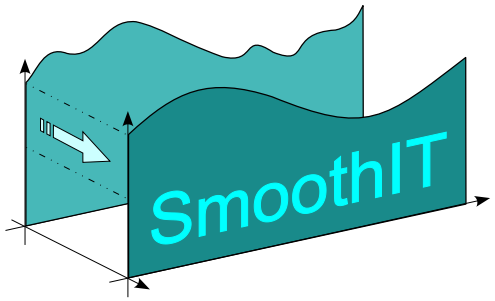
Simple Economic Management Approaches of Overlay Traffic in Heterogeneous Internet Topologies



European Seventh Framework STREP FP7-2007-ICT-216259

Serving the Incentives of Users and Providers

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The Internet Ecosystem: Today & Future

- Many players acting simultaneously
  - Customers/Users
  - Providers
    - ISPs
    - Overlay application providers
    - Over-The-Top providers
    - Content providers
    - ...

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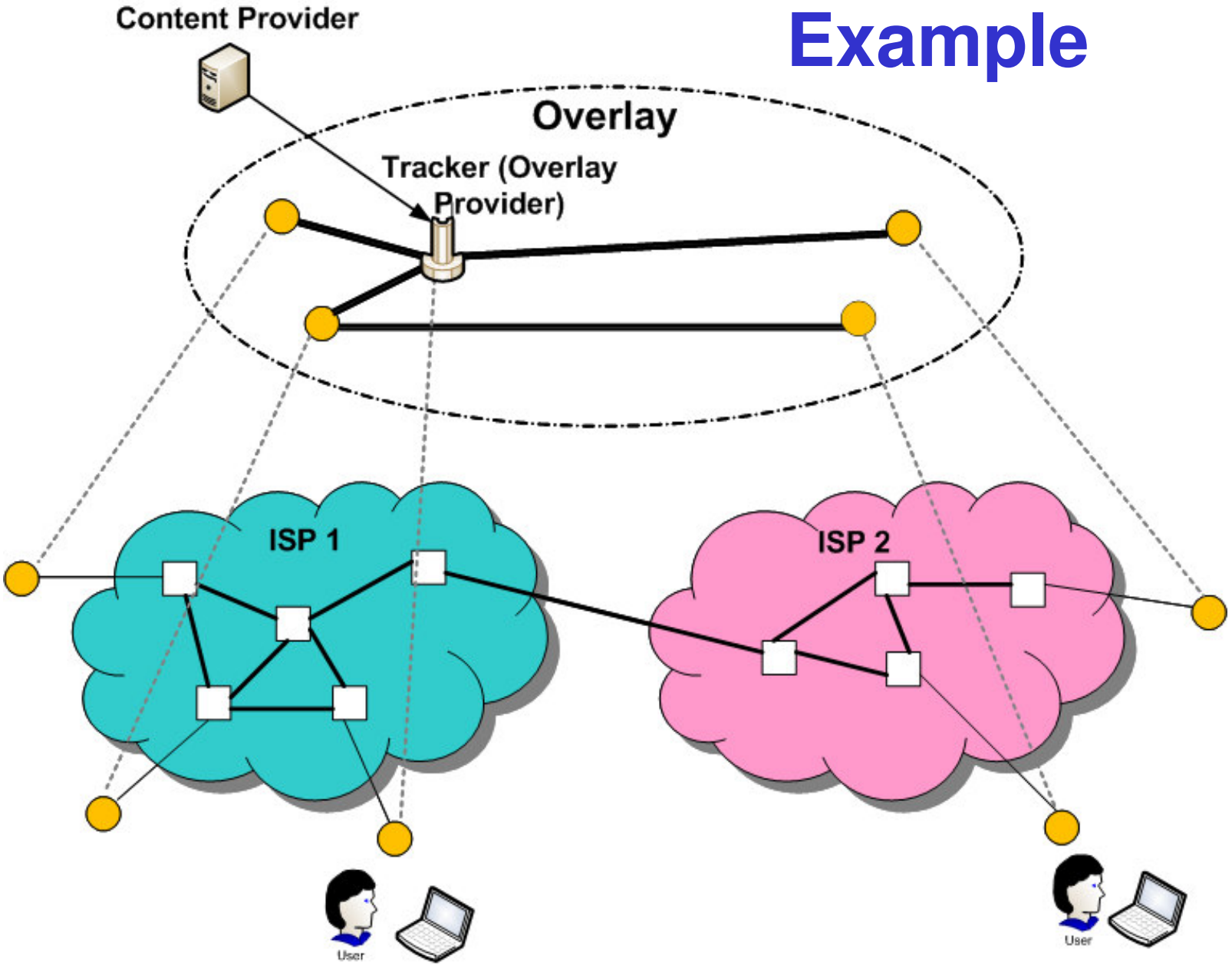
Example


Content Provider
Overlay
Tracker (Overlay Provider)
ISP 1
ISP 2
User
User

All-Win Situation

➔ Application traffic is optimized beneficially for all players

- *SmoothIT* project: deals with TripleWin situations
  - users, ISP, and overlay application provider

