Route Bazaar:
Automatic Interdomain Contract Negotiation

Ignacio Castro[†♦♣] **Aurojit Panda**[‡] **Barath Raghavan**[♦] **Scott Shenker**[‡♦] **Sergey Gorinsky**[†]

† IMDEA Networks Institute   ♦ ICSI   ♣ Open University of Catalonia   ‡ UC Berkeley

HotOS XV, Kartause Ittingen, Switzerland, 18 May 2015
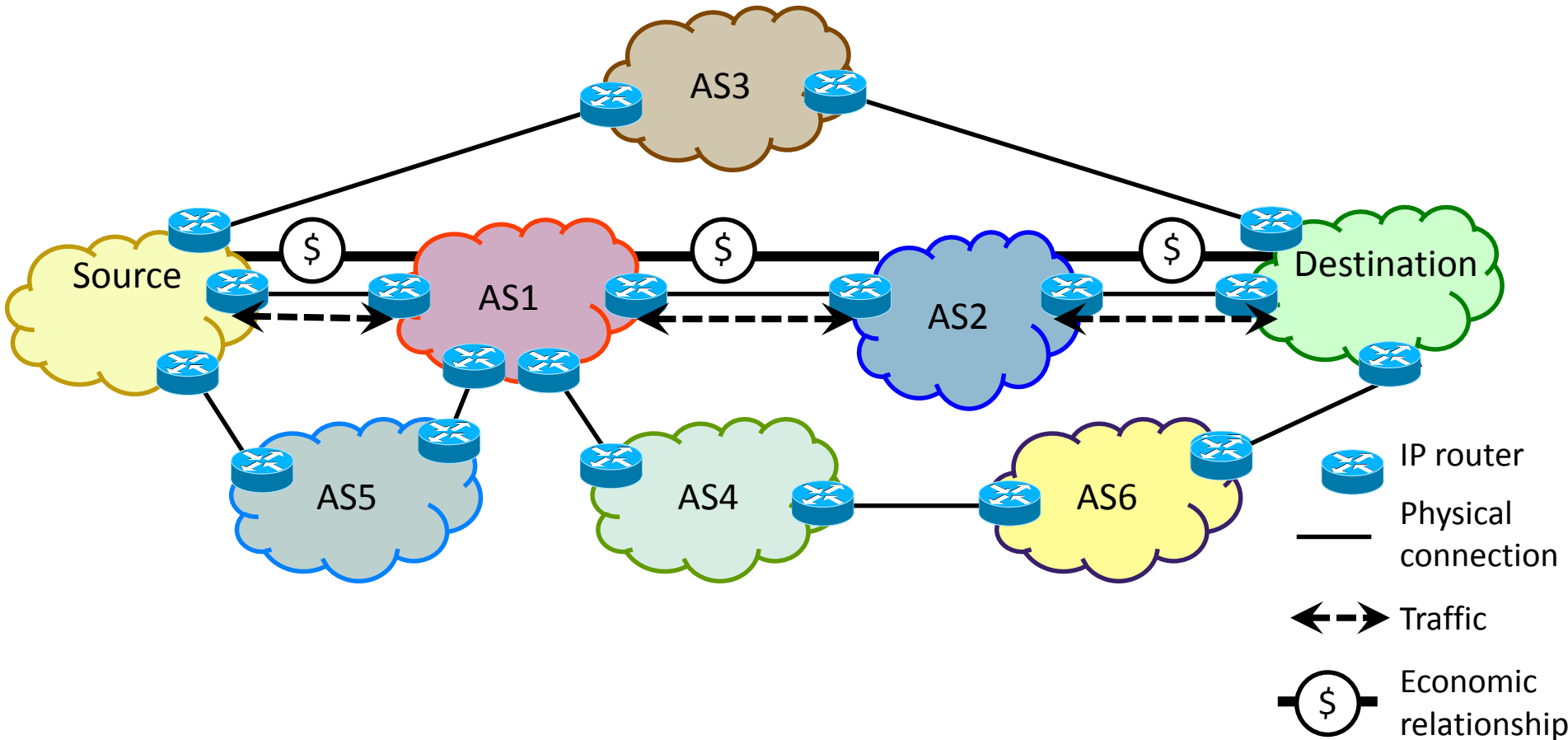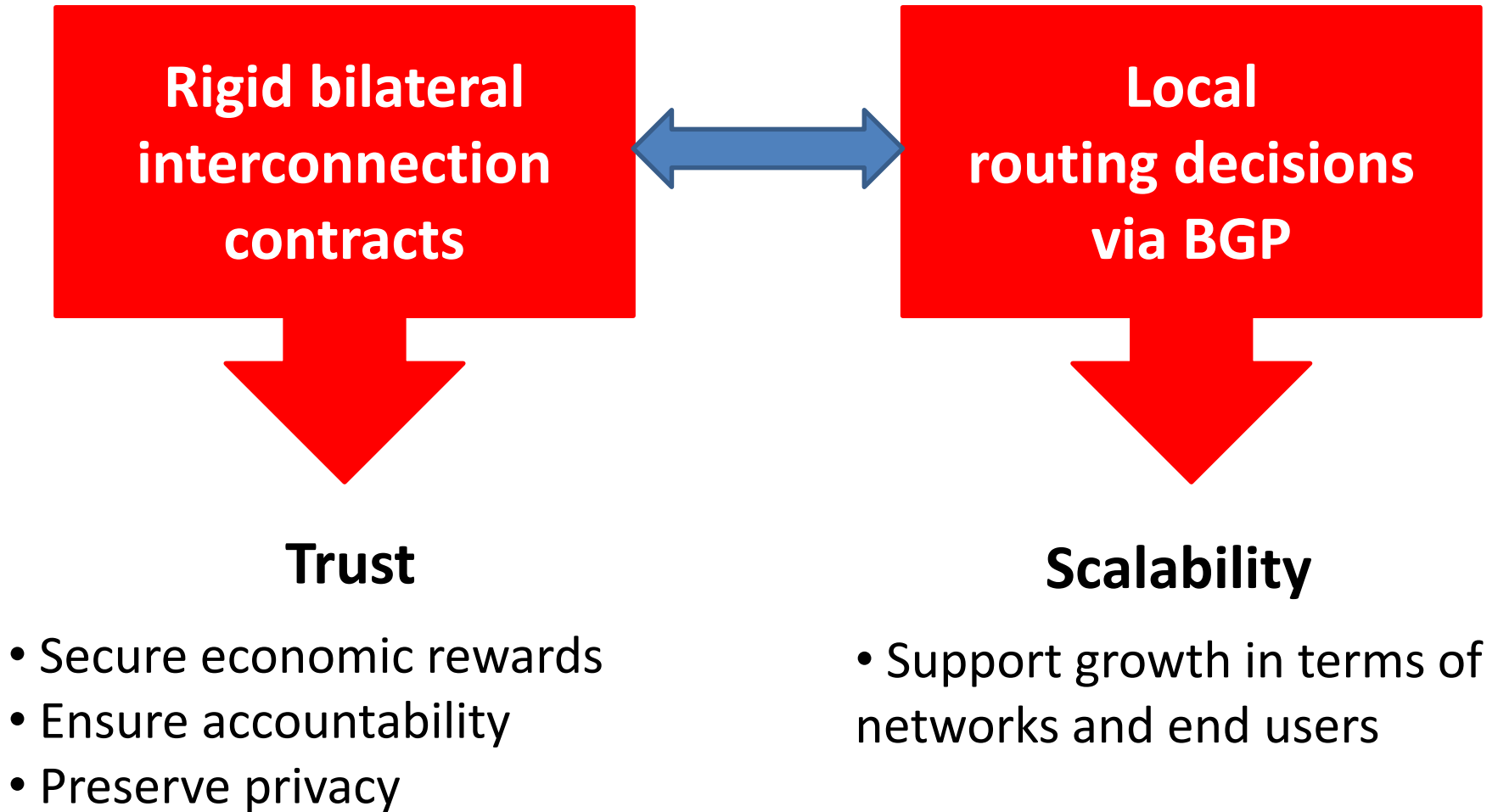
How to achieve end-to-end reachability?
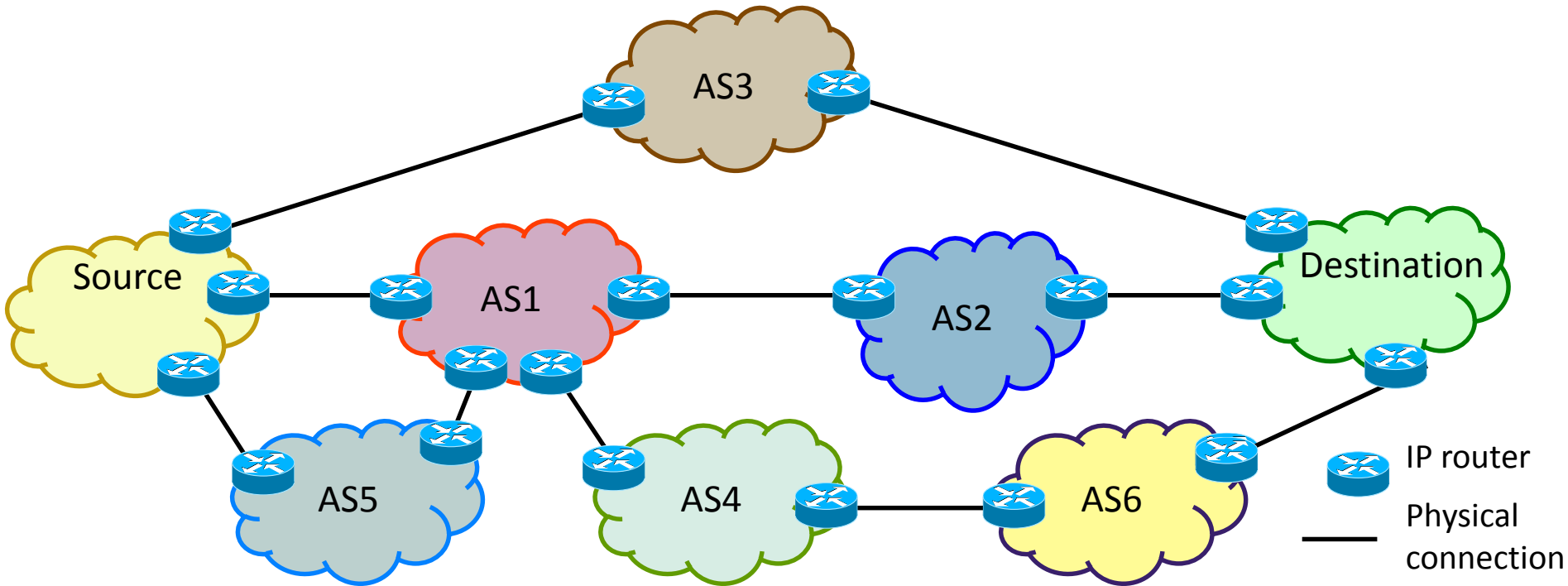
- Physical connectivity is not enough

