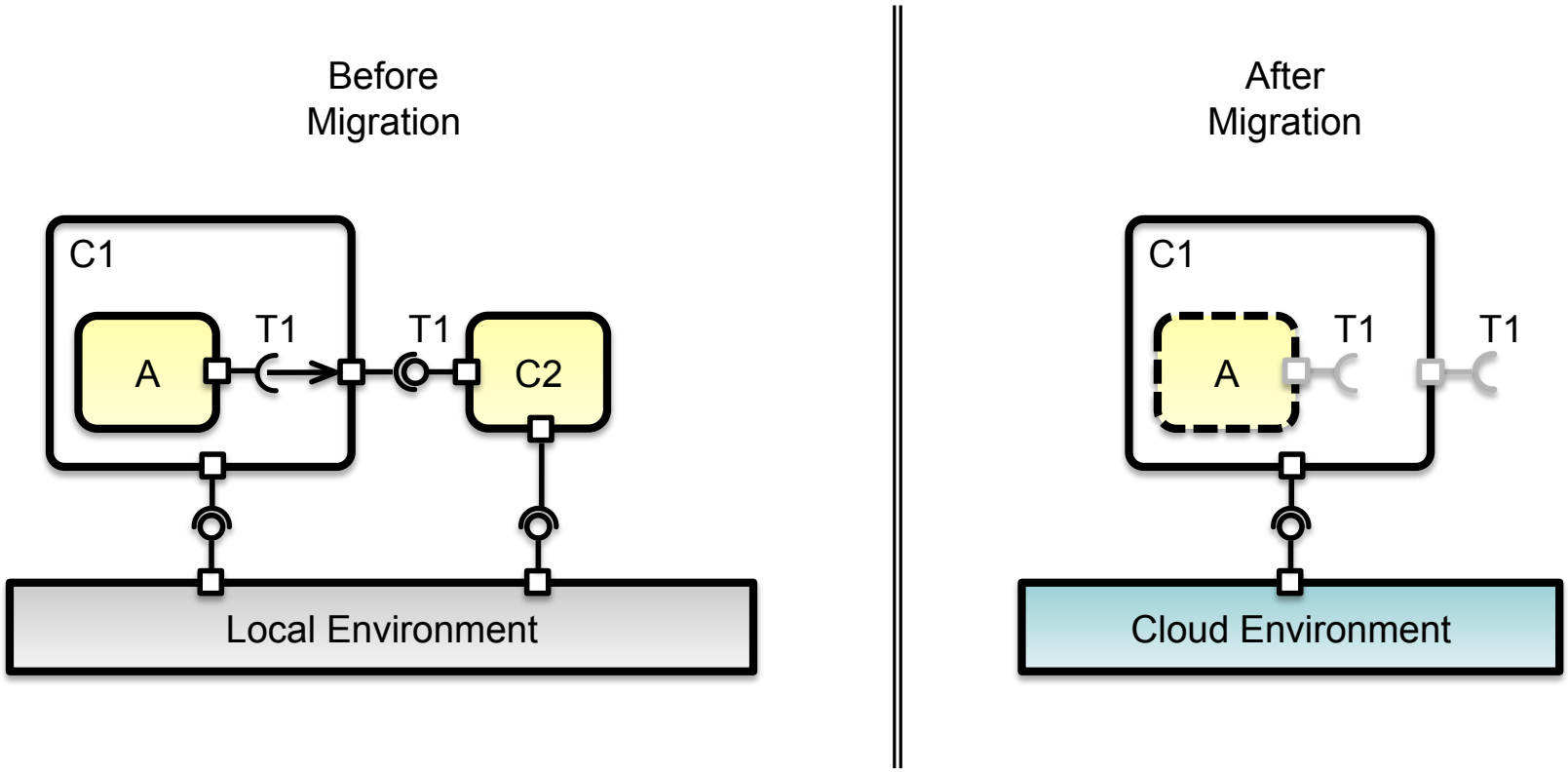
Compensation Mechanisms

- Incorporation (of environment service)