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Tussles in Future Internet

- Self-interested players with:
  - conflicting interests
    and
  - substitute or complementary functionalities

- Tussles lead the system to equilibrium operating points
  - Not to global optima

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Conventional Traffic Management

- Aims at achieving a global optimum
  1. for a single criterion;
  2. by a central entity
  – with full information

Future Internet Traffic Management

- Should take into account:
  - the interests of individual players
  - the distribution of information among them

➔ New approach: Economic Traffic Management
  - ETM

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Mechanism Design Theory

- *The "engineering" side of economic theory.*

  E.Maskin, Nobel Prize in Economic Sciences, 2007

- *... incentive constraints should be considered coequally with resource constraints in the formulation of the economic problem.*

  R.Myerson, Nobel Prize in Economic Sciences, 2007

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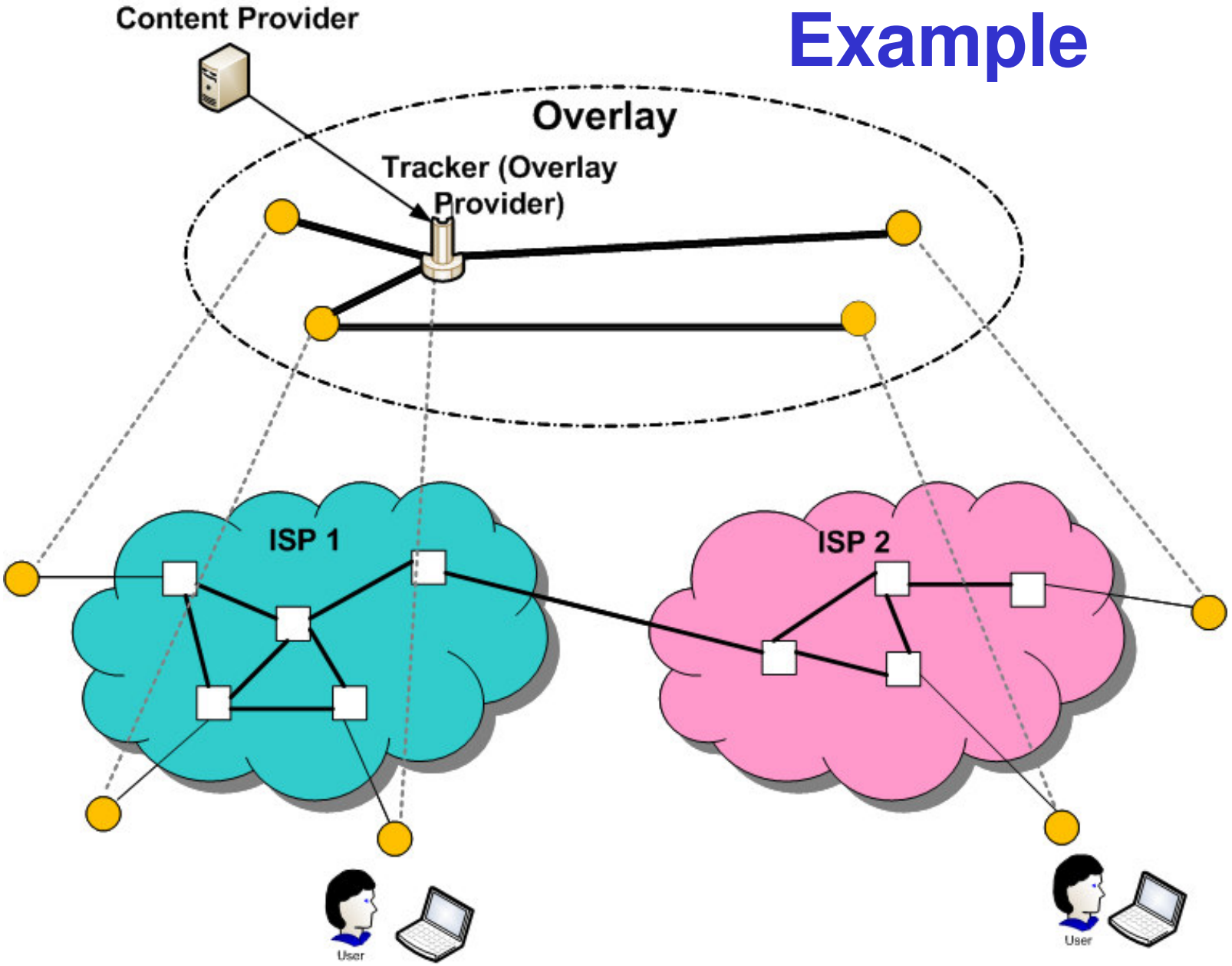
ETM in another Context