- Economic compensations are necessary
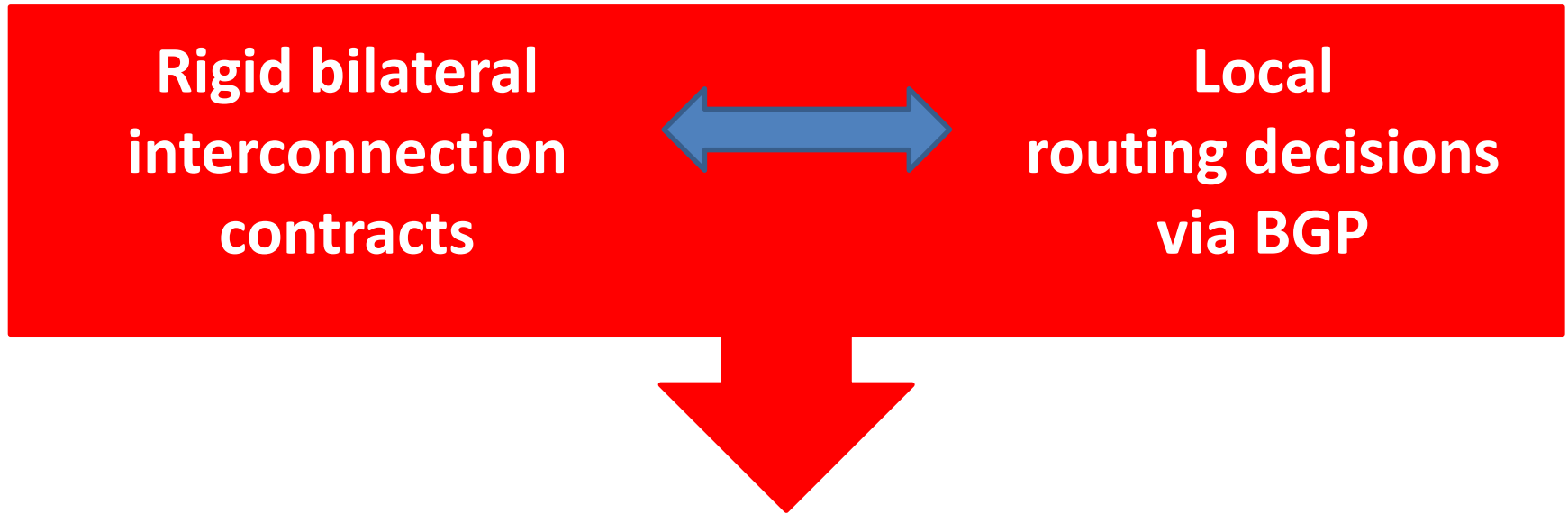
Current solution: bilateral contracts + BGP

- **Bilateral contracts:** provide economic compensations
- **BGP:** local decisions on routing

