PRoPHET Update

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Elwyn Davies
elwynd@folly.org.uk

Avri Doria   Samo Grasič   Anders Lindgren
avri@psg.com   samo@grasic.net   dugdale@gmail.com

We were done, weren't we?

- That's what we thought back at IETF 78
- Turned out we had been focusing too hard on the Delivery Predictability (DP) evolution
  - Unrelated to protocol state machine
- I checked the protocol state machine last summer and realized we were way behind the curve as regards RFC 5050
  - No fragmentation support
  - Behaviour in long encounters not very well-defined

Feux de Artifice
à la Chute Montmorency

Progress since IETF 78
Latest Version
http://tools.ietf.org/html/draft-irtf-dtnrg-prophet-09

- PRoPHET continued in use in N4C testbeds
  - Slovenia (continuous use for over 5 years)
  - Arctic Sweden (Summer testing 2010)

- More simulation work by Samo

- Draft updates include
  - Fragment support
  - Improved long encounter behaviour
  - Parking lot problem mitigation

PRoPHET v2 – Main Changes

- Previous versions (before -09) didn't…
  - Cope with bundle fragments
    - No way to specify offset/length in bundle offers/requests
  - Didn't include Source EID when specifying bundles in offers and requests
- Fixing this required fixes to key TLVs
  - Not backwards compatible – hence PRoPHET v2
- Doesn't change fundamental state machine operation

PRoPHET v2 – Improvements 1

- Clarified behaviour when encounters go on for a long time

  - When to send DPs again, etc.

- Coping with multiple simultaneous encounters

  - aka 'The Parking Lot Problem'

- Allowing requests and offers to be spread over multiple top level messages

  - DP exchanges already could – consistency reigns!

  - Better fit with using (reliable) TCP connections

- Cleaned up specification of error behaviour

PRoPHET v2
The Parking Lot Problem - Definition

- Lurking problem since early days!
    - Mostly in Elwyn's mind!

- What happens when several nodes are in wi-fi range at the same time?
    - Potential multiple exchanges
    - Circular updates
    - Out of control DP evolution

- Flaky Wi-Fi connections have similar effects
    - Potentially exagerate expectation of nodes meeting
    - Seen in real world – connections that come and go
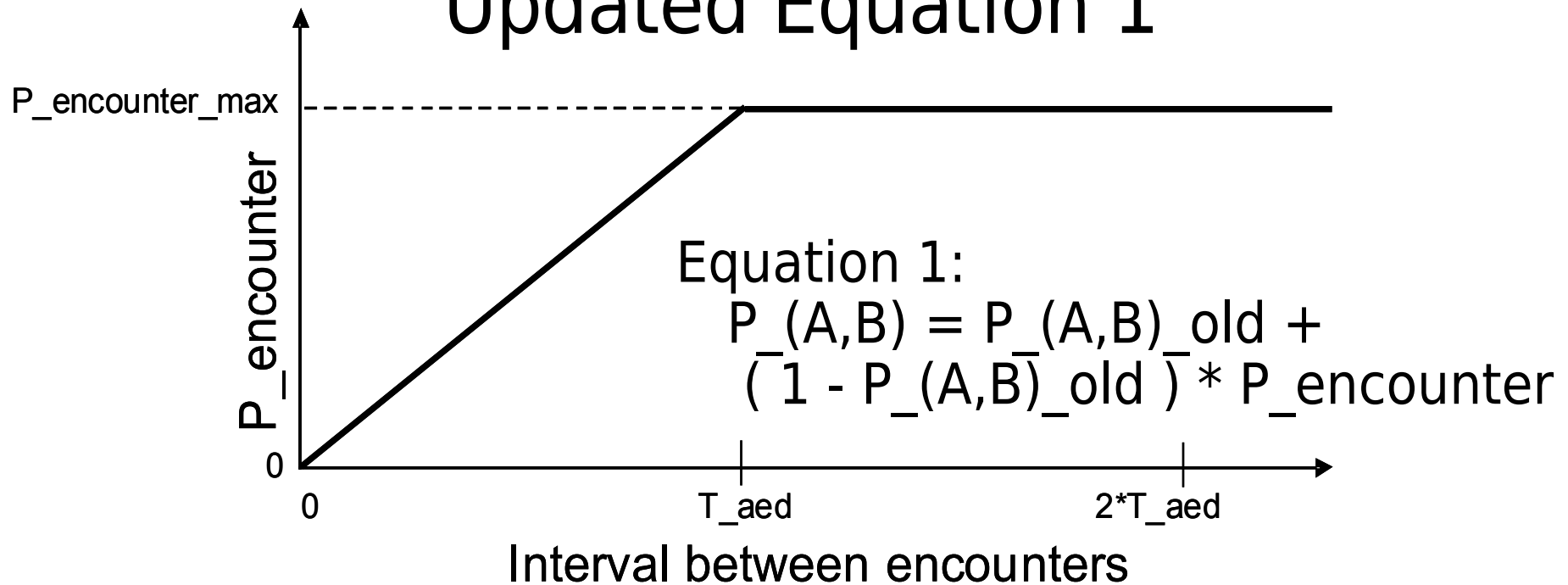
PRoPHET v2
The Parking Lot Problem - Mitigation

