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A Dynamically Adapting Mobile P2P Multiplayer Game for Hybrid Networks

UbiSettlers

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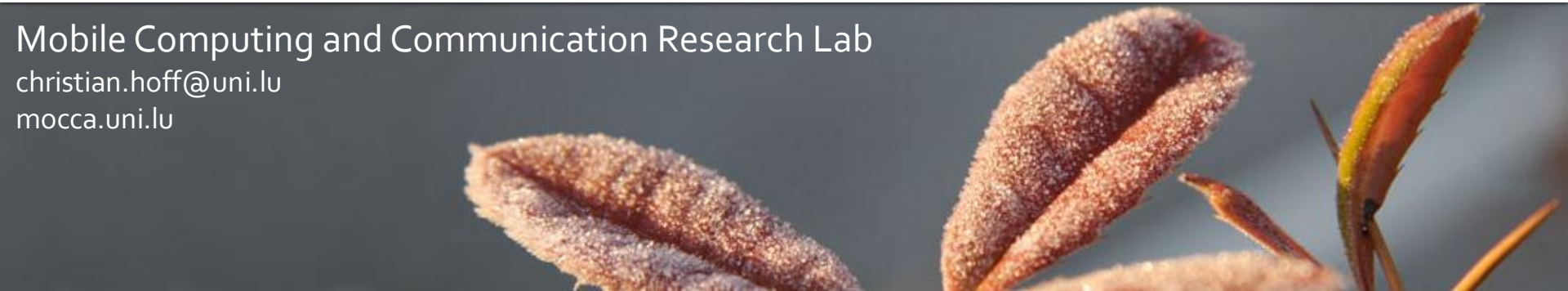

Outline

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- Inconsistencies in Game State
- Trading
- Network Feedback
- Stimulating Cooperation
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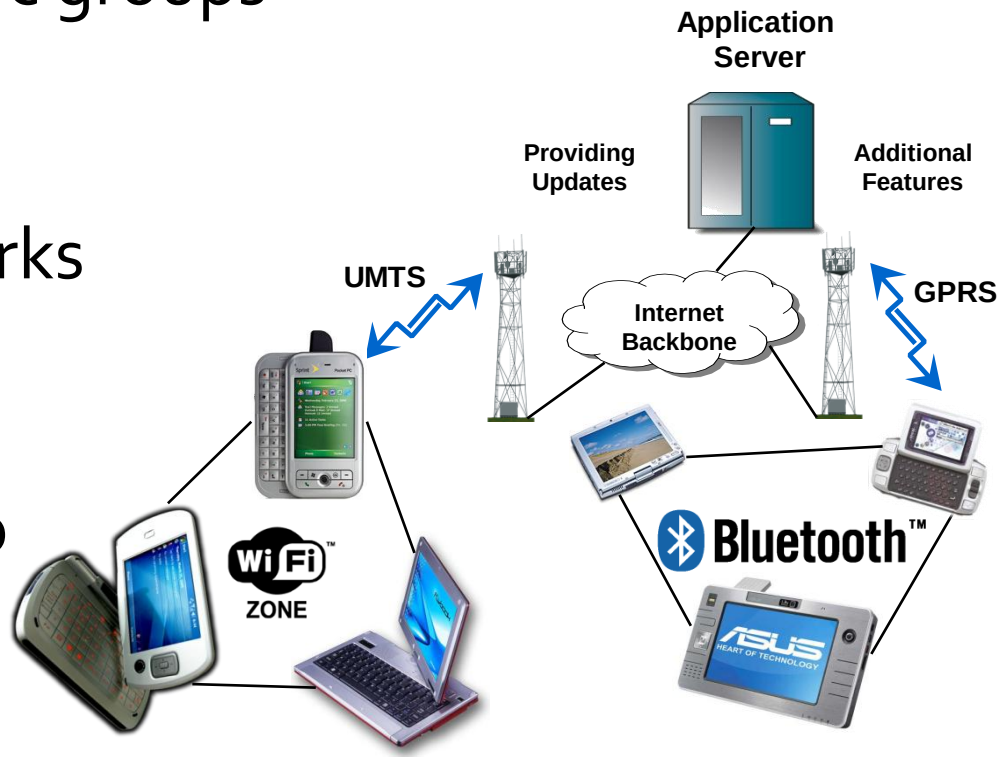
Introduction