3

Current solution gives trust and scalability

Rigid bilateral interconnection contracts ⟷ **Local routing decisions via BGP**

Trust

- Secure economic rewards
- Ensure accountability
- Preserve privacy

Scalability

- Support growth in terms of networks and end users

4

Scalability comes at the price of flexibility

Rigid bilateral interconnection contracts ⟷ **Local routing decisions via BGP**

Routing is inflexible and suboptimal

- Contract formation is not dynamic
- Routing policies are insufficiently rich
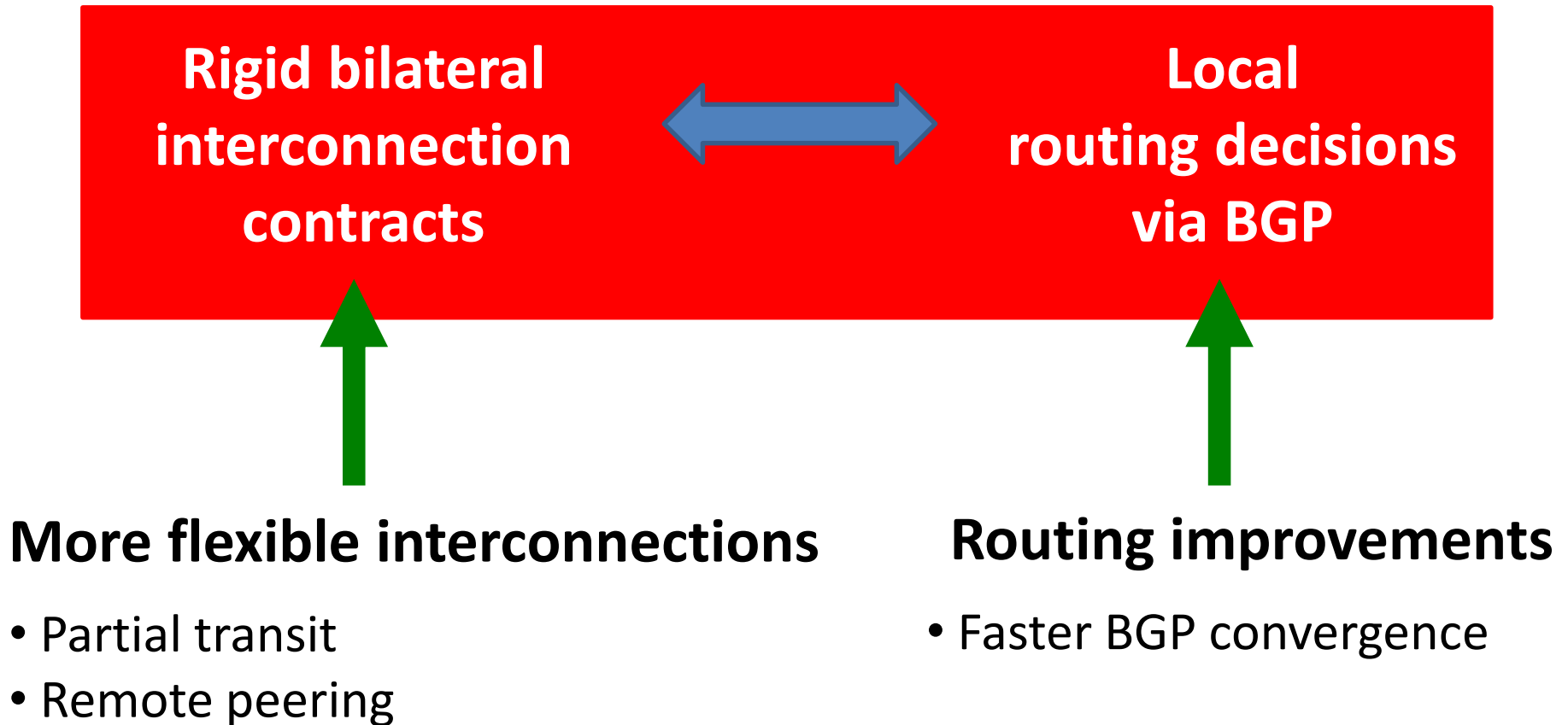
Negotiation takes more than time

Delivery around failures can be slow

The Internet struggles to assure end-to-end Quality of Service (QoS)

Prior fixes for each separate component

Rigid bilateral interconnection contracts ⟷ **Local routing decisions via BGP**

More flexible interconnections

- Partial transit
- Remote peering

Routing improvements

- Faster BGP convergence

9

Fixing only one component is not enough

"We never learned how to route money"

David D. Clark

Routing is bound to interconnection contracts

Is there a better solution?

Tackle contracts and routing jointly

bind interconnection contracts to routing

(instead of binding routing to interconnection contracts)
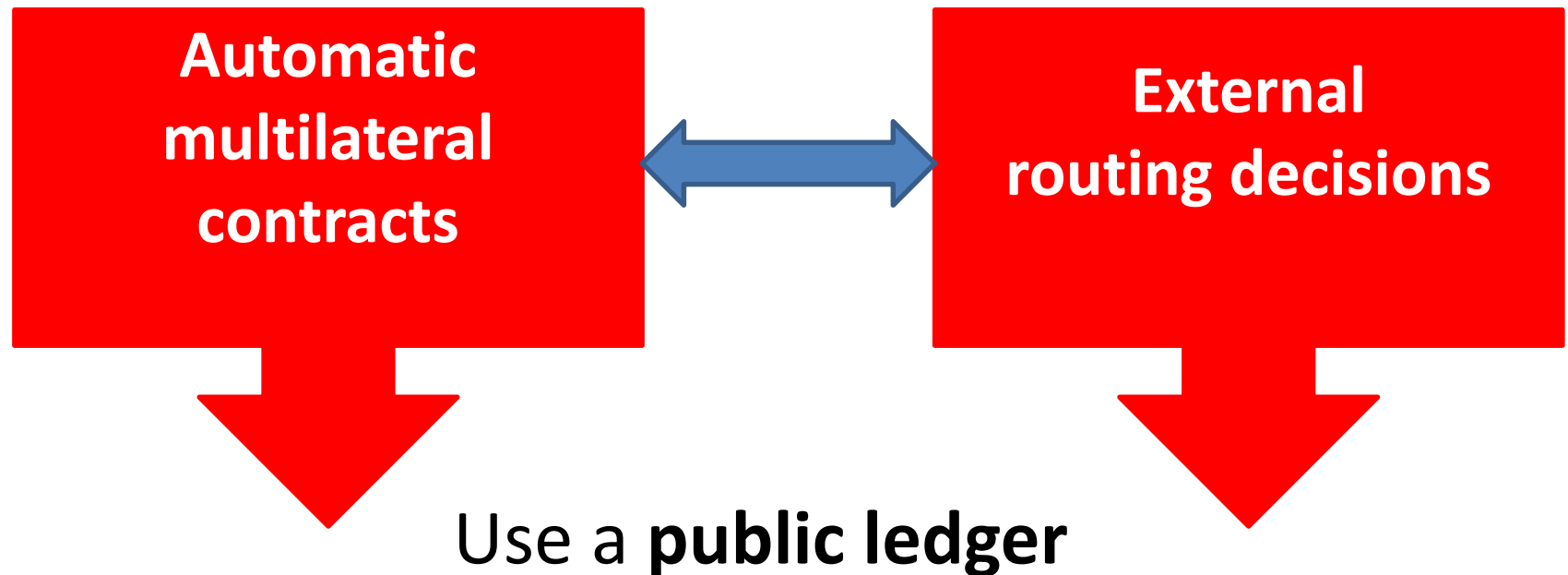
How? Inspiration from cryptocurrencies