1. Helped by the improved transitivity evolution (Eqn. 3) introduced in -06

    - P_(A,C) =
         MAX(P_(A,C)_old, P_(A,B) * P_(A,C) * beta)

    - Stops repeated updates ramping up DPs when there is no justification because neither A nor B has met C or got other input since last time.

2. (New): Modify Eqn 1 so that P_(A,B) is increased less if it is an unusually short time since last encounter

PRoPHET v2
Updated Equation 1

P_encounter_max

P_encounter

0

0   T_aed   2*T_aed

Interval between encounters

Equation 1:
P_(A,B) = P_(A,B)_old +
(1 - P_(A,B)_old) * P_encounter

- P_encounter becomes interval dependent

- Limits effect of short intervals

- Only need to store time since last encounter for short period – not for all nodes

PRoPHET v2
Interelating the Parameters

- Big complaint re. earlier versions of PRoPHET: *Too Many Arbitrary Parameters in DP Equations*

- PRoPHET v2 explains how to derive values for these parameters from the statistics of the underlying mobility model
  - Key parameter: Expected time between encounters

- Outline (very rough!):
  - Decay of DPs linked to 'tail' of inter-encounter PDF
  - P_encounter must 'undo' decay and then some
 - Transitivity factor (beta) related to path hop clounts

PRoPHET v2
Items Reverted/Corrected since v06

- Suppression of DP updates based on mutual agreement removed

  – Equation 1 improvement is a better solution

  – Does not require arbitrary agreement

- Recommended value for DP after first encounter is now 0.5

  – Could be adjusted if there was good external evidence for a different value in a particular case

 – In line with discussions after IETF 78 about what you can guess after one encounter!

Is PRoPHET v2 'Better'?

- Simulation appears to say 'yes'
- Samo has been working on simulations using ONE simulator
  - Compared with PRoPHET v1 , and
  - Epidemic, MaxProp, Spray and Wait
  - Short paper to be presented at CHANTS 2011
- Improvements implemented in recent tests and solve earlier problems
  - Especially the 'chain' problem reported at IETF 78

