Avatar Mobility in

Wei Tsang Ooi Mehul Motani
Huiguang Liang Ian Tay Ming Feng Neo
National University of Singapore

avatar mobility:

who is where, when

why do we care?

research in systems support for NVE

Dynamic **Partitioning** for a **Distributed Virtual Environment** - all 2 versions »
JCS Lui, MF Chan, KY Oldfield - Proc. of the 3rd High Performance Computing Asia Conference (..., 1998 - citeseer.ist.psu.edu
Dynamic **Partitioning** for a **Distributed Virtual Environment** (1998) (Make Corrections)
(7 citations) John CS Lui, MF Chan Oldfield KY So, TS Tam. **...**
Cited by 29 - Related Articles - Cached - Web Search

An efficient **partitioning** algorithm for **distributed virtual environment** systems - all 2 versions »
MF Chan, JCS Lui - IEEE Transactions on Parallel and Distributed Systems, 2002 - csa.com
An efficient **partitioning** algorithm for **distributed virtual environment**
systems. MF Chan, John CS Lui IEEE Transactions on Parallel **...**
Cited by 8 - Related Articles - Web Search

... Study of Modern Heuristics for Solving the **Partitioning** Problem in **Distributed Virtual Environment** ... - all 2 versions »
P Morillo, M Fernandez, JM Orduna - Proc. Int'l Conf. Computational Science and its Applications ..., 2003 - Springer
... widespread use of high performance graphic cards are making **Distributed Virtual**
Environment (DVE) systems **...** One of these key issues is the **partitioning** problem. **...**
Cited by 10 - Related Articles - Web Search - BL Direct

An ACS-based **partitioning** method for **distributed virtual environment** systems - all 10 versions »
P Morillo, M Fernandez, JM Orduna - Parallel and Distributed Processing Symposium, 2003. ..., 2003 - ieeexplore.ieee.org
Page 1. An ACS-Based **Partitioning** Method for **Distributed Virtual Environment**
Systems P. Morillo, M. Fernandez Instituto de Robotica **...**
Cited by 8 - Related Articles - Web Search

... of evolutive algorithms for solving the **partitioning** problem in **distributed virtual environment** ... - all 2 versions »
P Morillo, JM Orduña, M Fernández - Parallel Computing, 2004 - Elsevier
... reserved. A comparison study of evolutive algorithms for solving the **partitioning**
problem in **distributed virtual environment** systems. P **...**
Cited by 5 - Related Articles - Web Search

[PDF] A Fine-Grain Method for Solving the **Partitioning** Problem in **Distributed Virtual Environment** Systems - all 4 versions »
P Morillo, JM Orduna, M Fernandez, J Duato - Proc. of 16th. Intl. Conf. on Parallel and Distributed ... - informatica.uv.es
... ABSTRACT **Distributed Virtual Environment** (DVE) systems have ex- perienced a spectacular
growth last years. The **partitioning** problem has been proven as the most **...**
Cited by 4 - Related Articles - View as HTML - Web Search

[CITATION] An efficient **partitioning** algorithm for **distributed virtual environment** systems Parallel and ...
JCS Lui, MF Chan - IEEE Transactions on, 2002

how to partition a world into cells and assign cells to servers considering

- interaction across cells
- movement across cells
- avatar density in each cell
  :

Scholar

Results 1 - 5 of 5 for **allintitle: prefetching "virtual environments"**. (0.04 seconds)

Tip: Try removing quotes from your search to get more results.

On caching and **prefetching** of virtual objects in distributed **virtual environments** - all 2 versions »

JHP Chim, M Green, RWH Lau, HV Leong, A Si - Proceedings of the sixth ACM international conference on ..., 1998 - portal.acm.org

... On Caching and **Prefetching** of Virtual Objects in Distributed **Virtual Environments**
Jimmy HP Chimi hk Green: Rynson WH Lau* Hong Va Leongt Antonio Si! ...

Cited by 51 - Related Articles - Web Search

... data management using user-based caching and **prefetching** in distributed **virtual environments** - all 9 versions »

S Park, D Lee, M Lim, C Yu - Proceedings of the ACM symposium on Virtual reality software ..., 2001 - portal.acm.org

Page 1. Scalable Data Management Using User-Based Caching and **Prefetching** in
Distributed **Virtual Environments** Sungju Park Dongman Lee Mingyu Lim Chansu Yu ...

Cited by 10 - Related Articles - Web Search

A hybrid motion prediction method for caching and **prefetching** in distributed **virtual environments** - all 3 versions »

A Chan, RWH Lau, B Ng - Proceedings of the ACM symposium on Virtual reality software ..., 2001 - portal.acm.org

... **Prefetching** in Distributed **Virtual Environments** Addison Chan addi@cs.cityu.edu.hk
Rynson WH Lau rynson@cs.cityu.edu.hk Beatrice Ng beatrice@cs.cityu.edu.hk ...

