AmbientTalk: Object-oriented Event-driven programming in Mobile Ad hoc Networks

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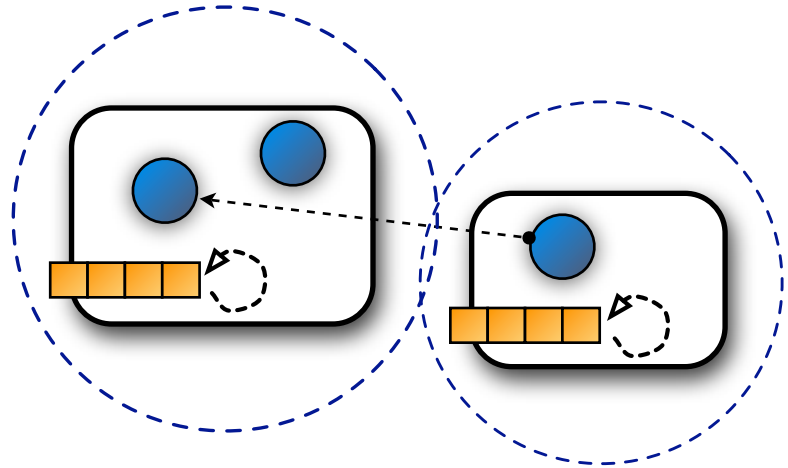
Context

Object-oriented programming languages



Software

Hardware

Pervasive Computing
(Mobile Networks)

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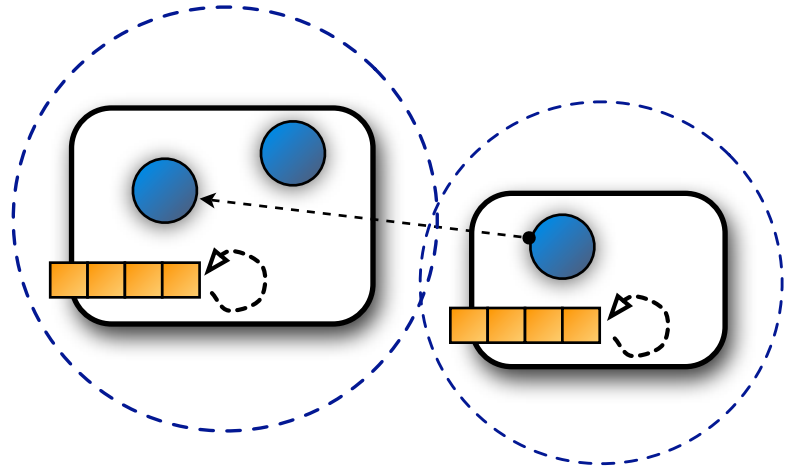

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Mobile Ad hoc Networks

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Loose Coupling

Decoupling communication in *Time* & *Synchronisation*

reduces impact of volatile connections

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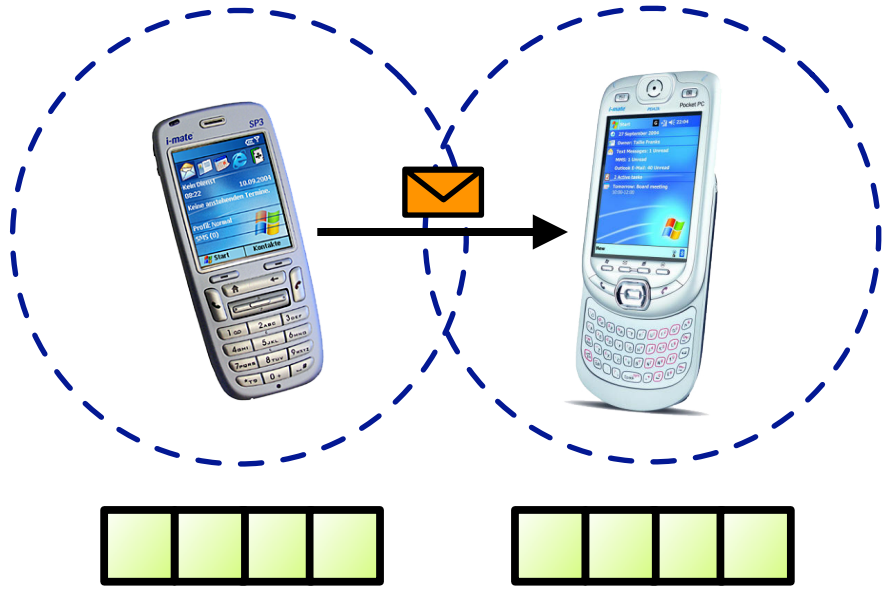

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asynchronous send

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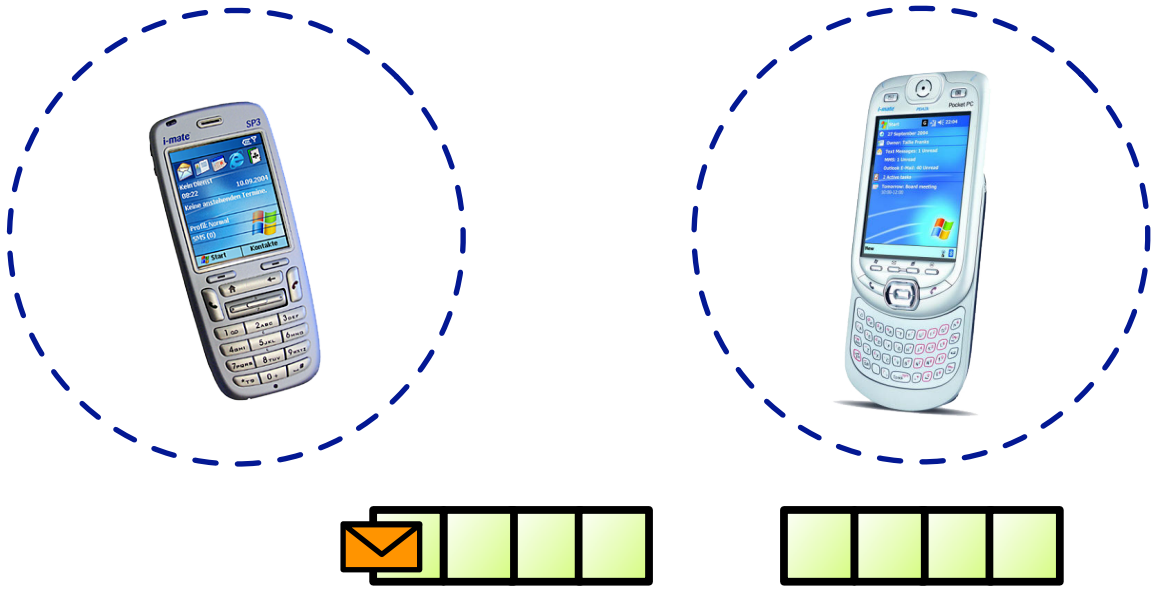

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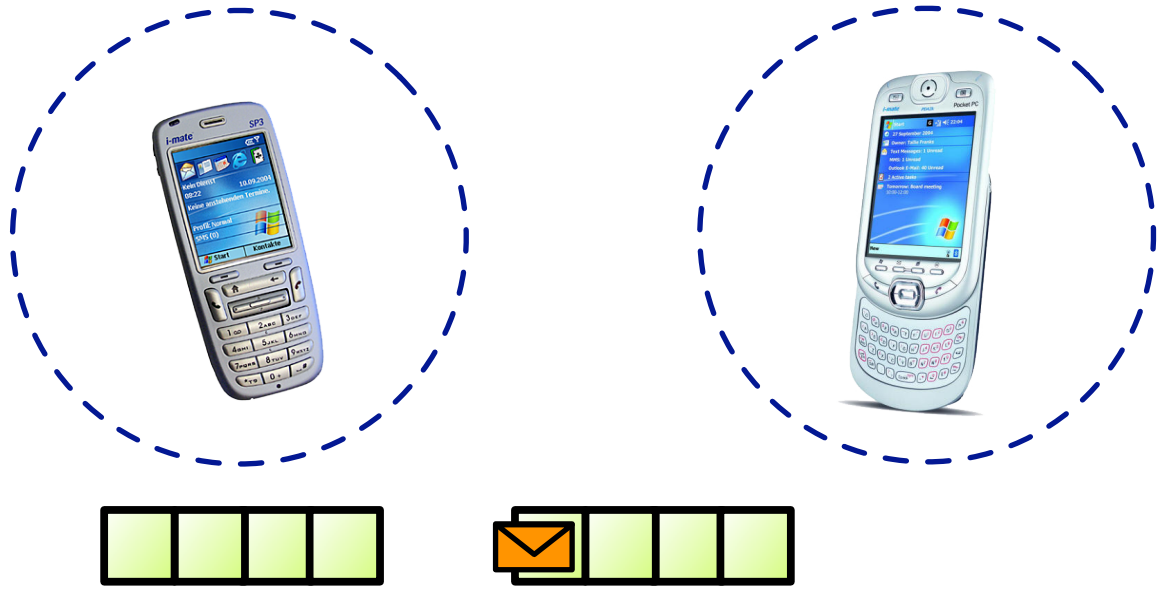

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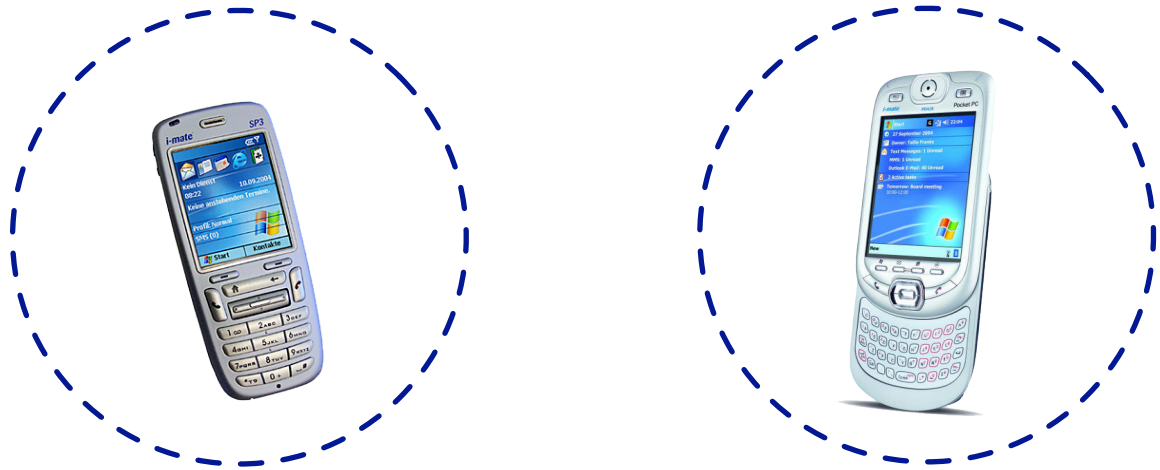

asynchronous receive

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provide service

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provide service require service