Win-Win

Example


Content Provider
Overlay
Tracker (Overlay Provider)
ISP 1
ISP 2
User
User

Overlays & Information asymmetry

1. Overlays built independently of physical topology

2. Underlay network not aware of overlay requirements

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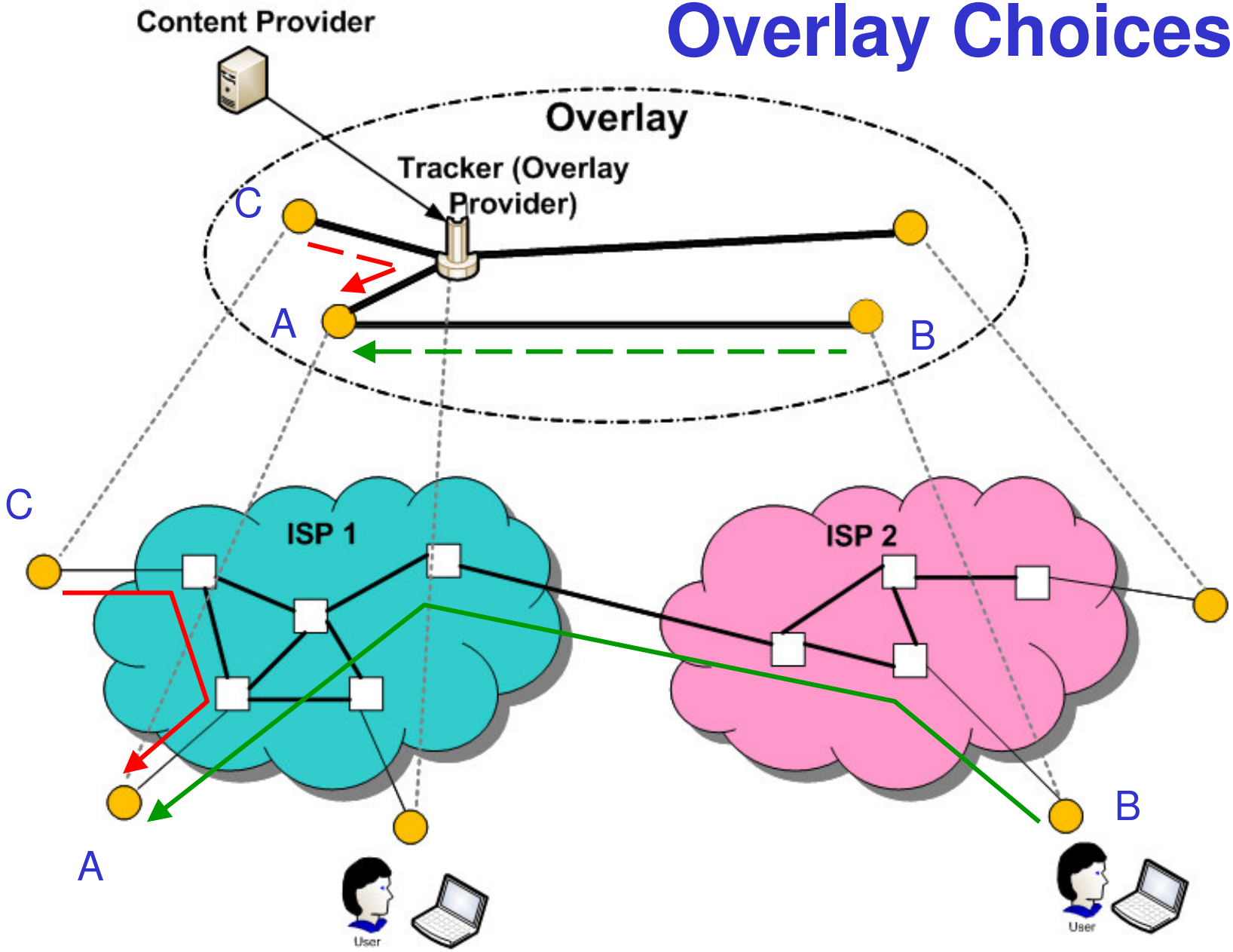
Overlay Choices



Optimization in Overlays

- Overlays include user's performance optimization mechanisms
  - Tit-for-tat in BitTorrent

- Perform suboptimally:
  1. due to incomplete information (→ asymmetry)
  2. conflict with ISP's incentives

→ Tussle between overlay and ISP

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ETM Mechanisms (I)

- Are based on economic incentives
  - providers' revenue/cost etc.
  - performance

  promoted compatibly for all players

- Do influence overlay traffic patterns
  - by users' individually optimal choices

- Stimulate information sharing among players

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ETM Mechanisms (II)

- Are highly distributed and scalable

- ISP shapes users' behavior desirably by:

1. providing users with extra underlay information
   - locality promotion "oracle" services
2. offering extra resources in the overlay to "help" local users

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Main Conclusions

- ETM can lead to TripleWin
  - Existing overlay optimization can benefit from ETM
- Locality reduces costly inter-domain traffic
  - … but does not always lead to TripleWin
- Use of resourceful entities is often effective

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Final Remarks

- No ETM approach can fit all cases/applications
- ETM should not affect adversely other applications
- ETM is compatible with Network Neutrality
  - Can improve overall performance
  - Applicable under flat-rate pricing and for multiple applications

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Thank you for your attention!

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