Cited by 8 - Related Articles - Web Search

[CITATION] ... Leong, and A. Si,"On Caching and **Prefetching** of Virtual Objects in Distributed **Virtual Environments**, ...

JH Chim, M Green, RW Lau - Proceedings of ACM Mutimedia, 1998

Cited by 1 - Related Articles - Web Search

Prediction-based **Prefetching** for Remote Rendering Streaming in Mobile **Virtual Environments** - all 2 versions »

S Lazem, M Elteir, A Abdel-Hamid, D Gracanin - Signal Processing and Information Technology, 2007 IEEE ..., 2007 - ieeexplore.ieee.org

... Prediction-based **Prefetching** for Remote Rendering Streaming in Mobile **Virtual**
Environments Shaimaa Lazeml Marwa Elteirl Ayman Abdel-Hamid2,3 Denis Gracanin' ...

Related Articles - Web Search

Key authors: **J Chim** - **R Lau** - **M Green** - **H Leong** - **A Si**

how to predict avatar movement (and therefore what a user will see next)?

A **Peer-to-Peer** Message Exchange Scheme for Large-Scale Networked **Virtual Environments** - all 10 versions »
Y Kawahara, T Aoyama, H Morikawa - Telecommunication Systems, 2004 - Springer
... [7] Y. Kawahara, H. Morikawa and T. Aoyama, A **peer-to-peer** message exchange scheme for large scale networked **virtual environments**, in: Proc. ...
Cited by 39 - Related Articles - Web Search - BL Direct

VON: a scalable **peer-to-peer** network for **virtual environments** - all 2 versions »
SY Hu, JF Chen, TH Chen - Network, IEEE, 2006 - ieeexplore.ieee.org
VON: a scalable **peer-to-peer** network for **virtual environments** Shun-Yun Hu Jui-Fa Chen Tsu-Han Chen Inst. of Phys., Acad. Sinica, Taipei, Taiwan; ...
Cited by 25 - Related Articles - Web Search - BL Direct

... Mechanisms for Closely Coupled Collaboration in Multithreaded **Peer-to-Peer Virtual Environments** - all 6 versions »
JM Linebarger, GD Kessler - Presence: Teleoperators & **Virtual Environments**, 2004 - MIT Press
... Designed for **peer-to-peer virtual environments** in which several threads have access to the shared scene graph, these algorithms are straightforward and ...
Cited by 12 - Related Articles - Web Search - BL Direct

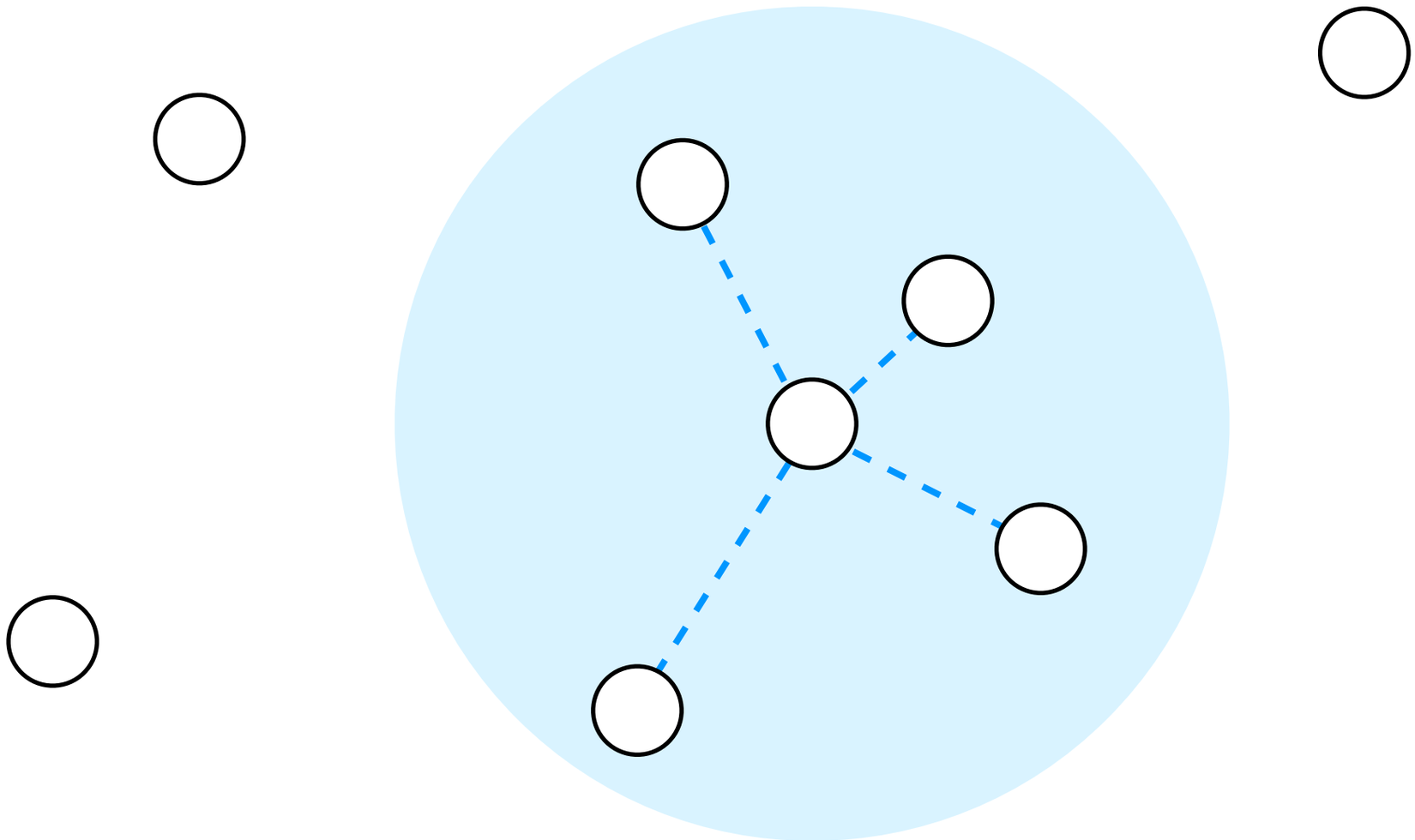
Supporting scalable **peer to peer virtual environments** using frontier sets - all 6 versions »
A Steed, C Angus - Proceedings of IEEE Virtual Reality 2005, 2005 - doi.ieeecomputersociety.org
Page 1. Supporting Scalable **Peer to Peer Virtual Environments** using Frontier Sets Anthony Steed 1 , Cameron Angus 2 Department of ...
Cited by 9 - Related Articles - Web Search