Ubiquitous Flea Market

Example: buy/sell concert tickets to proximate peers

demand

offer

Ubiquitous Flea Market

Example: buy/sell concert tickets to proximate peers

AmbientTalk: the language

- Distributed object-oriented language
- Event-driven concurrency based on actors [Agha86]
- Future-type asynchronous message sends
- Built-in publish/subscribe engine for service discovery of remote objects

AmbientTalk: the project

- Started in 2005
- Small team: 3-6 people
- Interpreter
- Pure Java implementation
- Runs on J2ME/CDC phones

Objects

```
def Item := object: {
  def category;
  def description;
  def ownerContactInfo;
  def init(c,d,o) {
    category := c;
    description := d;
    ownerContactInfo := o;
  }
  def getContactInfo() {
    ownerContactInfo
  }
  def placeSupply() {...}
  def placeDemand() {...}
}
```

- Prototype-based
- Objects are created:
  - anonymously
  - by cloning others

```
def ticket := Item.new(ConcertTicket,"...","...");
ticket.placeDemand();
```

Extensible language

```
def fac(n) {
  (n = 0).ifTrue: {
    1
  } ifFalse: {
    n * fac(n-1)
  }
}
```

- Block closures
- Keyworded messages
- Interfacing with JVM

Extensible language

```
def fac(n) {
  (n = 0).ifTrue: {
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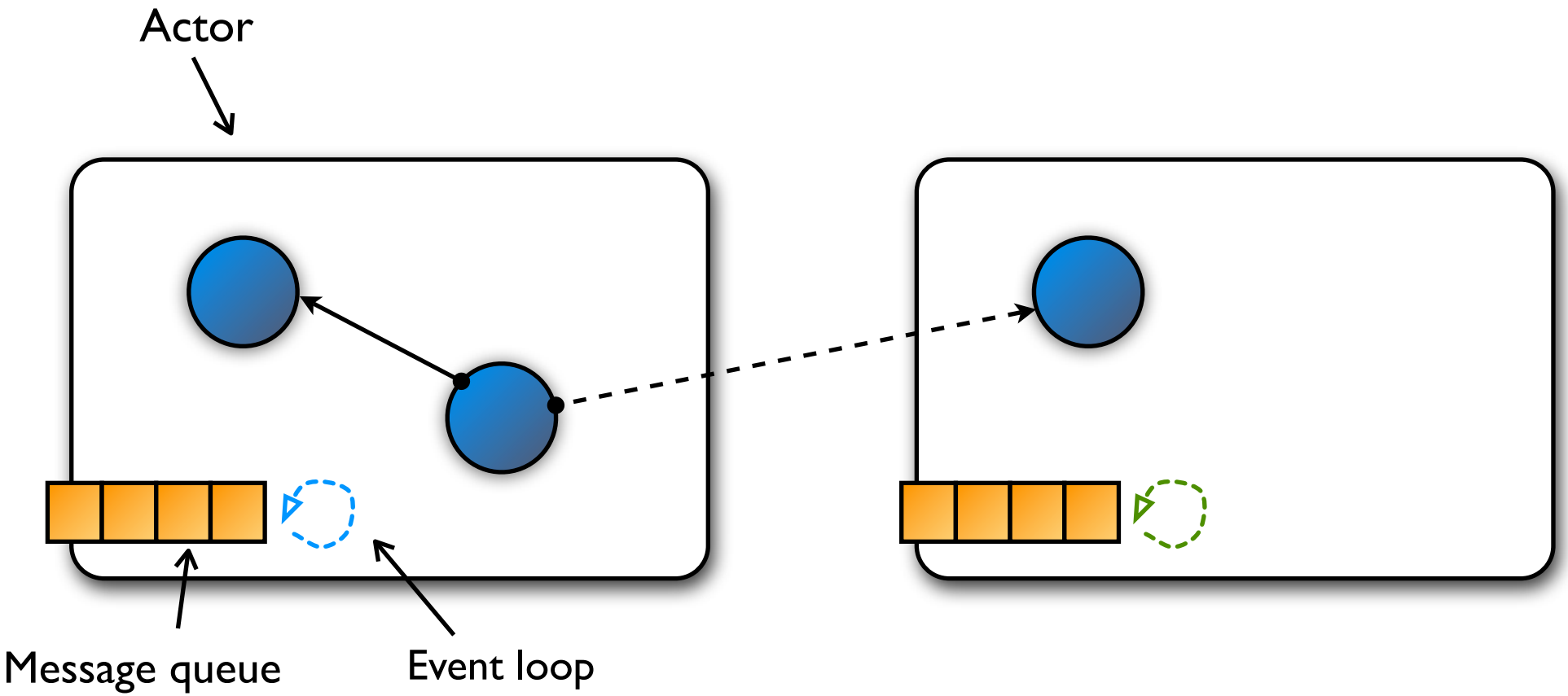
  } ifFalse: {
    n * fac(n-1)
  }
}
```

- Block closures
- Keyworded messages
- Interfacing with JVM

```
def Button := jlobby.java.awt.Button;
def b := Button.new("test");
b.addActionListener(object: {
  def actionPerformed(ae) {
    println("button pressed");
  }
});
```

Event loop concurrency

Based on E programming language [Miller05]



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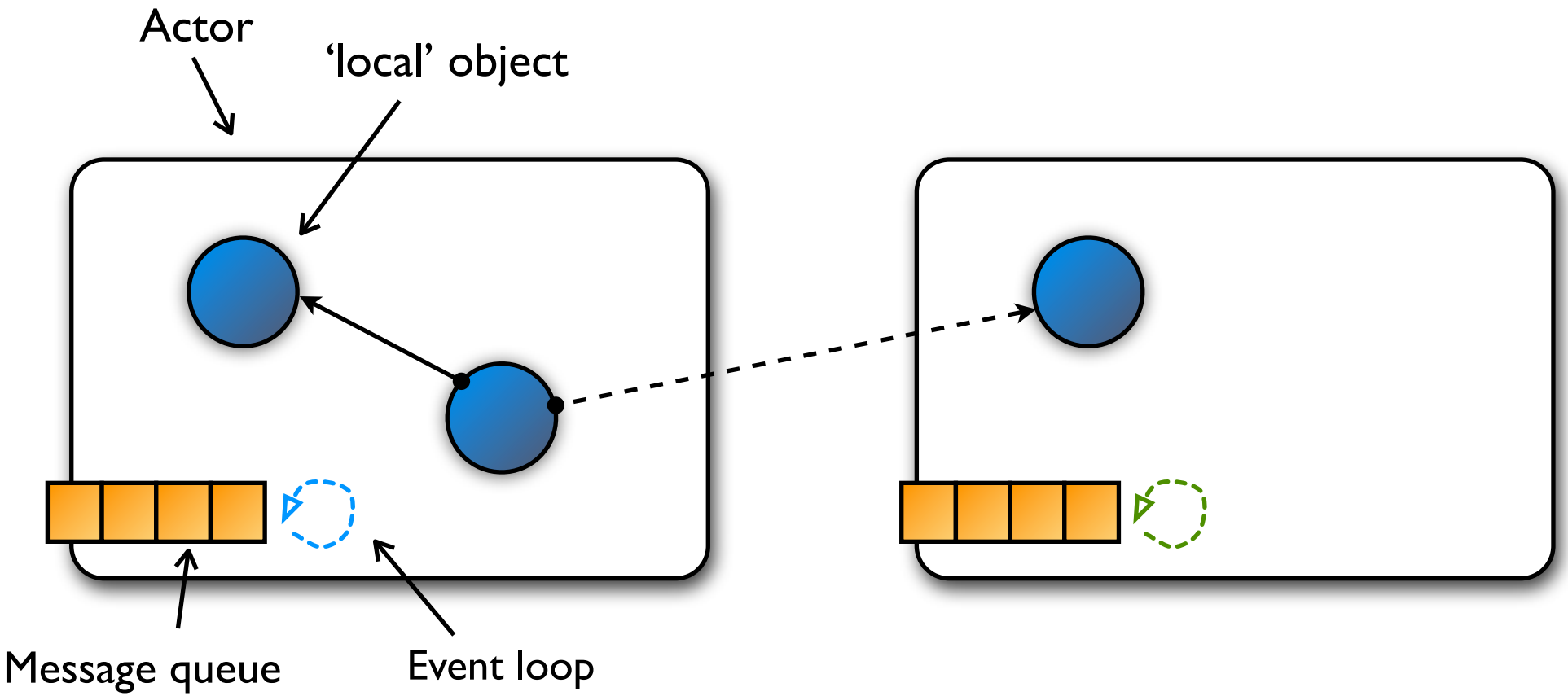