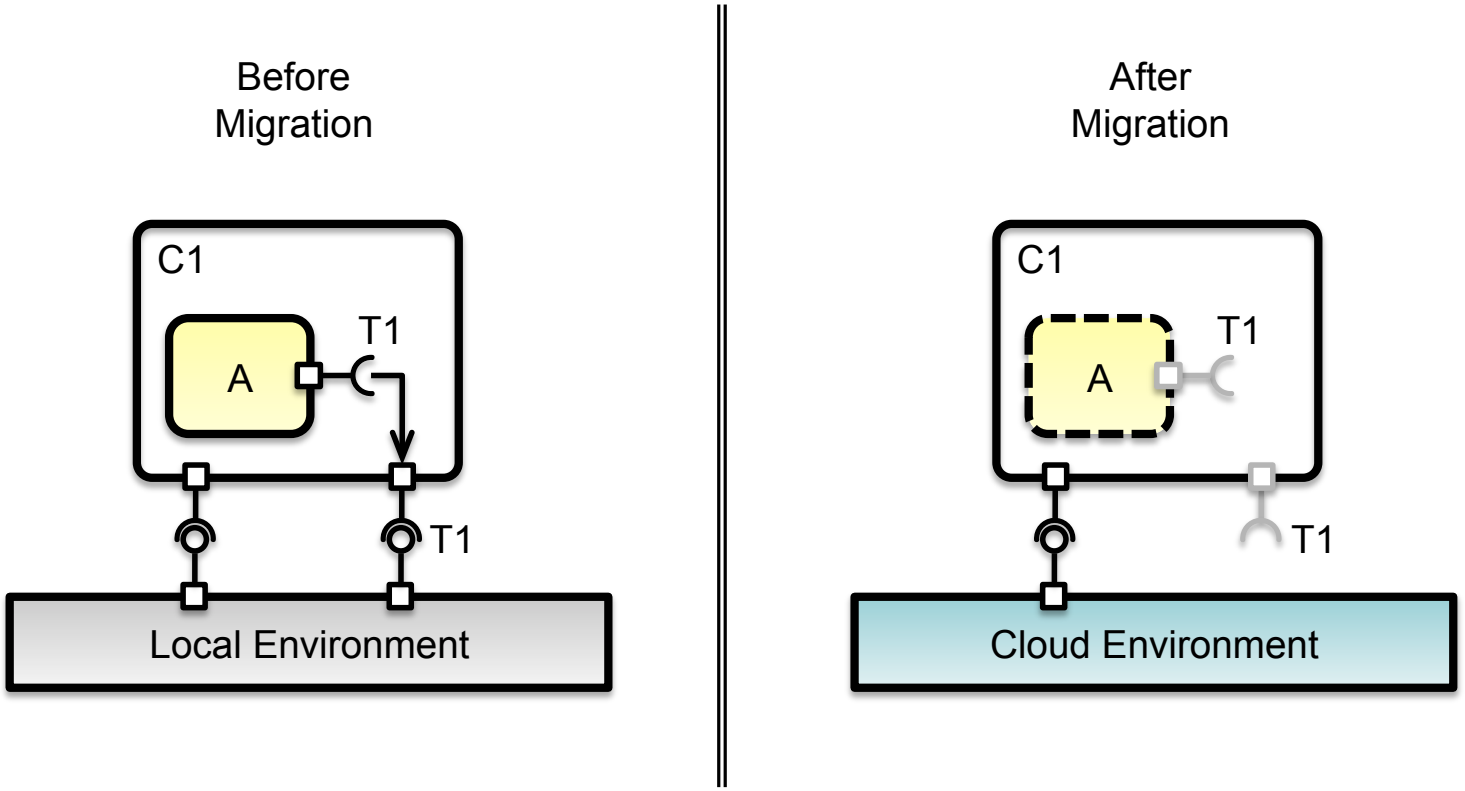
Compensation Mechanisms

- Suppression (of external service)



Compensation Mechanisms

- Suppression (of environment service)



Talk Outline

- Cloud computing (quick) overview
- Cloud migration strategies
- **Concluding remarks**

In Conclusion

- Cloud migration requires a careful examination of the target application's runtime architecture
- Our proposed characterization can support developers in this analysis by highlighting several useful component migration mechanisms as well as their implementation requirements

Ongoing Work

- Implementing some of our proposed cloud migration mechanisms in the form of non-intrusive code transformations (“cloud detours”)
  - Early prototype uses AOP and generic cloud APIs (e.g., jclouds) to automatically transform (“cloudify”) a file-based legacy application to use a cloud-based storage service
- Winner of a SEIF 2013 Ward

Future Work

- Refine the proposed characterization / classification
  - Additional migration scenarios and purposes
  - Additional implementation mechanisms
- Cloud-bound architecture recovery and conformance-checking
- Other suggestions?

What About the ‘Stairway’ from the Title?

“There's a lady who's sure all that glitters is gold
And she's buying a stairway to heaven. ...”

Stairway to Heaven
(Jimmy Page – Robert Plant)
Led Zeppelin, 1971

Source: http://timtirelli.com/

Final Message

Not all that glitters in the cloud is gold.

Understanding your architectural choices and migration alternatives can be a good first step towards building a gentle stairway to (cloud) heaven!

Source: http://www.enterprisecloudtoday.com/

Thank You!

Stairway to Heaven: An Architecture-Level Characterization of Cloud Migration Strategies

Nabor C. Mendonça

Programa de Pós-Graduação em Informática Aplicada (PPGIA)
Universidade de Fortaleza (UNIFOR)
Fortaleza, Ceará, Brazil
nabor@unifor.br, nabor.mendonca@gmail.com
https://sites.google.com/site/nabormendonca/

SEIF Brazil Workshop 2013, November 25-26 | Rio de Janeiro