Simulation based on traces from N4C Trials in Summer 2010
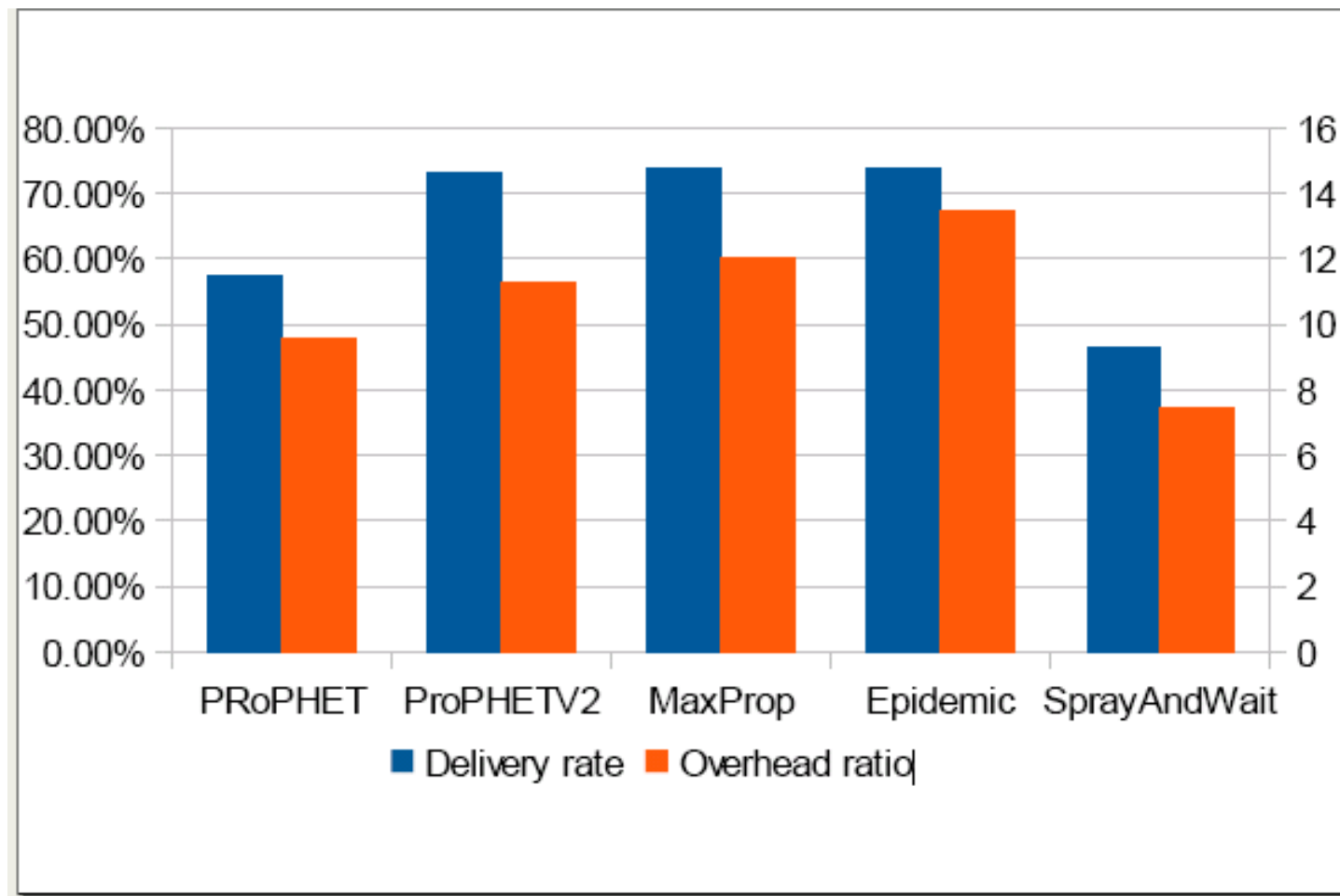
Simulation using
ONE Working Day Model