Public ledger (or blockchain) in cryptocurrencies

- records transactions
- enables checking of the account balance for each user

provides decentralized trust

Public ledger for contracts & routing

Automatic multilateral contracts ⟷ **External routing decisions**

Use a **public ledger**

- Similarly to blockchains in cryptocurrencies
- Registers agreements and its implementation
- Provides trust and scalability
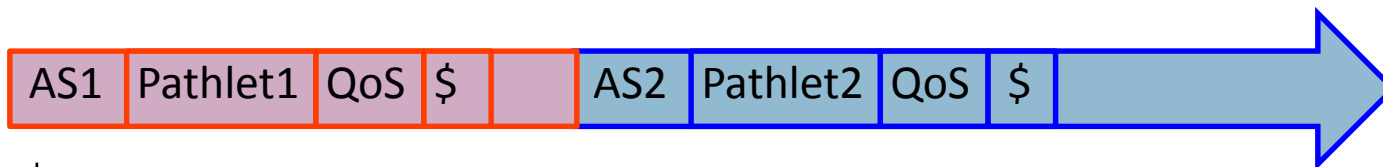
14

Route Bazaar: in a nutshell
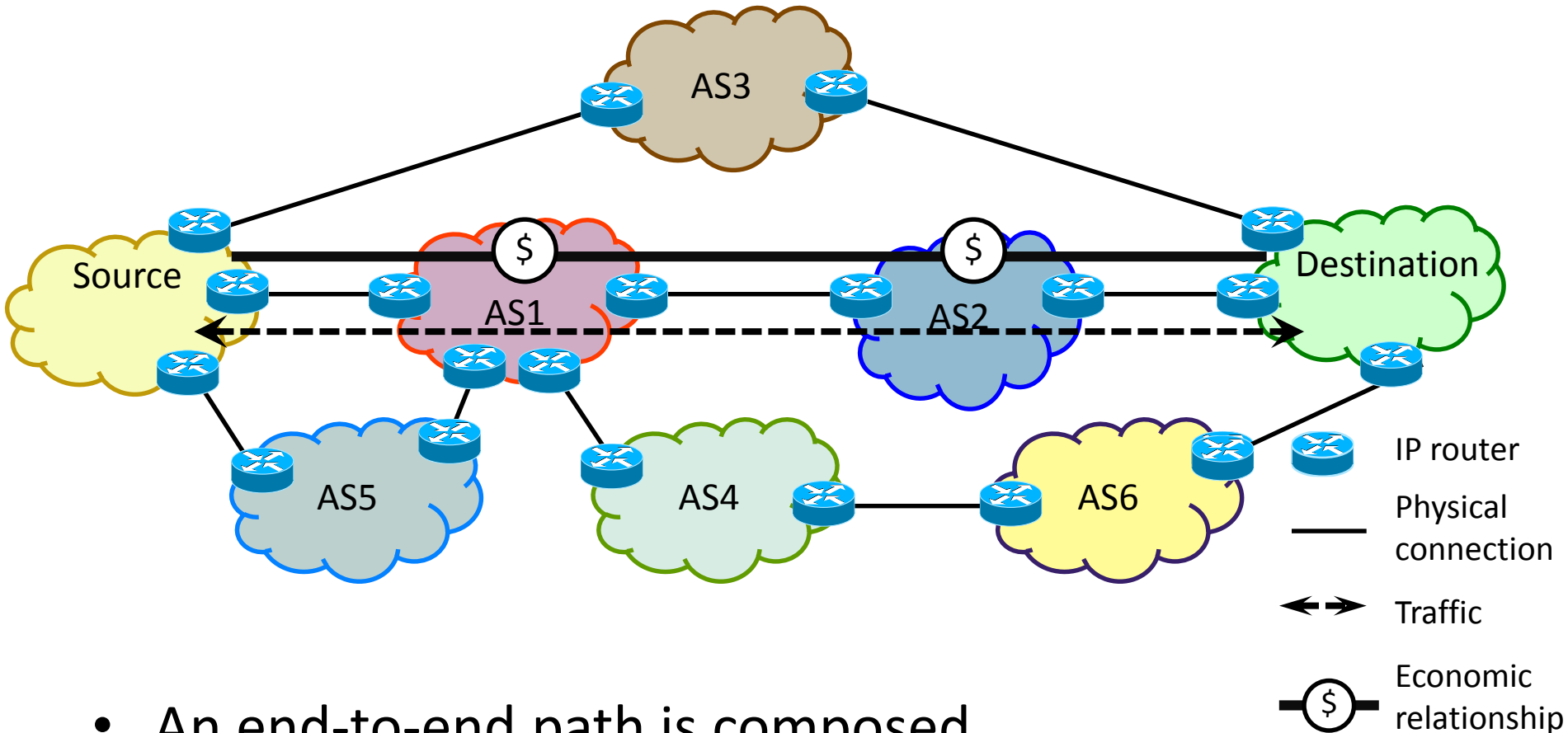
- An end-to-end path is composed
- The public ledger registers
  - Path contract
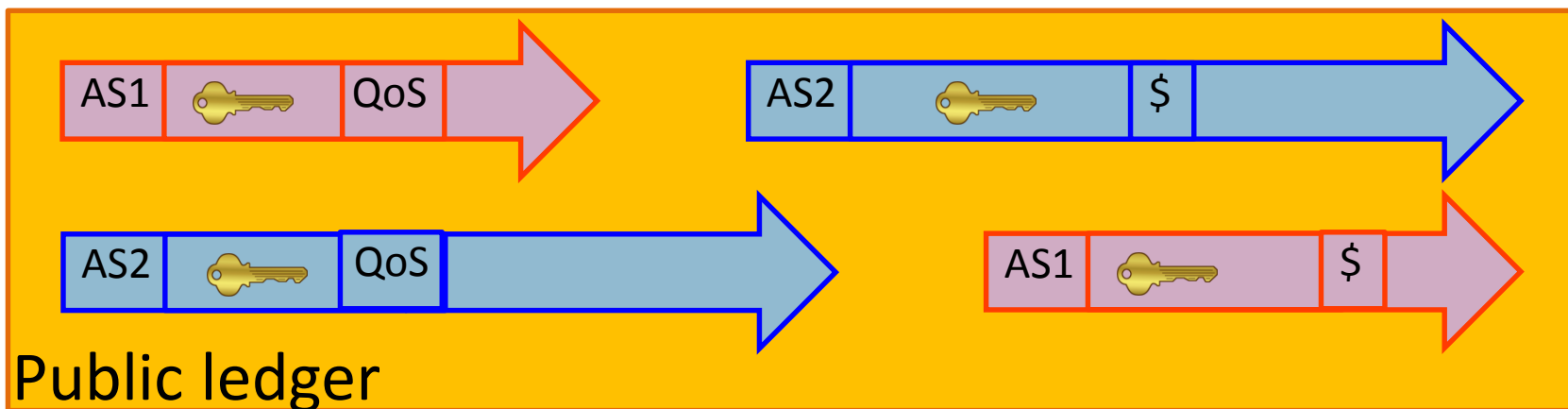 - Forwarding & payment proofs