Providing full awareness to distributed **virtual environments** based on **peer-to-peer** architectures
P Morillo, W Moncho, JM Orduna, J Duato - Lecture Notes on Computer Science, 2006 - Springer
... **Environments** Based on **Peer-to-Peer** Architectures * ... Supporting scalable **peer to peer virtual environments** using frontier sets. In IEEE Virtual Reality-2005. ...
Cited by 6 - Related Articles - Web Search - BL Direct

[CITATION] VON: a scalable **peer-to-peer** network for **virtual environments**. Network
SY Hu, JF Chen, TH Chen - IEEE, 2006
Cited by 4 - Related Articles - Web Search

A Hybrid Solution to Support Multiuser 3D Virtual Simulation Environments in **Peer-to-Peer** Networks - all 4 versions »
A Boukerche, RB Araujo, M Laffranchi - Proceedings of Distributed Simulation and Real-Time ..., 2004 - doi.ieeecomputersociety.org
... the issues involved in the implementation of 3D MUVEs in hybrid **peer-to-peer** networks, and ... of multi-user 3D games and multi-user **virtual environments** in general ...

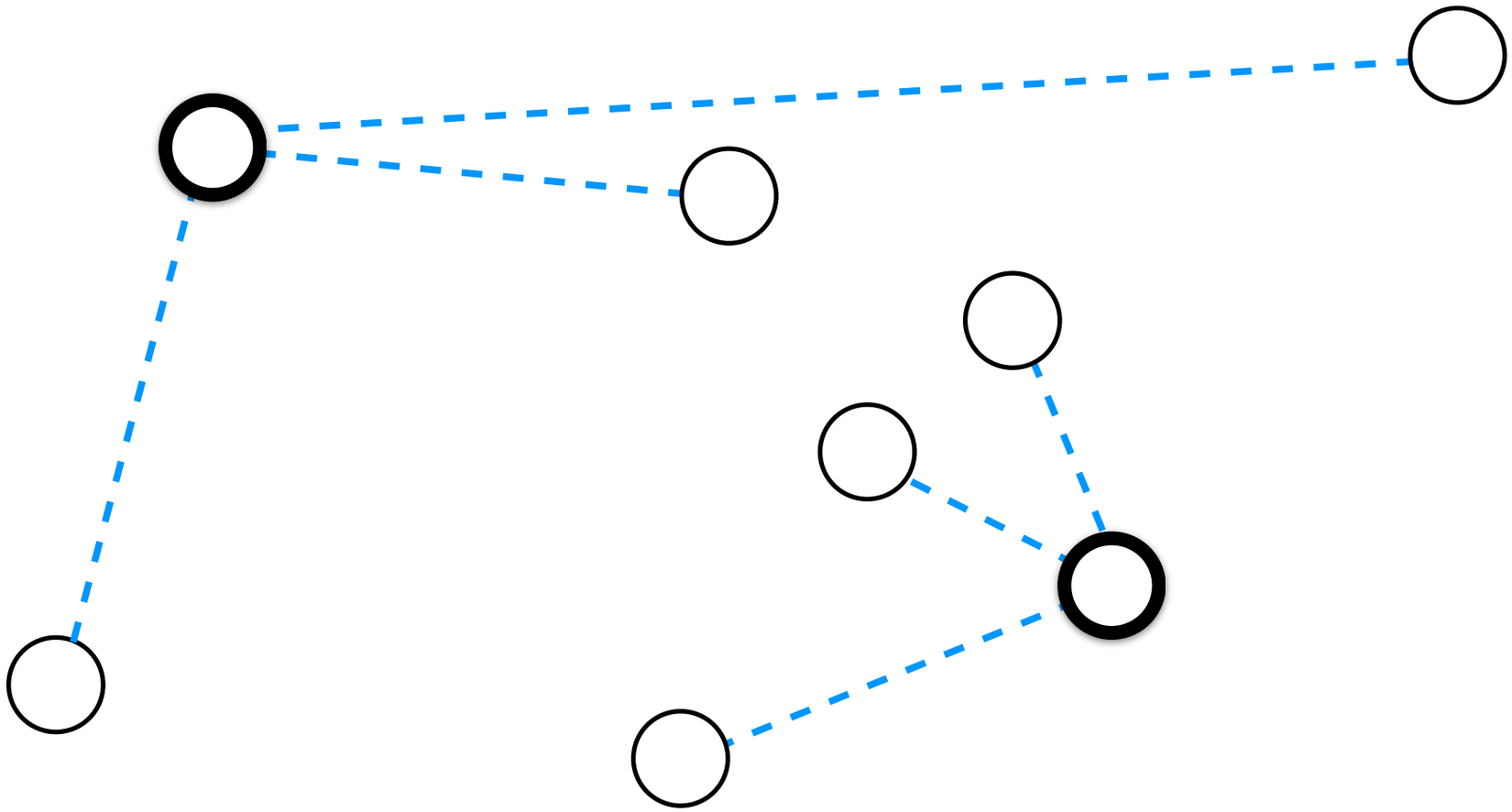
Aol-based scheme



how many connections?

how stable are the connections?

supernode-based scheme



how to pick supernodes?

how stable are the supernodes?

how to simulate avatar mobility?

random walk
random waypoint
clustered movement
:

or,

small-scale implementation

no large-scale NVE
available until recently

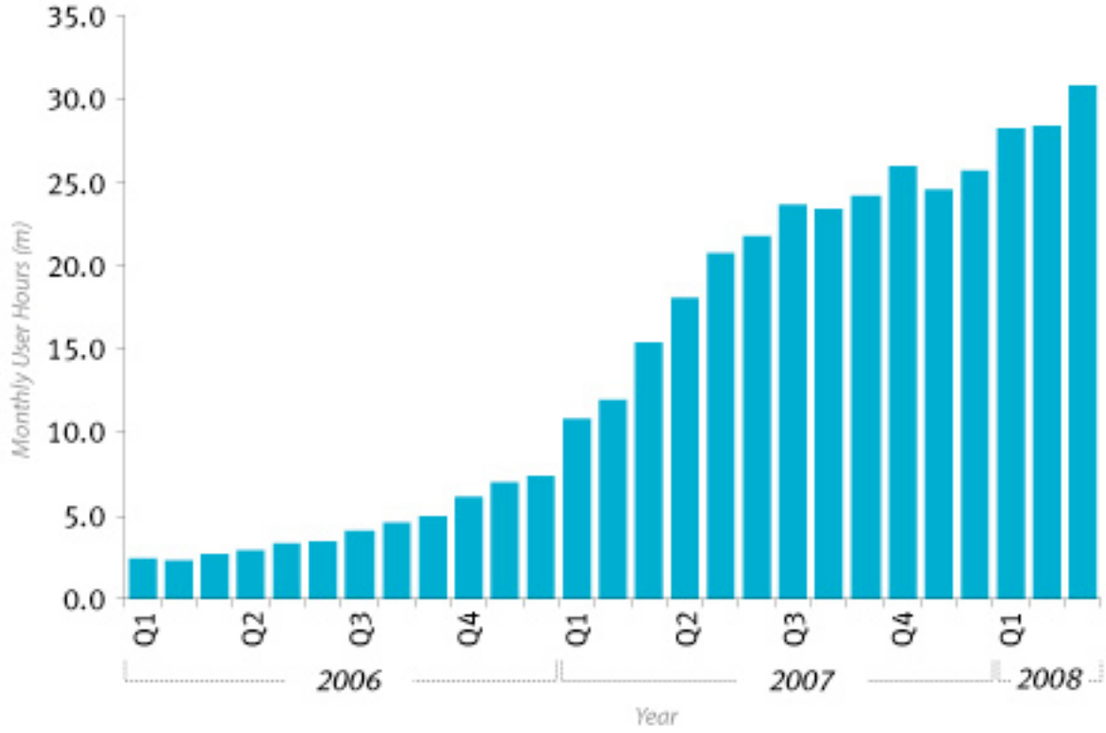
"My life is so great that I literally wanted a second one!"
- *Dwight Schrute, The Office*