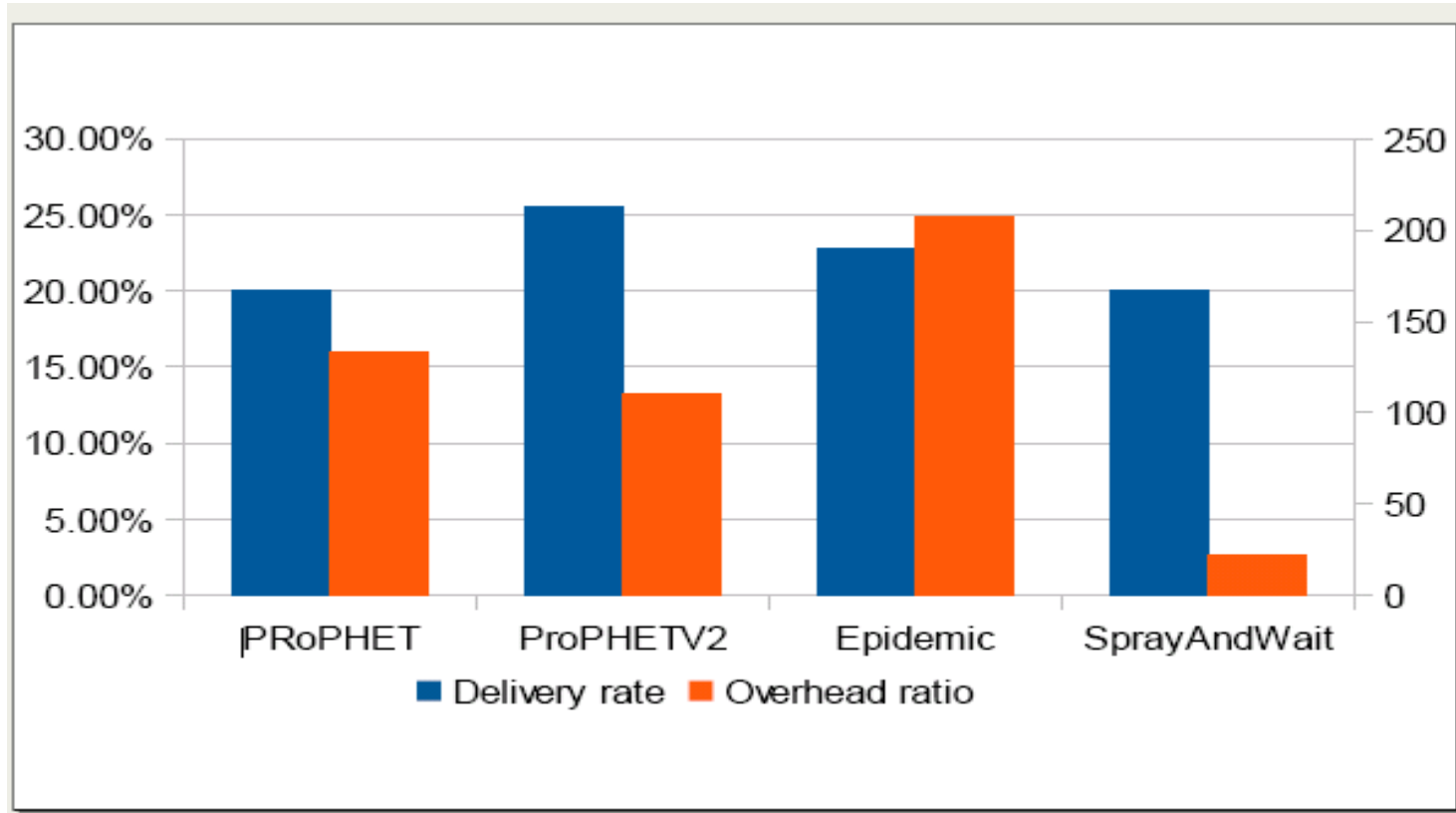
Unable to run MaxProp for same period in ONE at the moment.
(simulation 'grinds to a near halt after 600K seconds).