Route Bazaar: path selection
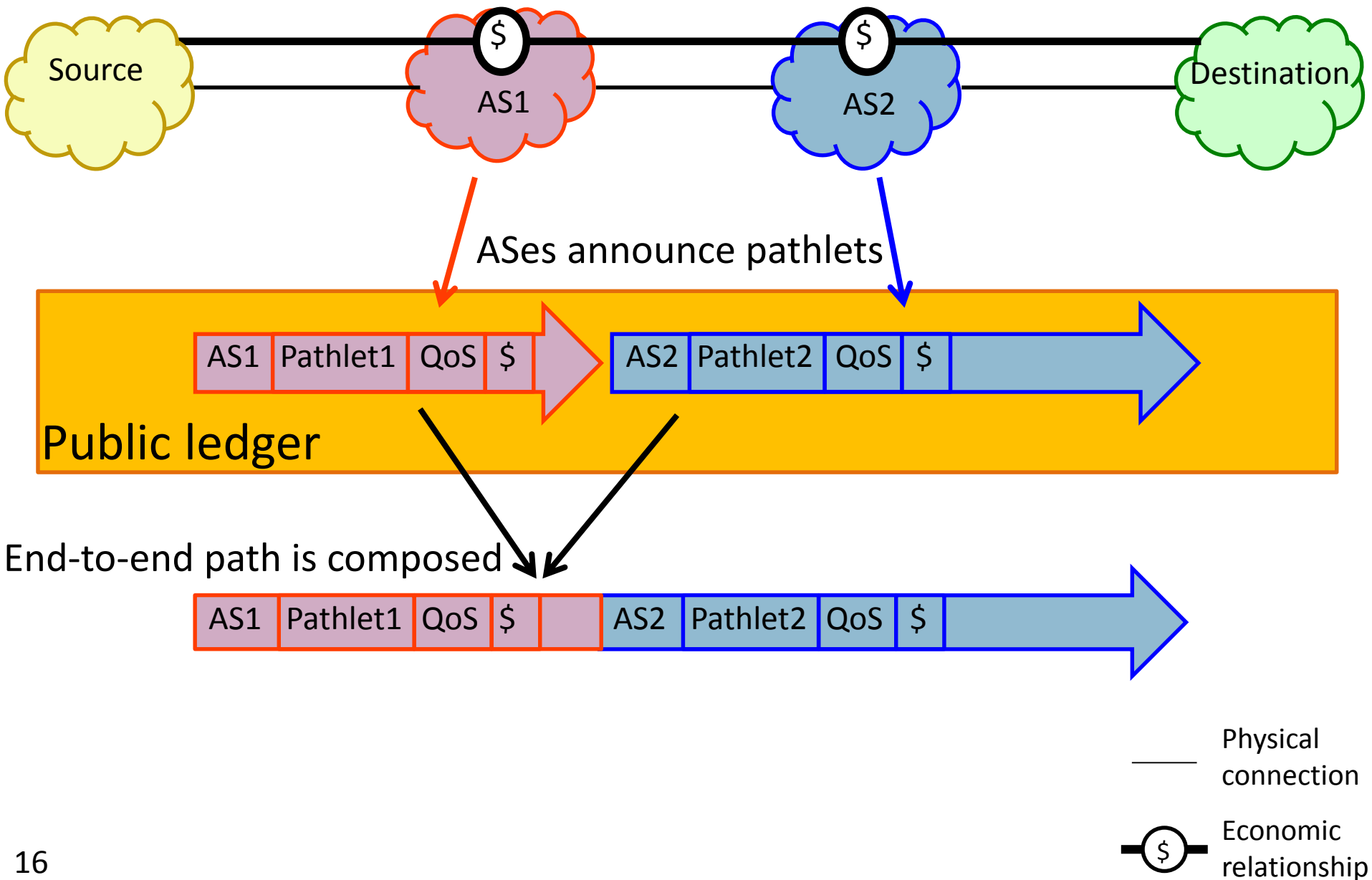
Route Bazaar: contract formation