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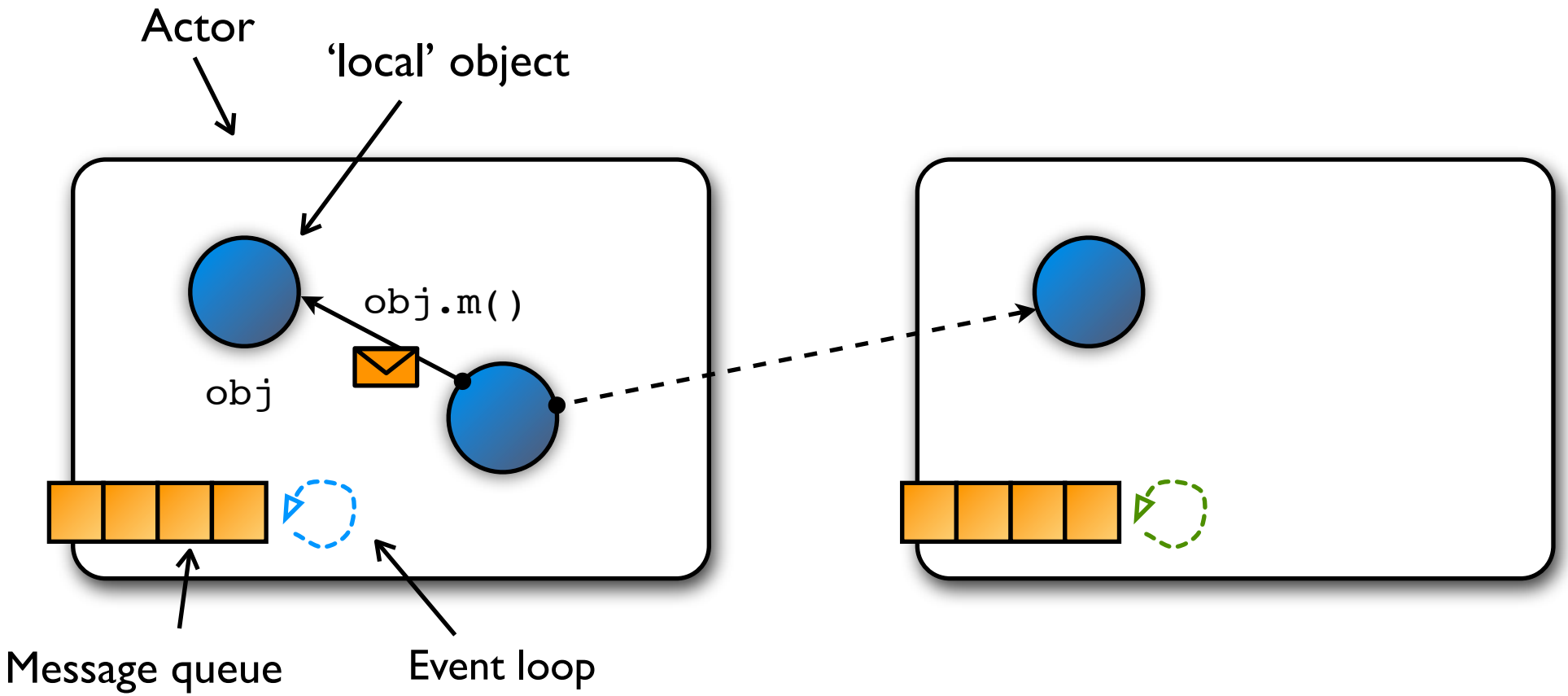

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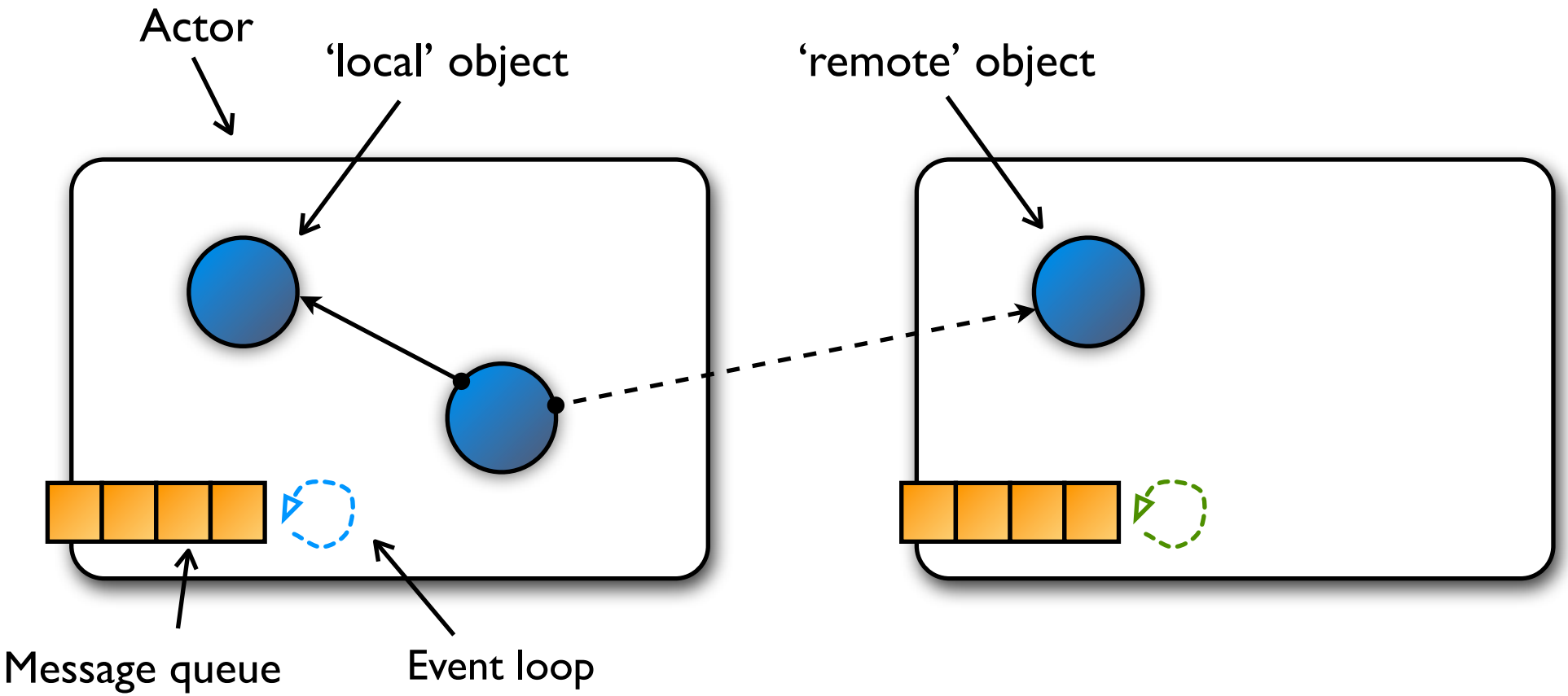

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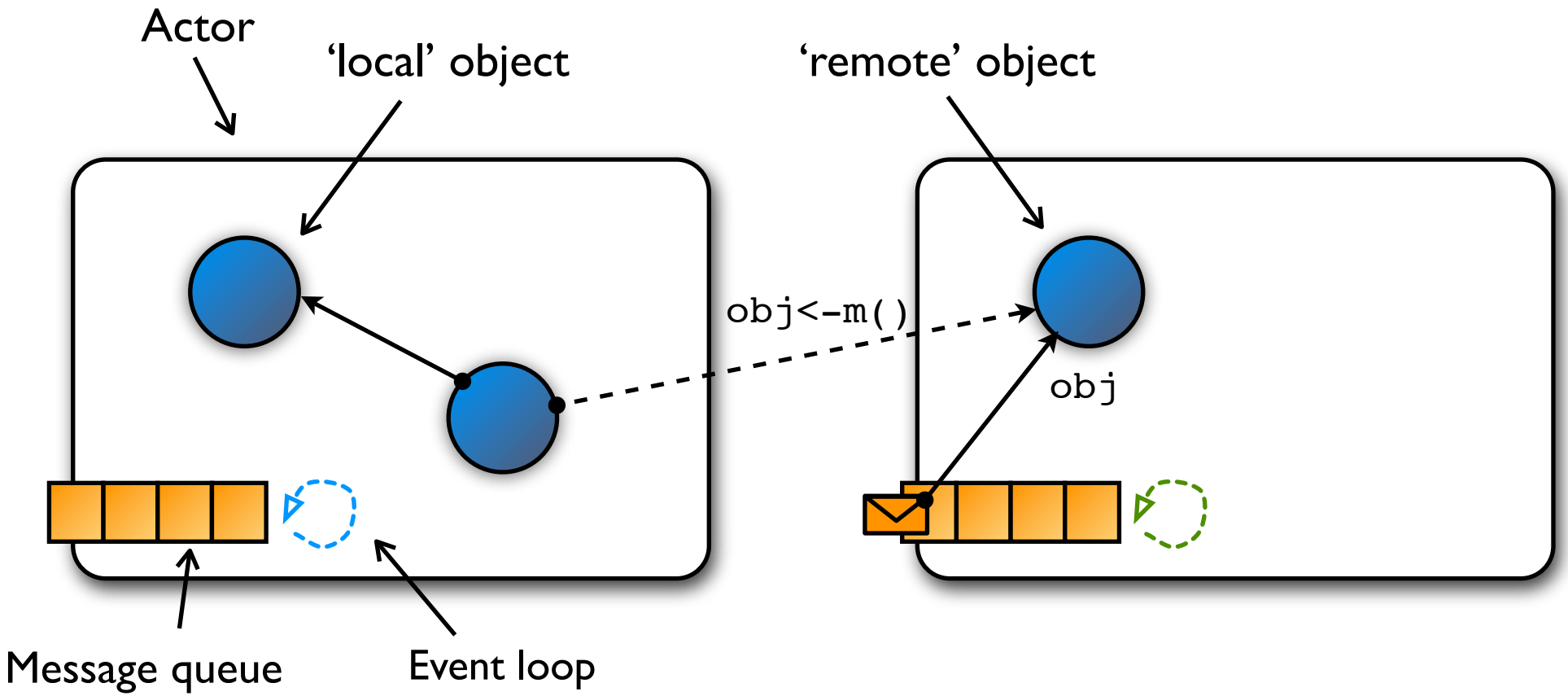