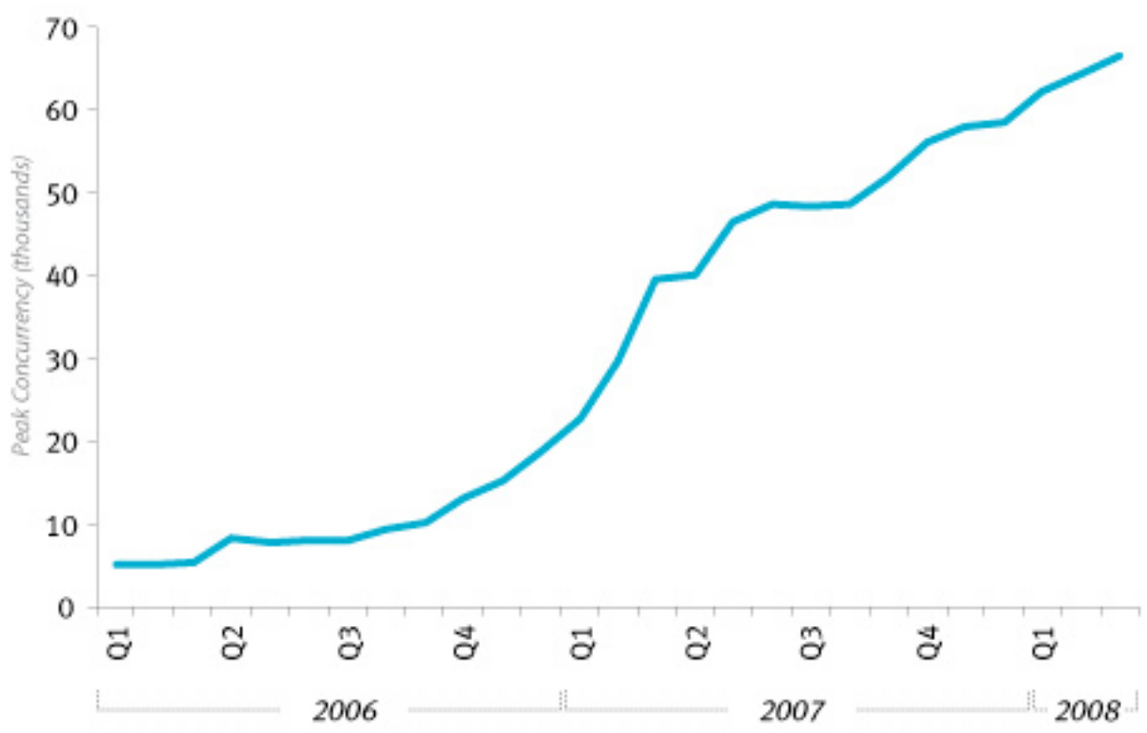
256x256 m regions.