AS1	Pathlet1	QoS	$		AS2	Pathlet2	QoS	$	

- Path contract is registered
  - Forwarding and payment commitments
- Each contracted pathlet is anonymized

Public ledger

Route Bazaar: verification

All involved networks register proofs of forwarding & payment in the public ledger

Public ledger

QoS	QoS	AS1	QoS	QoS	AS2	QoS	QoS
Sou.	AS1	$	AS2	AS2	$	AS2	Des.
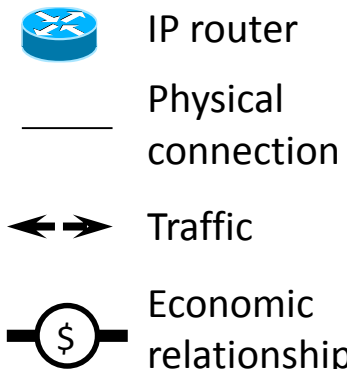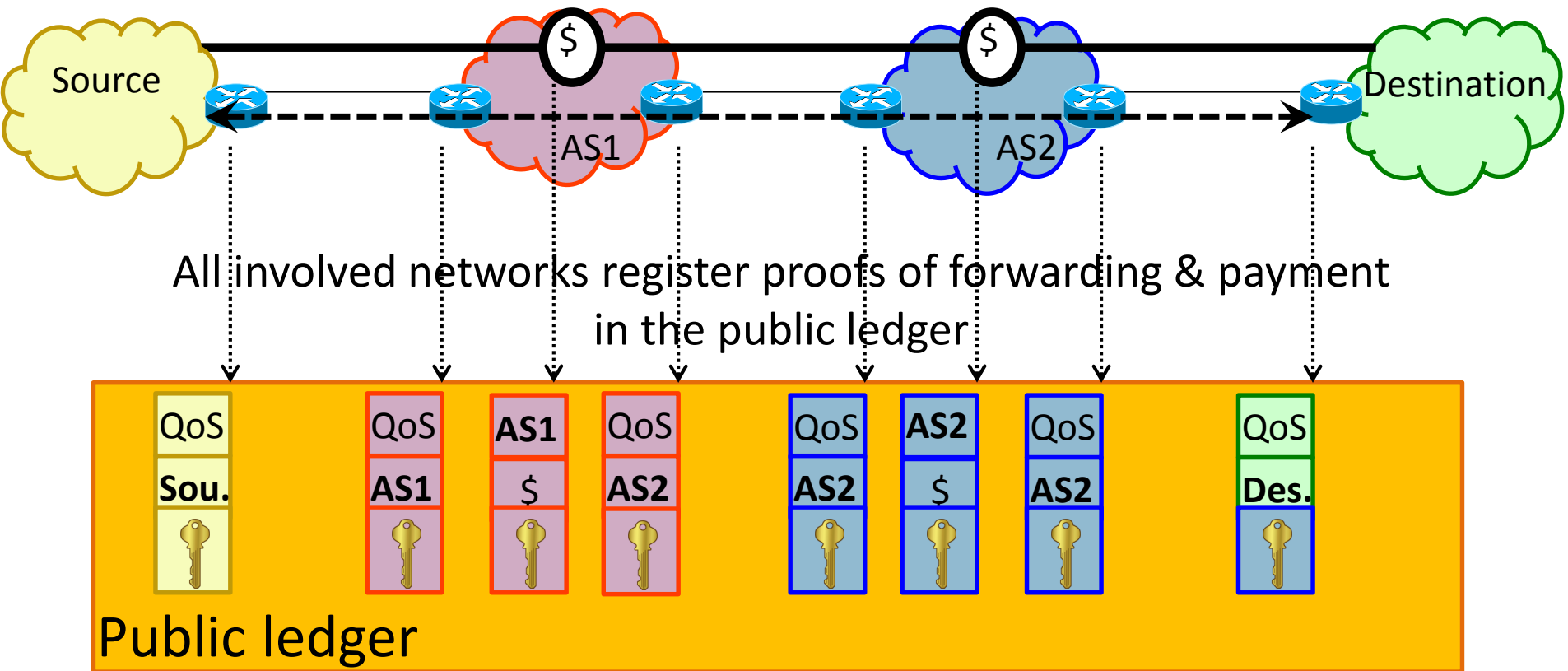
- Conformance of forwarding to routing
- Conformance to payment commitments