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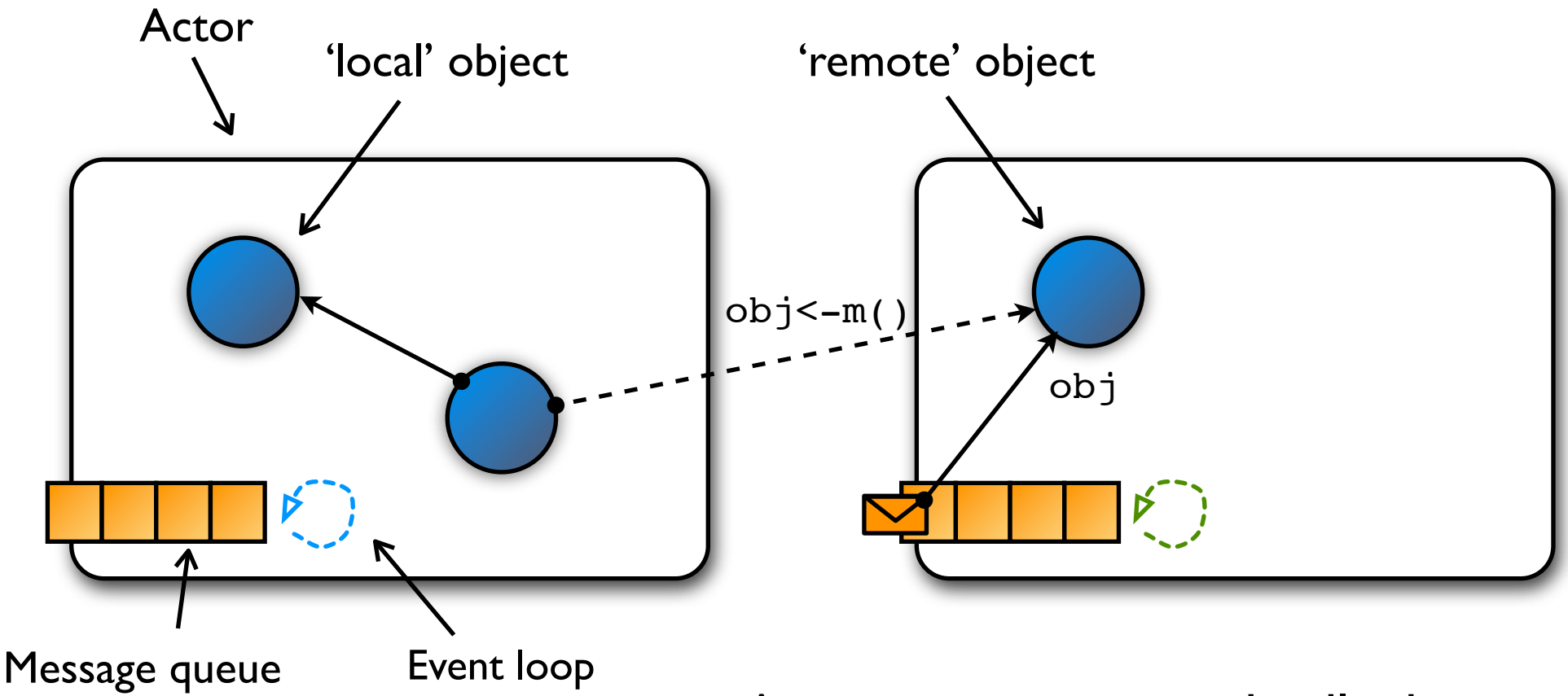
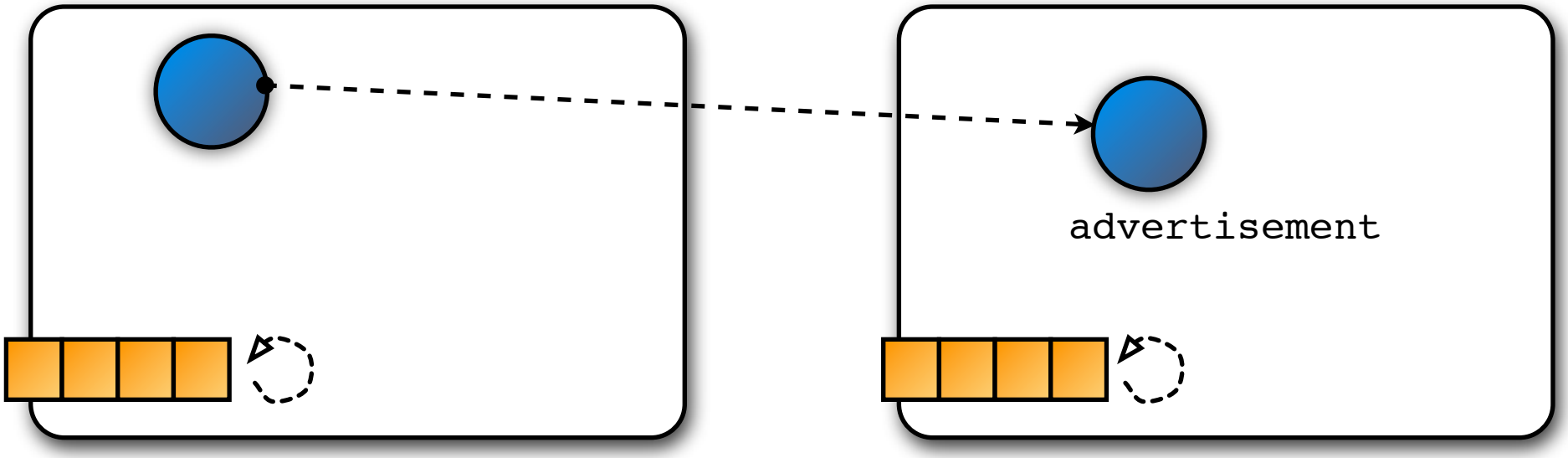


Actors cannot cause deadlock

No race conditions on objects

Futures

```
def future := advertisement<-getContactInfo()
```



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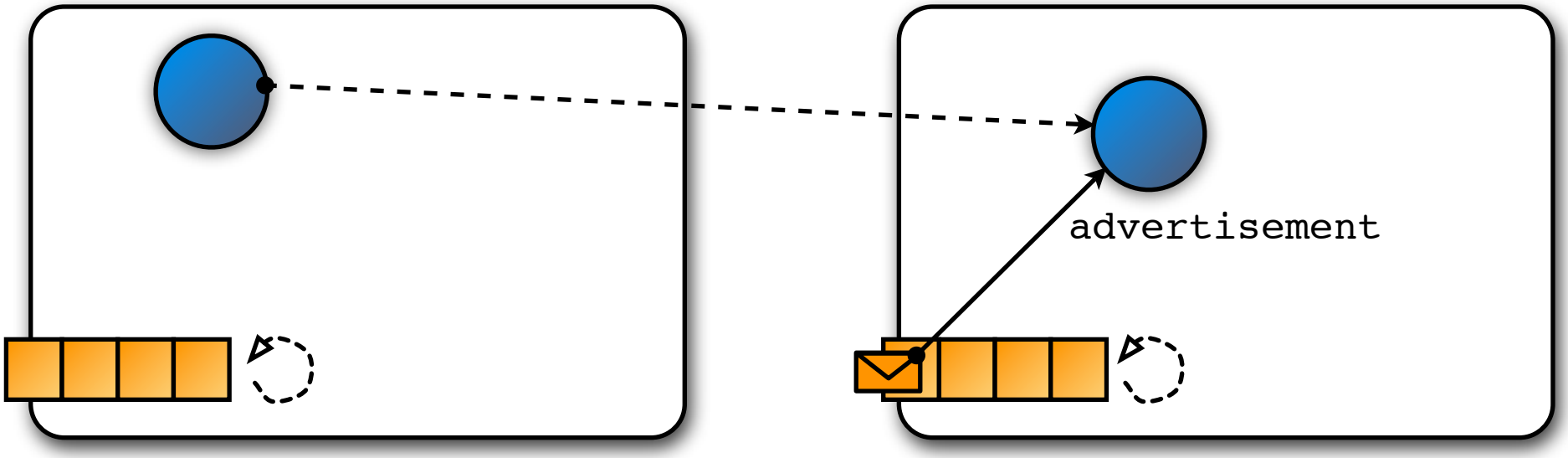

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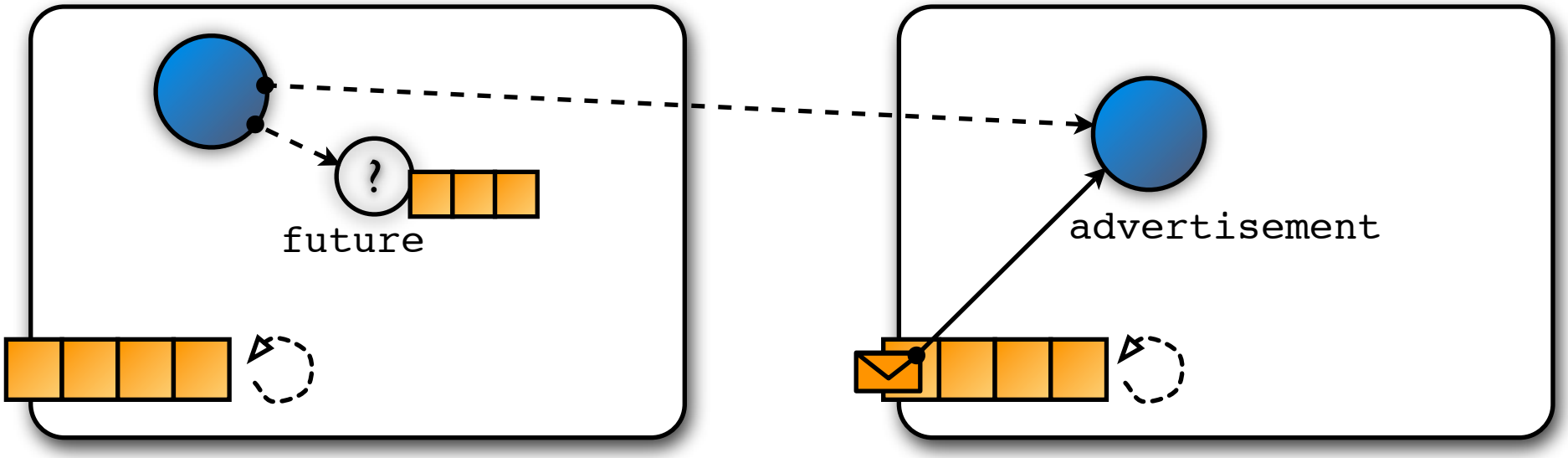