Progress towards RFC

- Another RG Last Call completed

  - A few comments but nothing that authors believe need any action

Next Steps

- Pass the improvements to IRSG reviewer

- Complete IRSG process and pass to IESG before publication approval.

Thank You

BACKUP

Refresher: Old DP Equations

- Notation: P(A,B): Delivery Predictability in Node A for delivering a bundle to Node B.

- Eqn 1: On A encountering B

  - $P\_(A,B) = P\_(A,B)\_old + (1 - P\_(A,B)\_old) * P\_encounter$

- Eqn 2: If A hasn't encountered D for a while:

  - $P\_(A,D) = P\_(A,D)\_old * gamma\char`^K$

- Eqn 3: Does A meeting B mean that A is a better bet for delivering to C? Transitivity...

  - $P\_(A,C) = P\_(A,C)\_old +$
    $(1 - P\_(A,C)\_old) * P\_(A,B) * P\_(B,C) * beta$
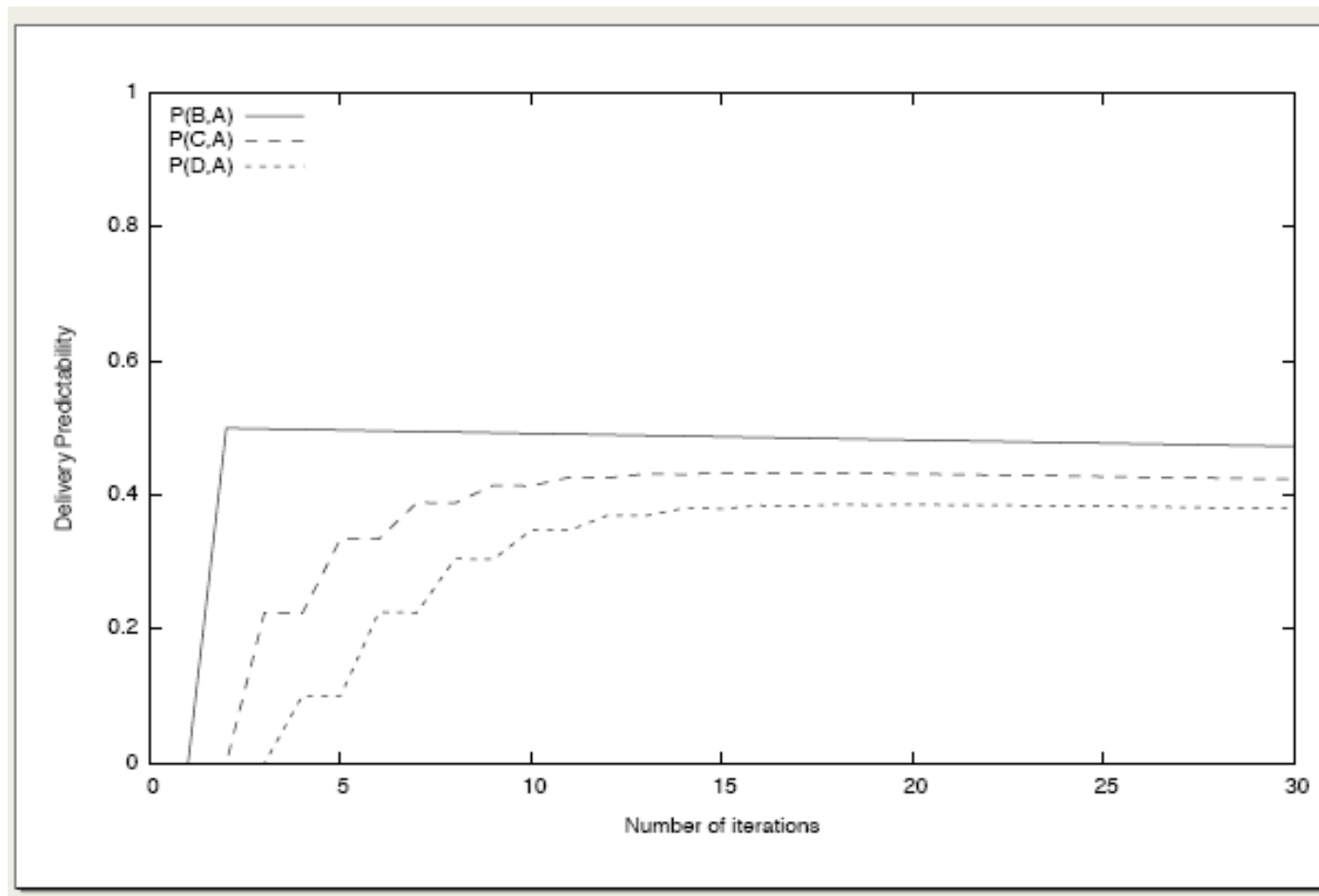
Chain Problem Example
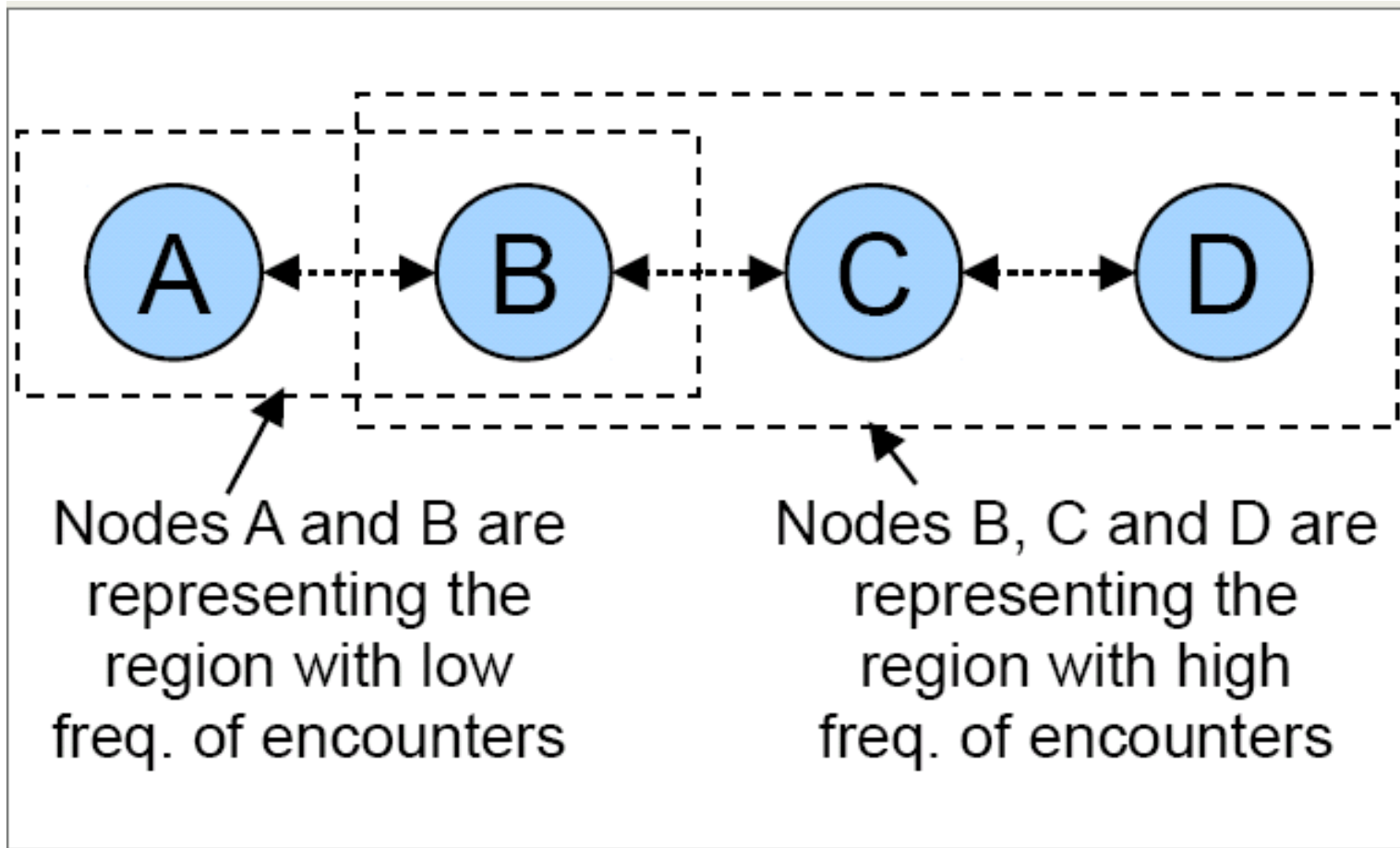
Chain Simulation with PRoPHET v1
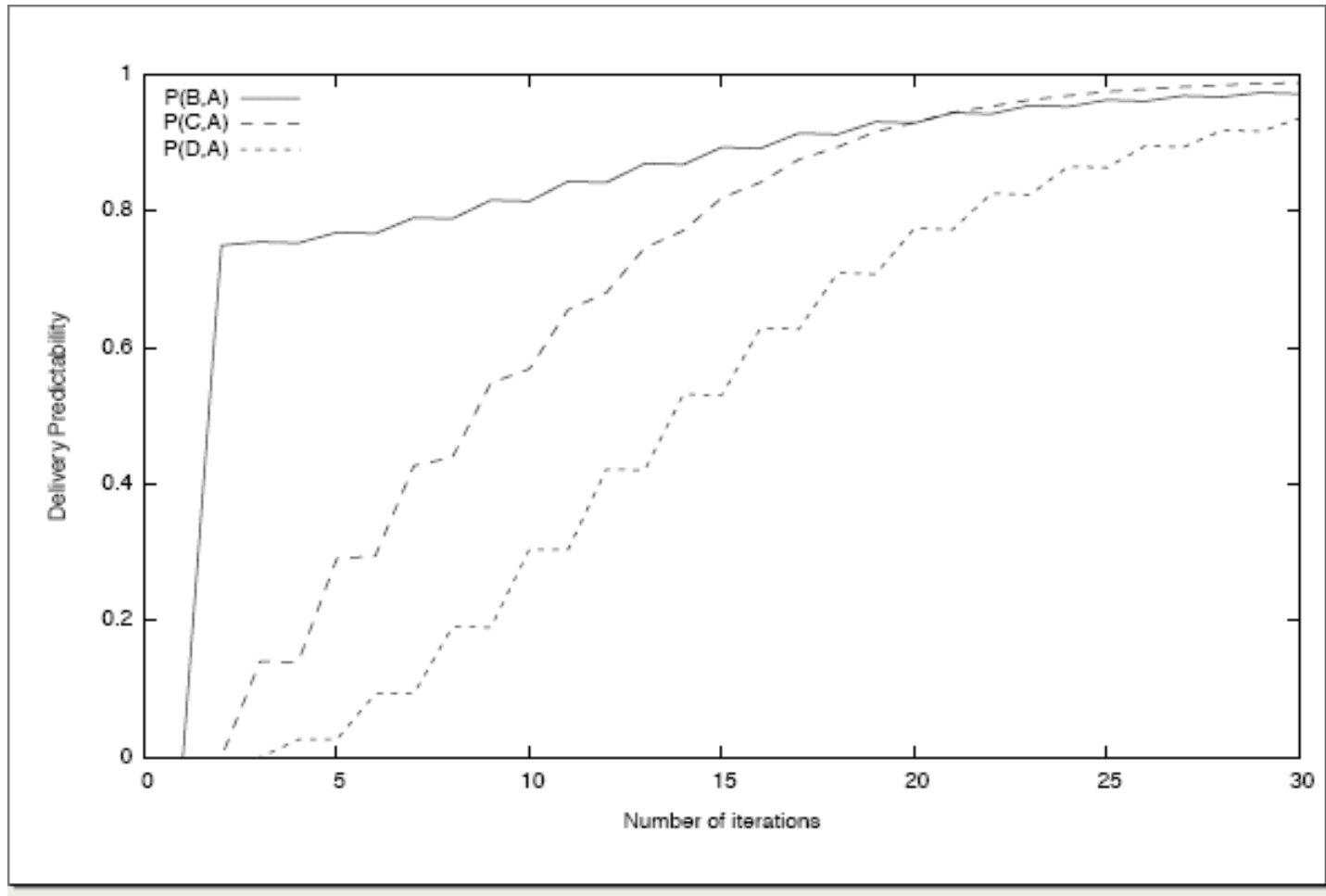
- PRoPHET v1 sets DP to 0.75 on first encounter

Chain Simulation with PRoPHET v2

- PRoPHET v2 sets DP to 0.5 on first encounter