IP router

Physical connection

Traffic

$ Economic relationship

Route Bazaar: privacy

1. Announcements

| AS1 | Pathlet1 | QoS | $ | | AS2 | Pathlet2 | QoS | $ |

2. Contract

Public ledger
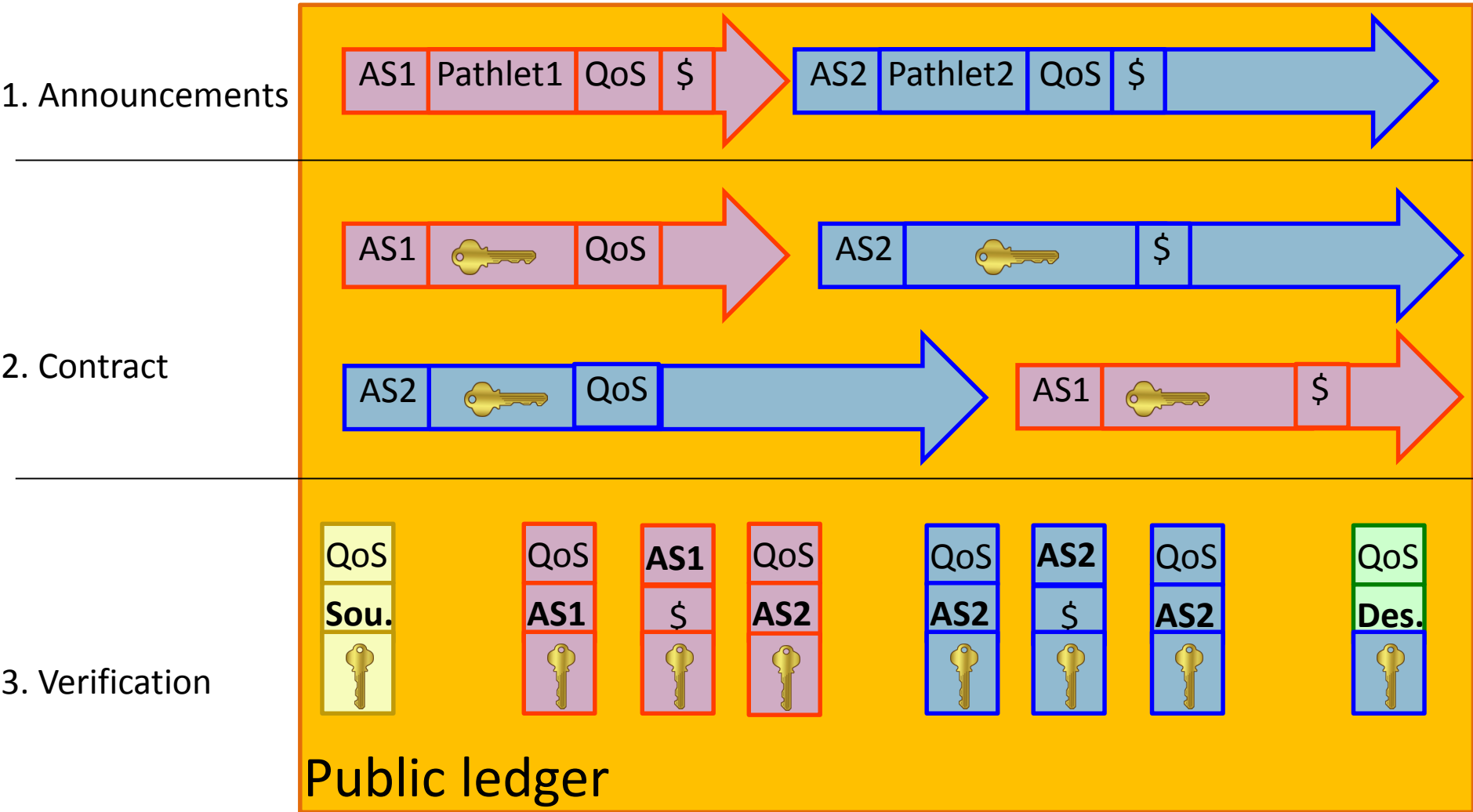
Paths are private but providers and customers have a history

Route Bazaar contributions

Binding interconnection contracts to routing
(instead of binding routing to interconnection contracts)

- Dynamic contract formation
- Support of flexible routing
- Backwards compatibility

Ignacio Castro   ignactro@gmail.com