- hand-held game consoles become more and more popular
  - Nintendo DS or Playstation Portable
  - support IEEE 802.11 networks
- limitations
  - single-hop neighborhood only
  - maintain global game state
  - strong coupling between players during a single game
- UbiSettlers tries to overcome these limitations by
  - using hybrid networks
  - introducing network feedback mechanisms
  - explicitly allowing inconsistencies in game state

Hybrid Networks

- different communication technologies involved
- self-organizing ad hoc groups
  - WiFi in ad hoc mode
  - bluetooth
- infrastructure networks
  - GPRS or UMTS
  - WiFi access points
- devices connected to several networks act as gateways



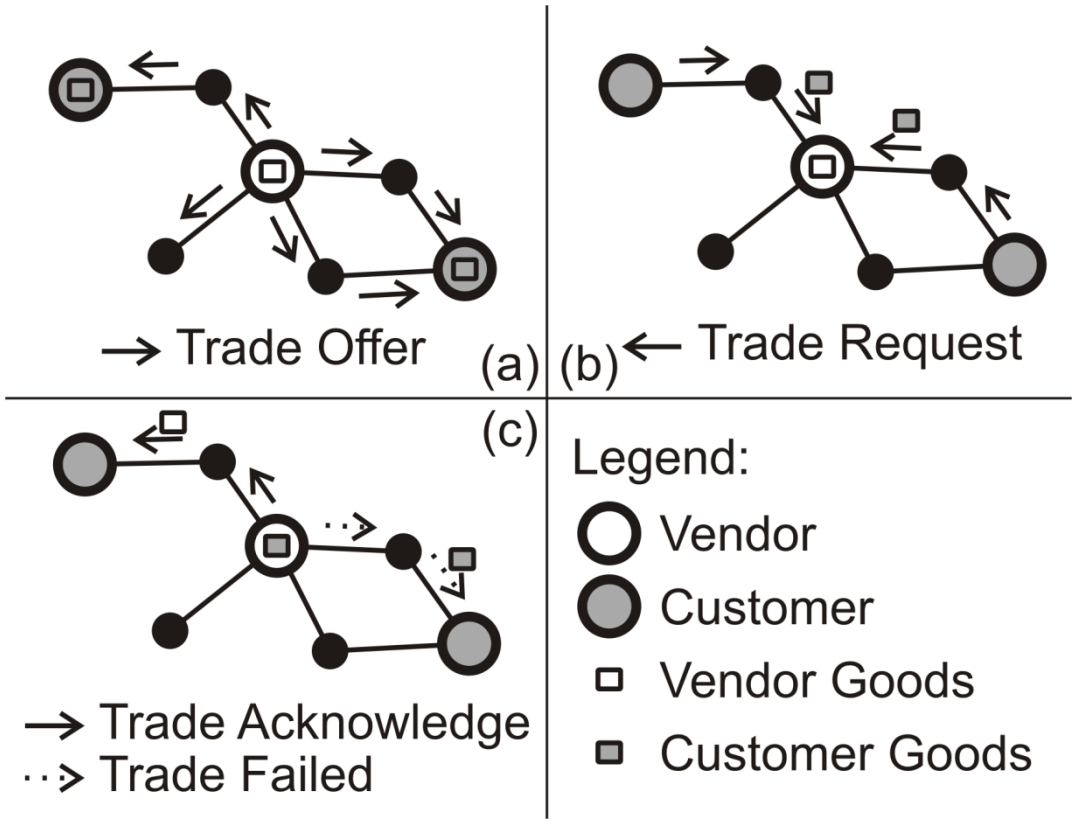
UbiSettlers

- inspired by the game „The Settlers“
- real-time strategy game for multiple players
- each player controls an island
- goals:
  - civilize island
  - evolve population
  - establish infrastructure
- instruments:
  - create buildings to speed up processes
  - trading with other players
  - teamwork to create complex buildings