MMC
MMC

470,478

residents logged in between 12-19 June 2008





secondlife.com/whatis/economy-graphs.php

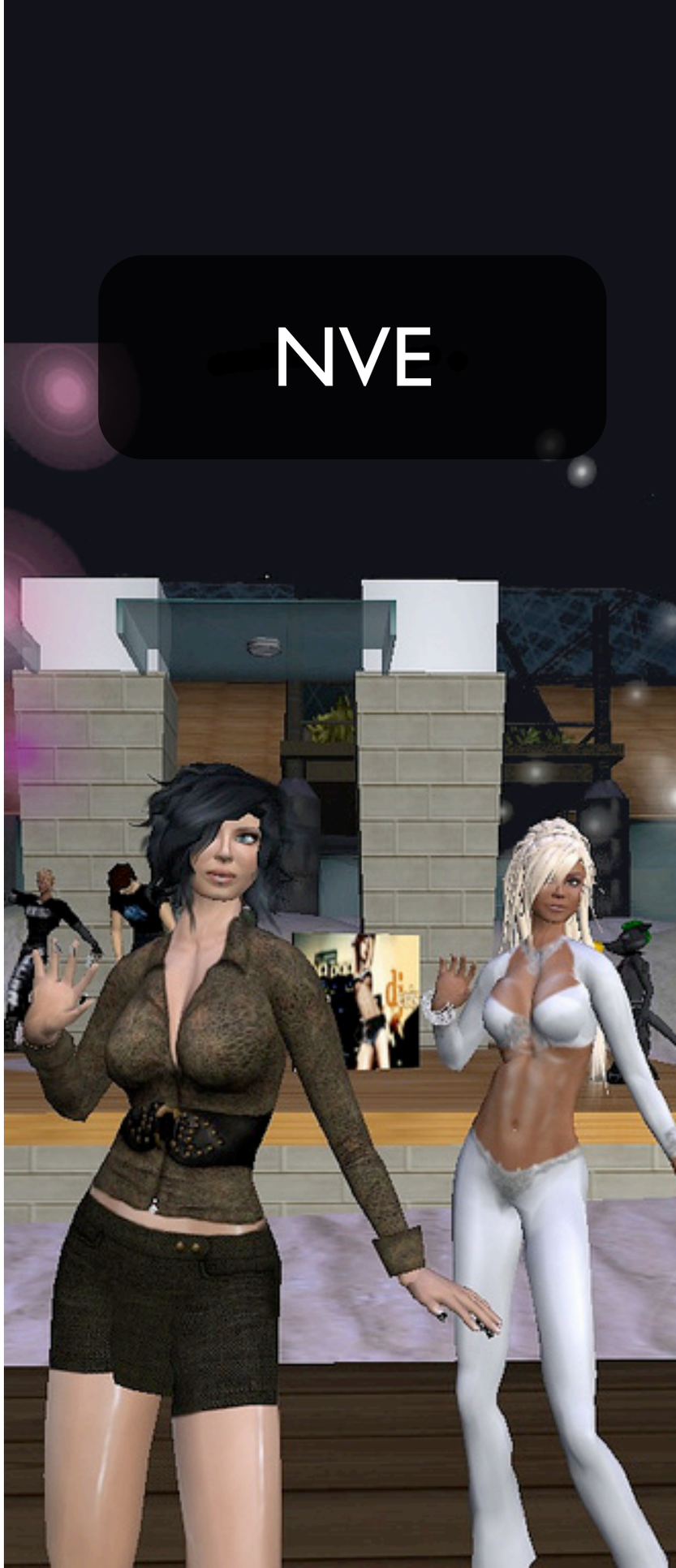
- collect mobility traces of avatars in Second Life
- what it means w.r.t. systems design for NVEs?