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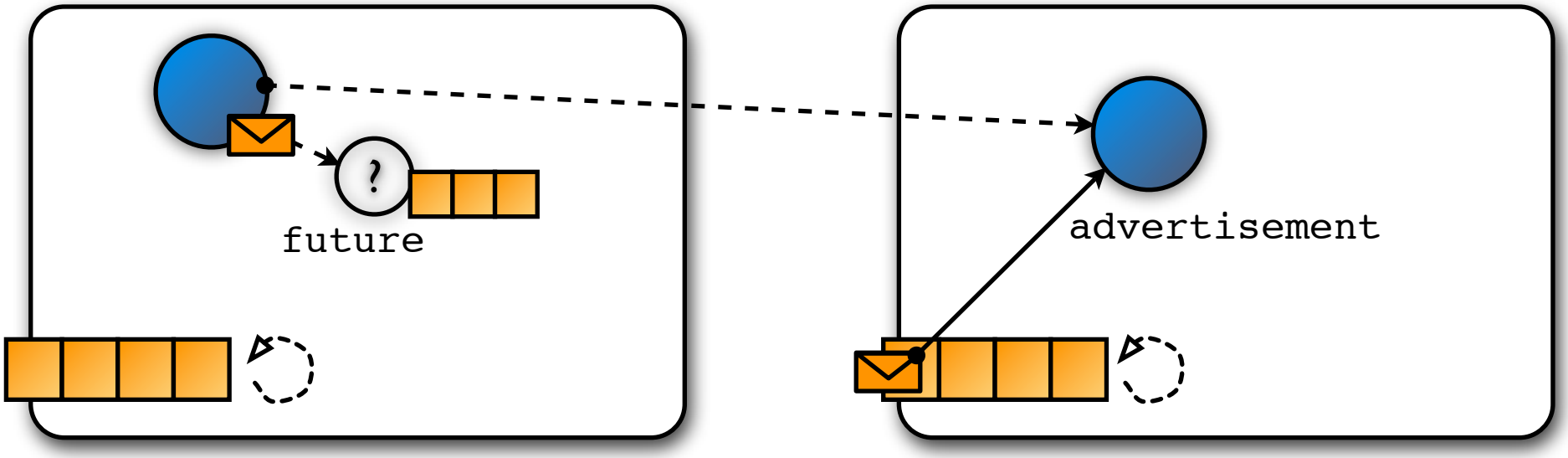

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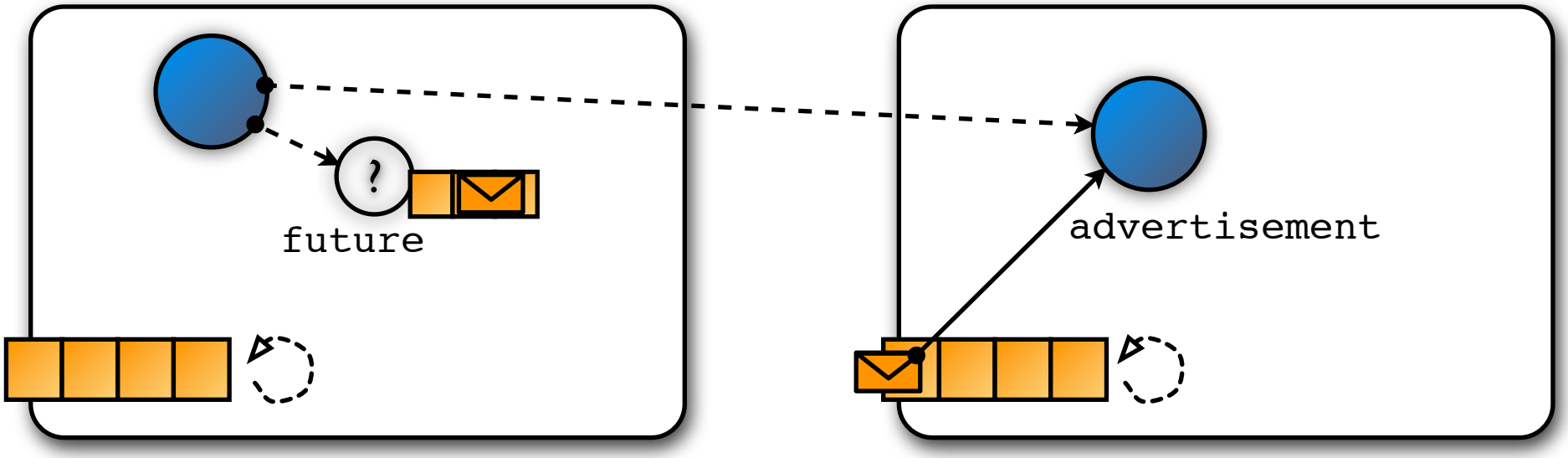

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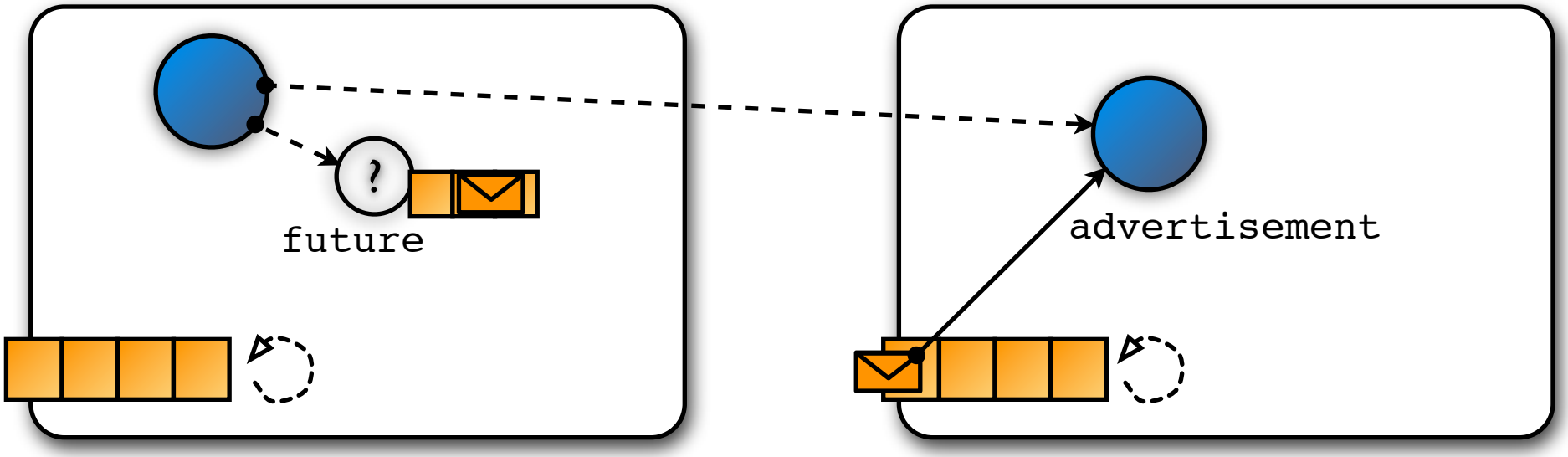


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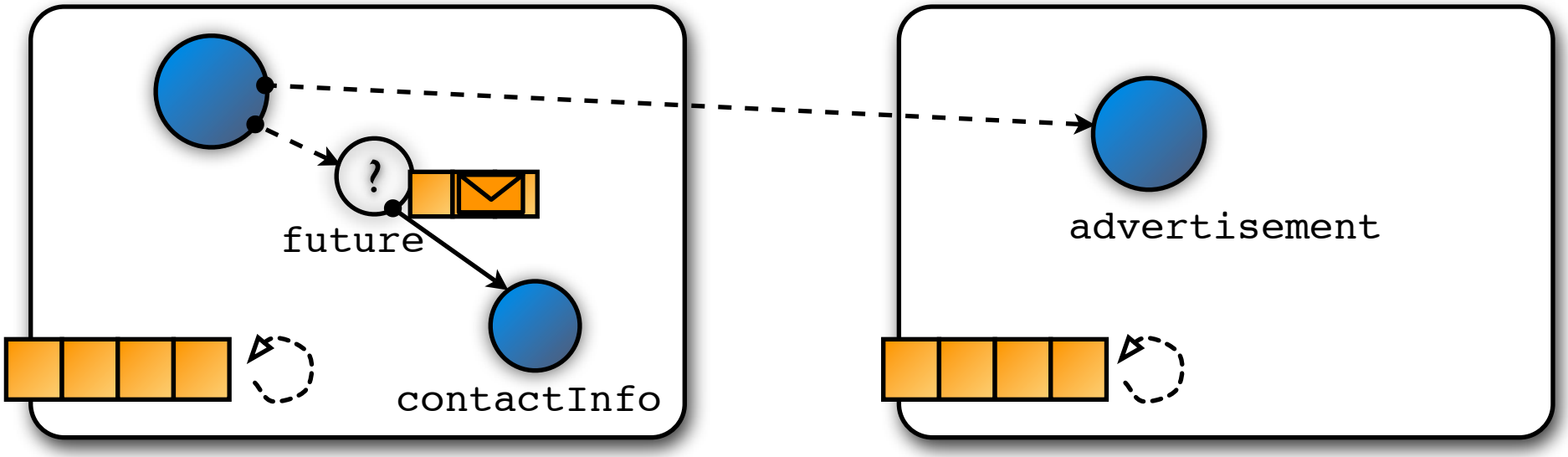