Inconsistencies

- UbiSettlers explicitly allows inconsistencies in the global game state
- inconsistencies are mapped on appropriate game elements
  - e.g. lost trading message → pirates capturing the merchant ship
- softens the strong requirements of common mobile games
  - multihop connections
  - dynamic joining and leaving users
  - game state gets not lost due to disconnections

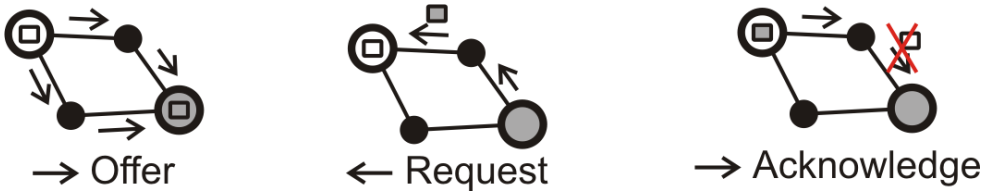
Trading



- handshake model for local trading
- flooding and LMR protocol
- reconciliation protocol
  - generic approach to conciliate data items
  - merging different versions of trade offer lists
  - introduces small message overhead
  - higher data freshness

Trading (contd)

- inconsistencies in global state allowed, e.g.



  - vendor received goods, customer not
  - explained after timeout through pirates
- automatic trading
  - place periodically recurring offers
  - maintained and propagated in the background
  - matching offers are negotiated automatically
- trade brokers in the backbone
  - vendors send offers to trade brokers
  - interested customers participate in an auction (cf. eBay)

Network Feedback

- mapping network events on game elements
  - lost messages → pirates
  - disconnections from backbone → disabling trade brokers
  - new devices → automatic trading
  - hop count → distance between islands
  - topology → prefer local/near trading partners (highlighted in offer list)
  - …
- "random generator" for game elements
- uses topology and routing information
  - already maintained by used protocols
  - achieved by modifications to these protocols

Network Feedback (contd.)

- Lightweight Mobile Routing (LMR)
  - reactive routing protocol for multihop MANETs using request-reply messages
  - adopted to support gateway links to backbone
  - messages augmented with additional information, e.g. hop count
- Weighted Application-aware Clustering Algorithm (WACA)
  - clustering algorithm for hybrid wireless networks using master-slave paradigm
  - master devices are selected upon
    - battery power
    - wireless networking technologies
    - signal strength, …
  - already maintained topology information
    - e.g. knowledge about master/slave devices or used network technology
    - made available for applications

Stimulating Cooperation

- two classes of common approaches introduced in literature
  - token-based or market-based
    - reward devices for relaying packets
  - trust management or reputation-based
    - devices observe behavior of other devices
    - misbehaving devices are punished
- it is not clear which of these approaches is the best for specific application scenarios
- Huang *et al. (2004)* conclude: "incentive systems should be tailored to the needs of each individual application rather than a general solution"

Stimulating Cooperation (contd.)

- simple application specific incentives
  - trading for balancing different island properties
  - research of blueprints for complex buildings only in teamwork possible
- application specific token-based approach
  - adapted protocol introduced by Buttyán and Hubaux (2003)
  - players have to pay the merchants and their ships (sending messages)
  - passing ships (forwarded messages) pay for the usage of the harbor
  - different link costs for ad hoc and infrastructure links
- again inconsistencies are allowed
  - no exact mapping of virtual fees to real network topology required

Current Status

Conclusion

- we presented a real-time strategy game for hybrid wireless networks
- we soften the strong requirements of common mobile games by allowing inconsistencies
- we introduced the concept of network feedback (not restricted to mobile games)
  - assimilation of existing protocols
- we presented an adapted protocol for stimulating cooperation in hybrid networks

Thank you…

…for your attention!

Questions?