Trace Collection

FPS

MMORPG

NVE

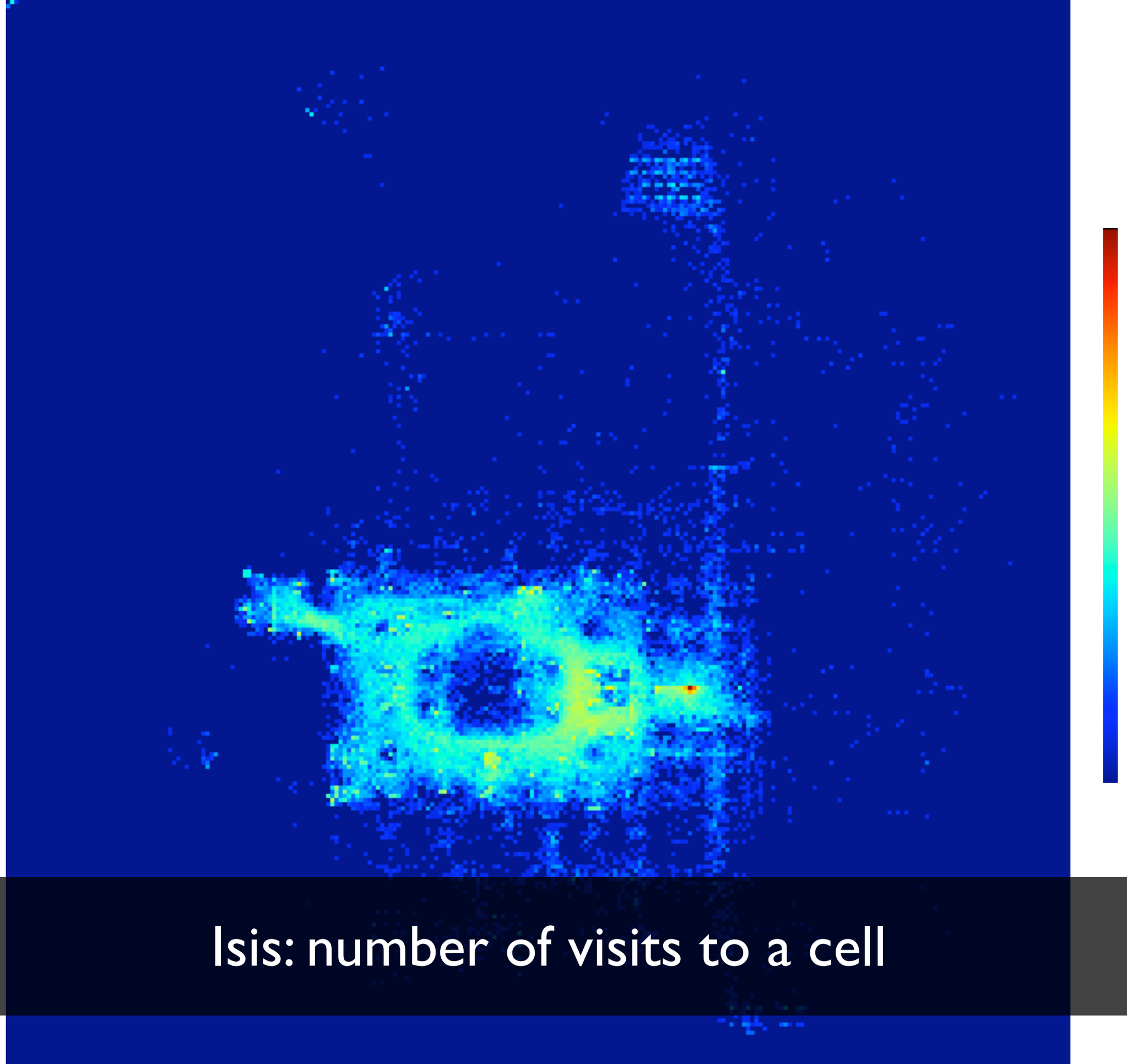


Linden, can we get access to the server traces?

No.

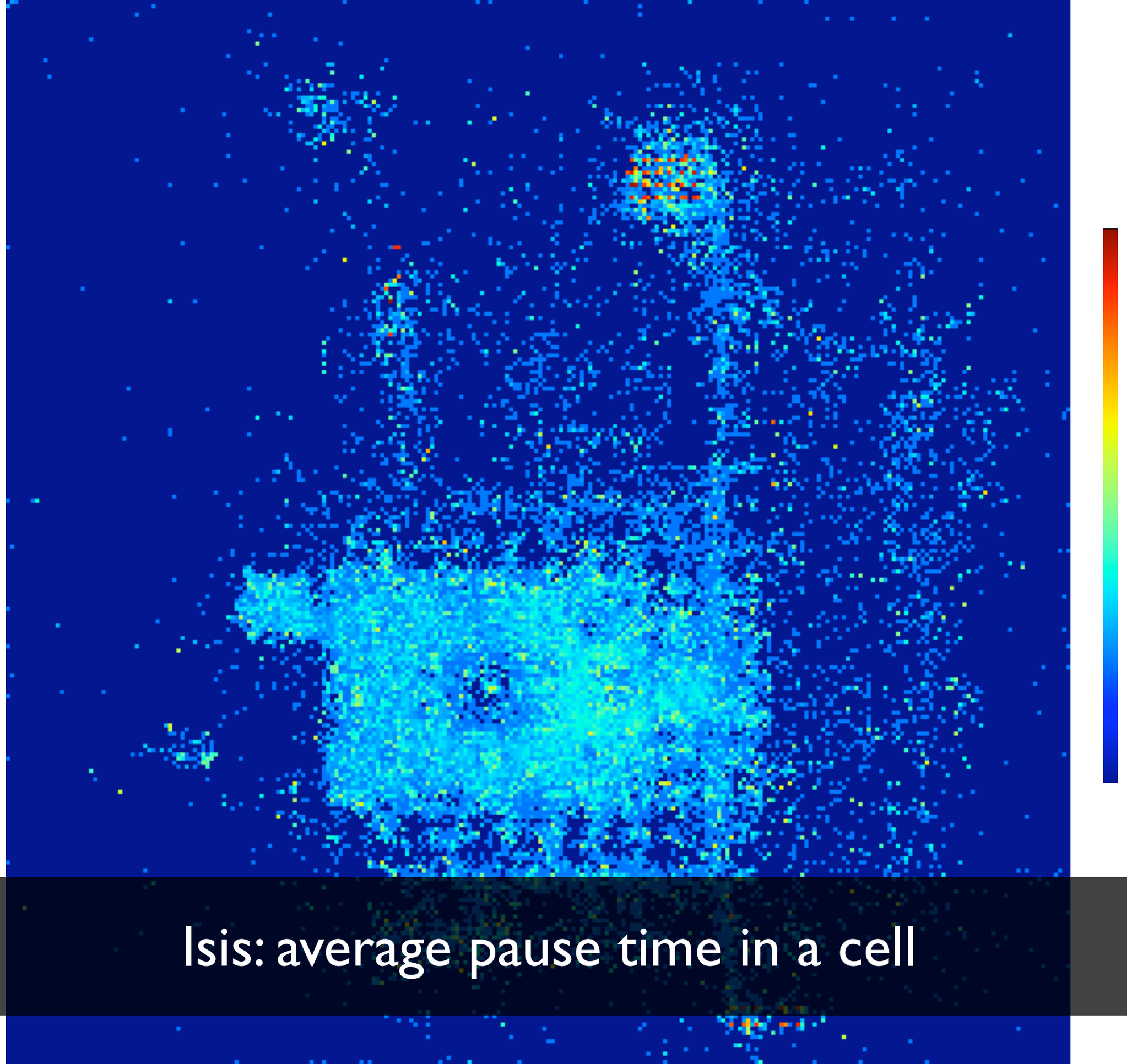
- Wrote our own client
- Parses packets using *libsecondlife*
- Insert bots into regions
- Log positions of avatars every 10s