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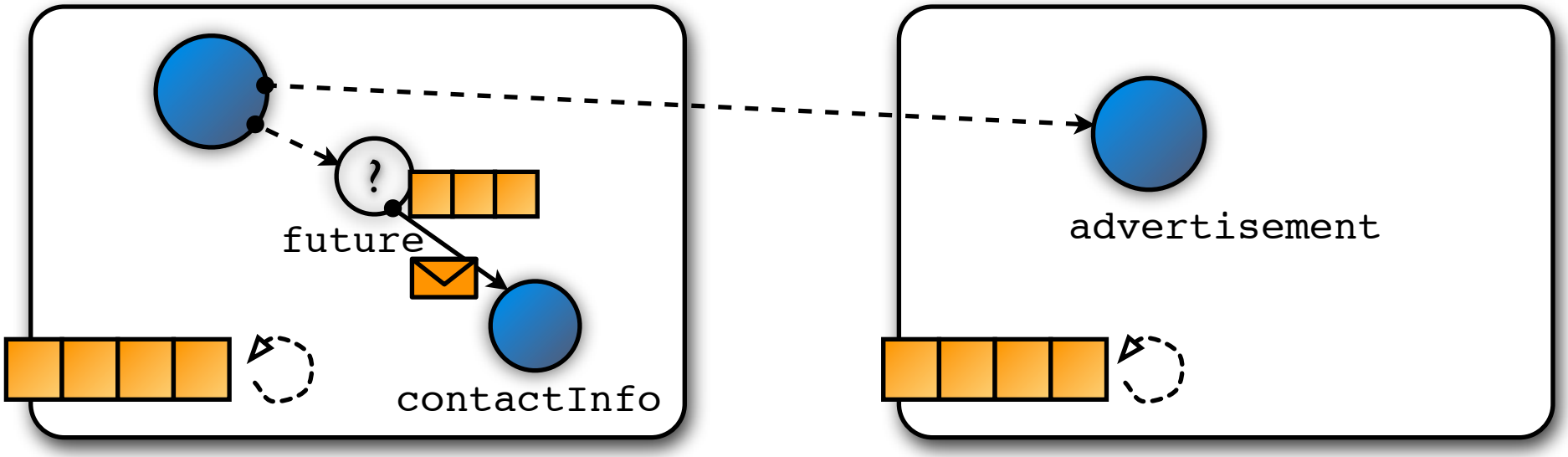


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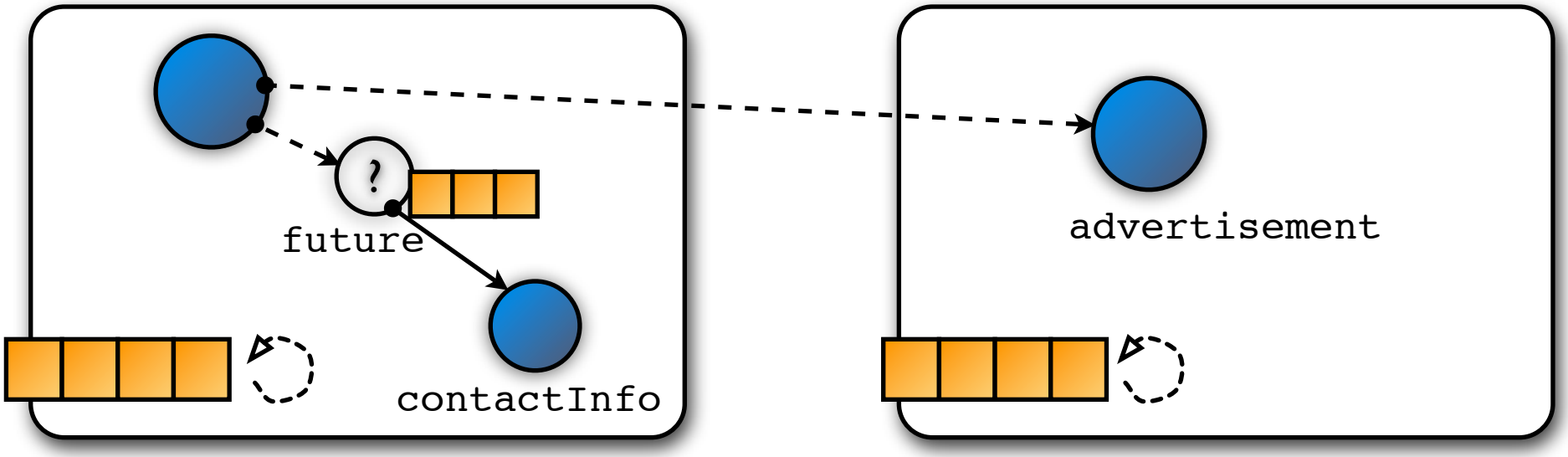


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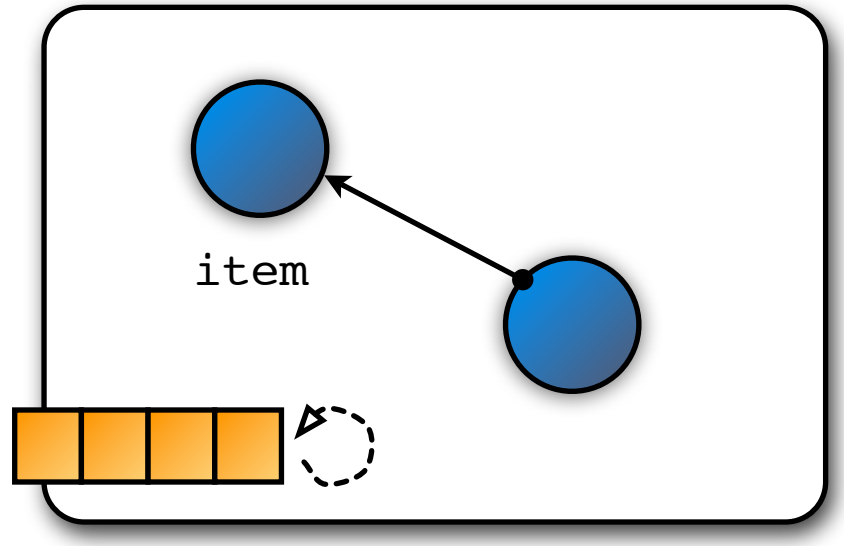
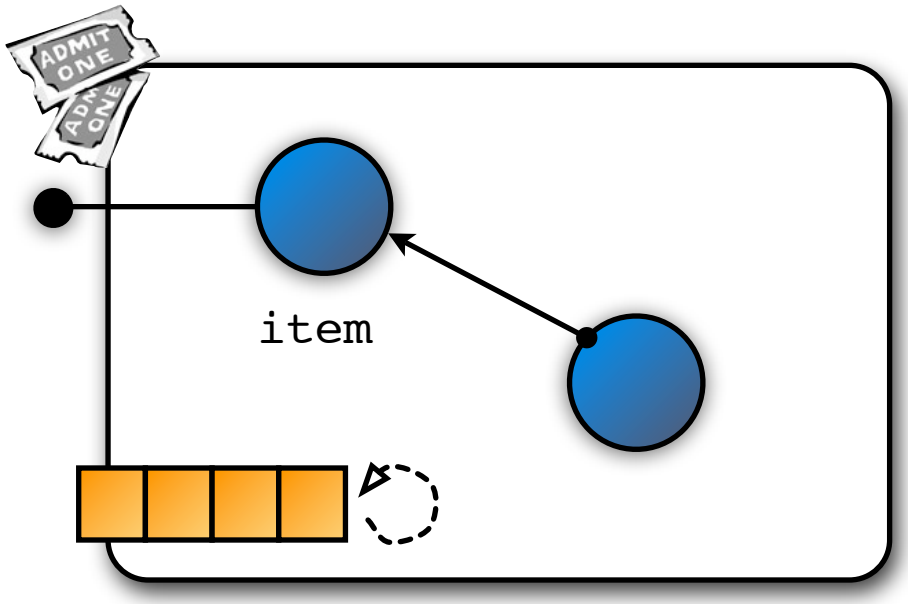
Exporting objects



Exporting objects

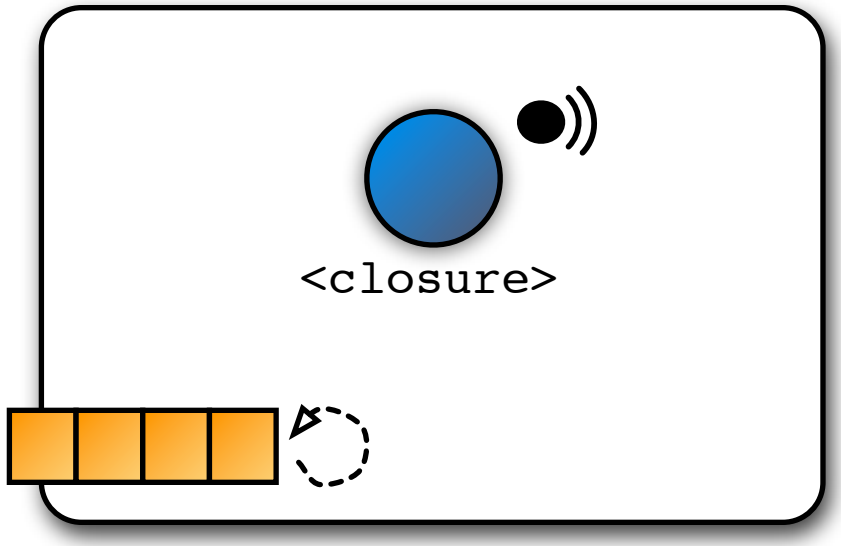
```
deftype ConcertTicket;

def Item := object: {
  def category; // a type tag
  ...
  def placeSupply() {
    export: item as: category;
  }
}
```



Service Discovery

```
def placeDemand() {
  whenever: category discovered: {|item|
    ...
  }
}
```



