A Dynamically Adapting Mobile P2P Multiplayer Game for Hybrid Networks

UbiSettlers

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Outline

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

Legend:
- Vendor
- Customer
- Vendor Goods
- Customer Goods

→ Trade Offer
→ Trade Acknowledge
⇒ Trade Failed

(a)

(b) ← Trade Request

(c)
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)
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
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
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”
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
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?