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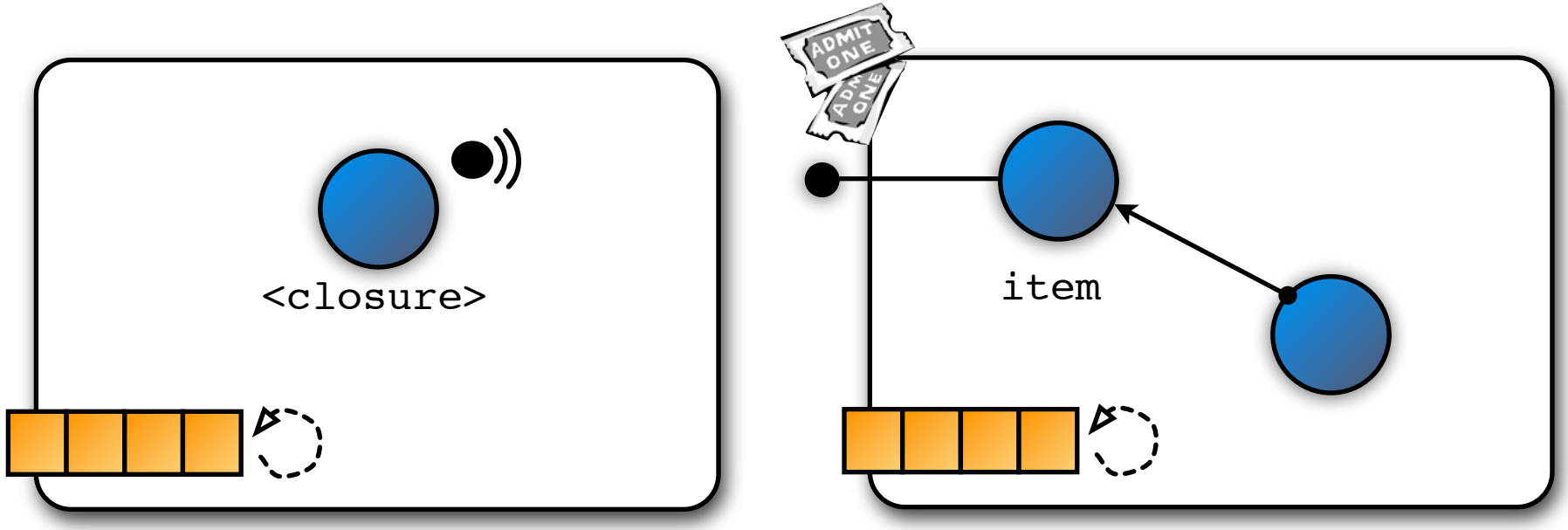

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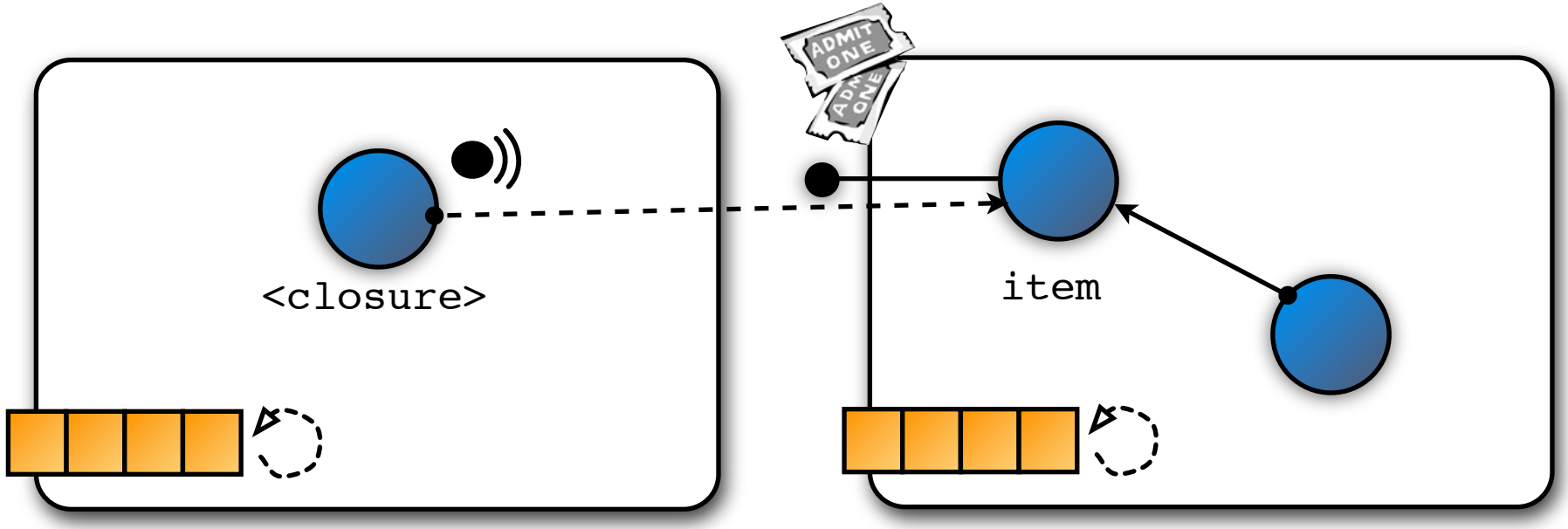

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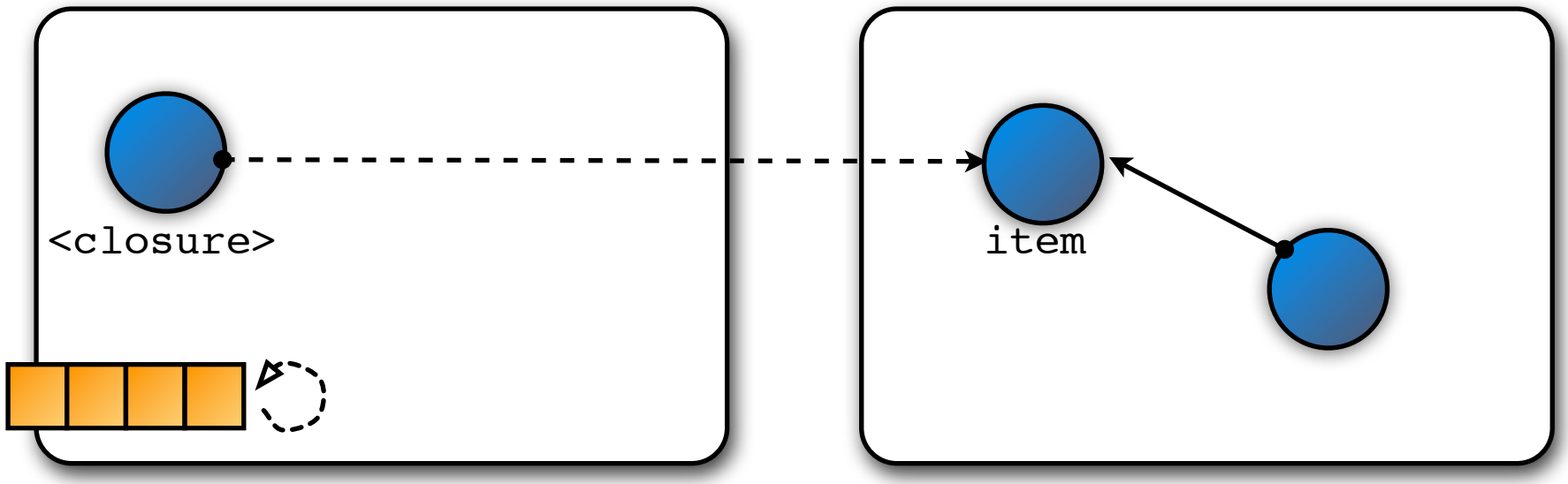

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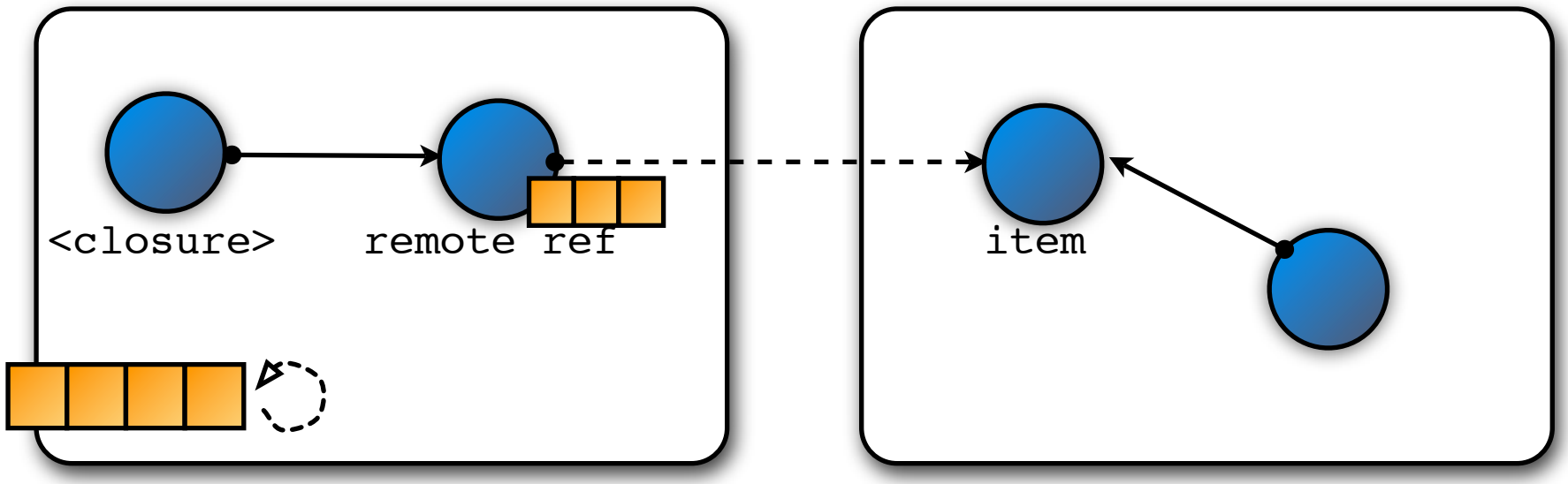

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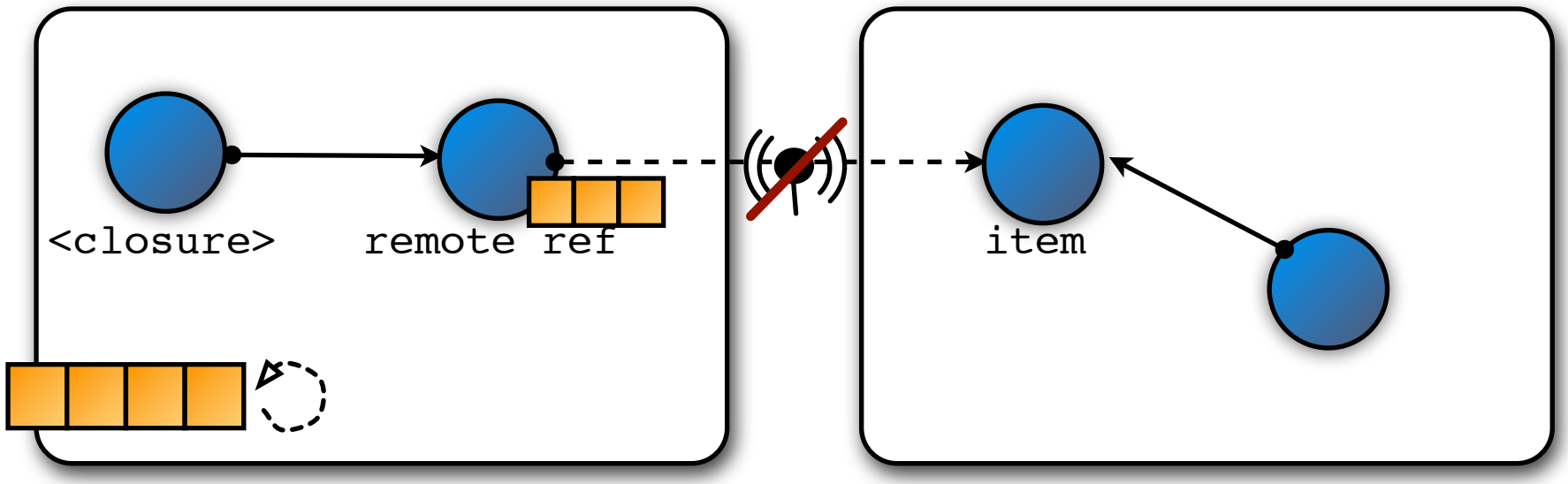

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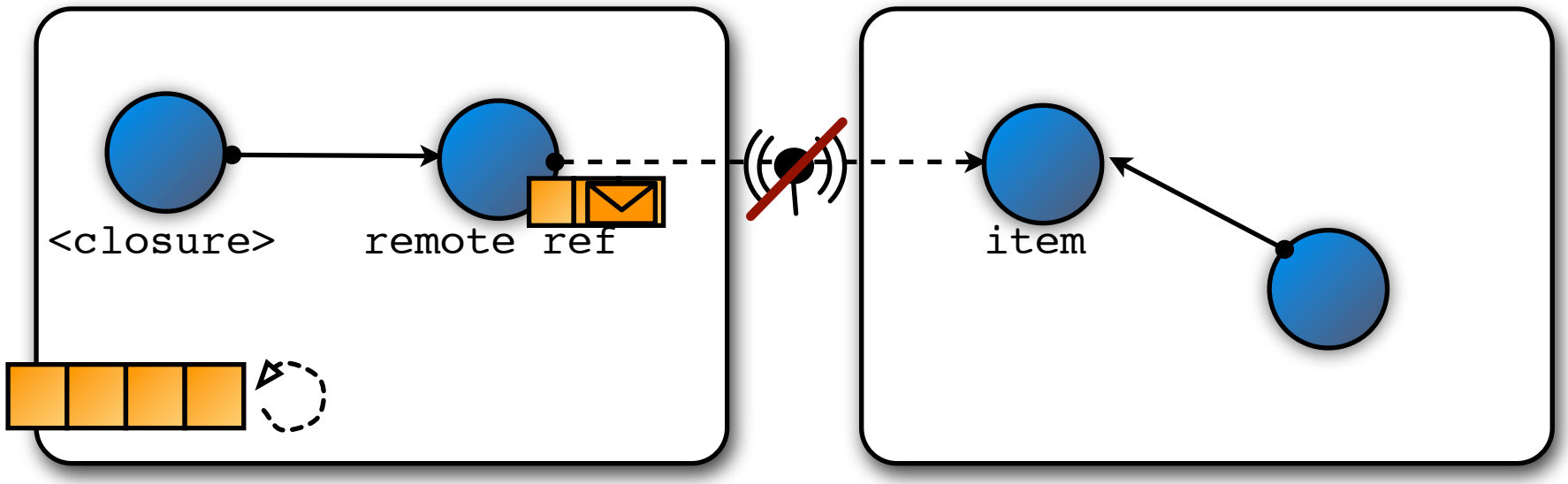

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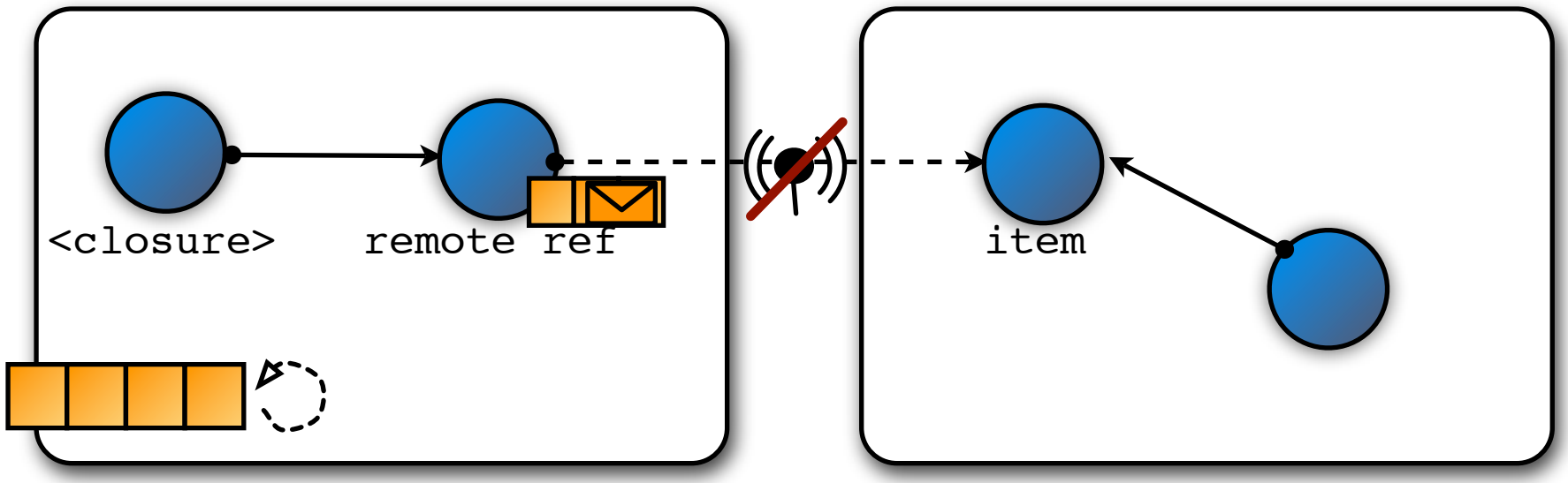


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  println("Item available again")
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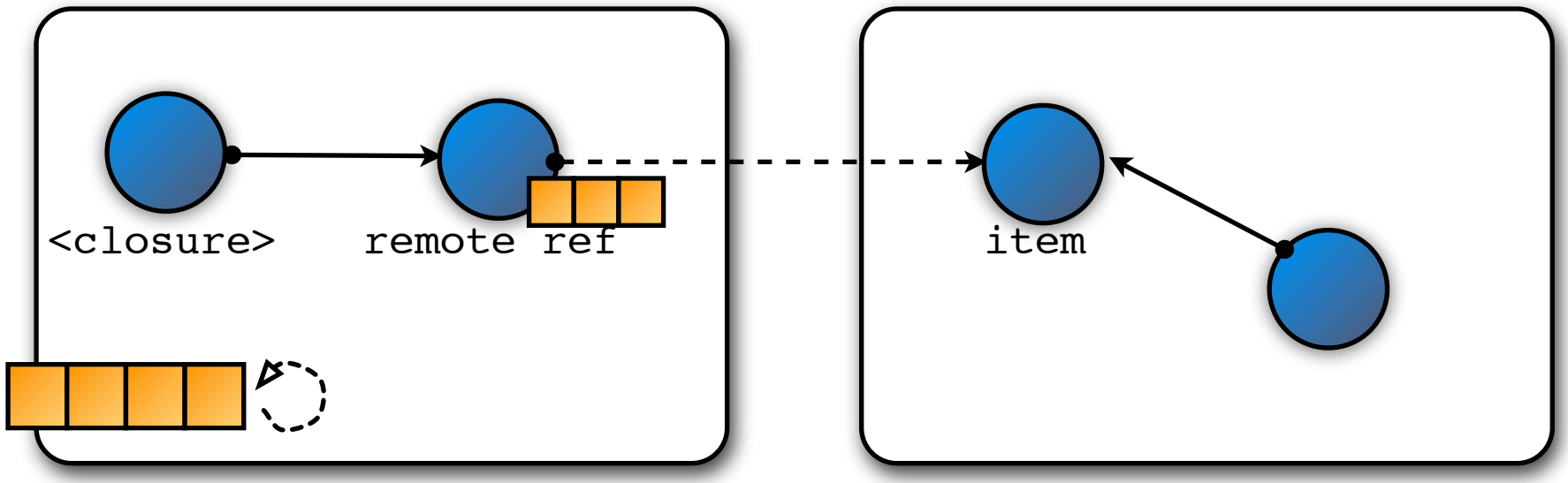


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Events + Objects

- Block closures as first-class event-handlers
  - preserve state (all lexically visible variables)
  - can be arbitrarily nested
- Leads to less 'inversion of control'

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```

Conclusion

- MANETs → loosely coupled collaboration
  -  Volatile Connections → time & sync-decoupling
  -  Scarce Infrastructure → space-decoupling
- AmbientTalk: event-driven OO language
  - Buffered asynchronous messages: tolerate temporary network failures by default
  - Built-in service discovery: no servers required

http://prog.vub.ac.be/amop