who is
where,
when
(doing what)



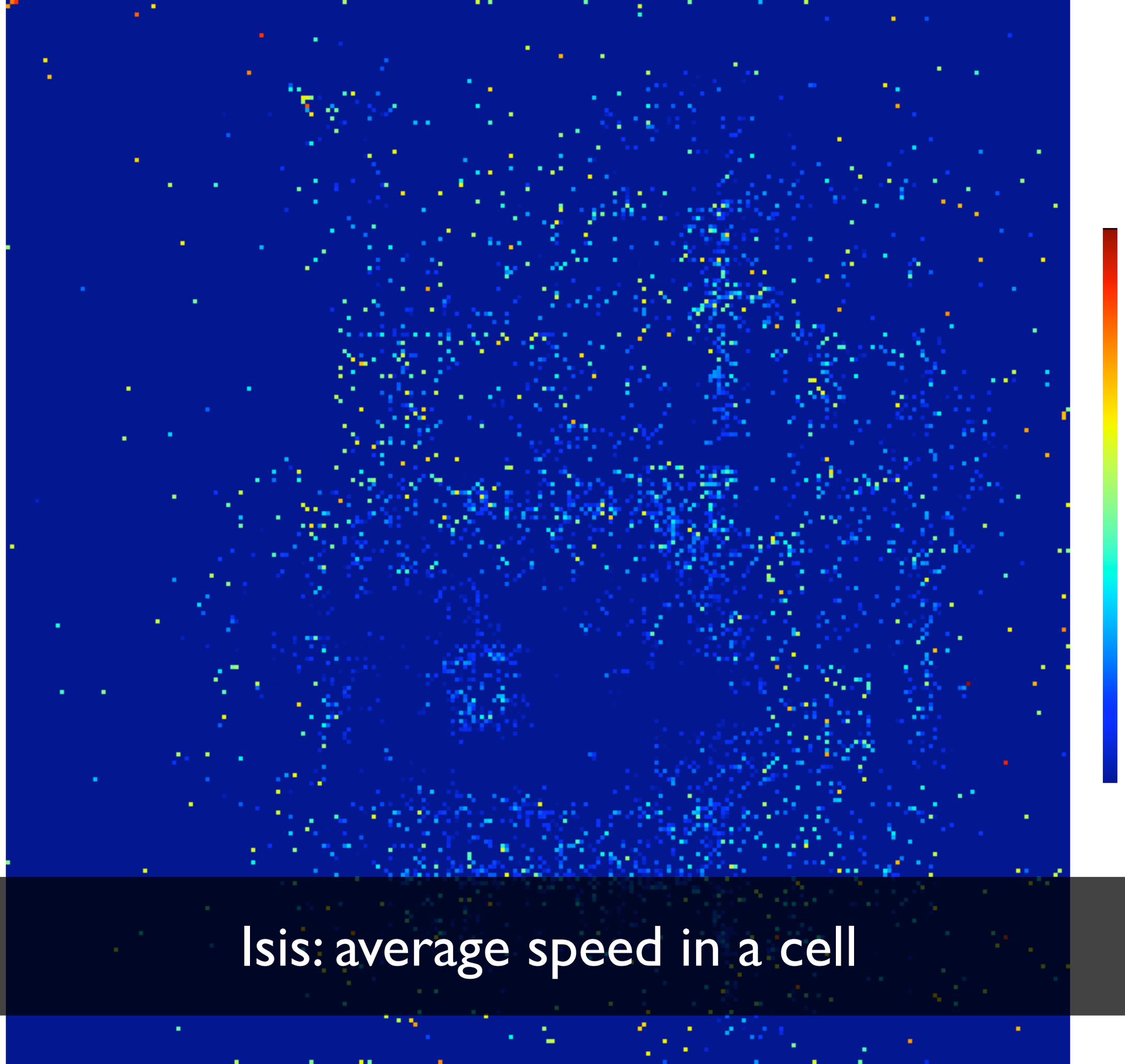
Isis: number of visits to a cell

caching/prefetching based on popularity of locations?



Isis: average pause time in a cell

pick supernodes from sticky location?

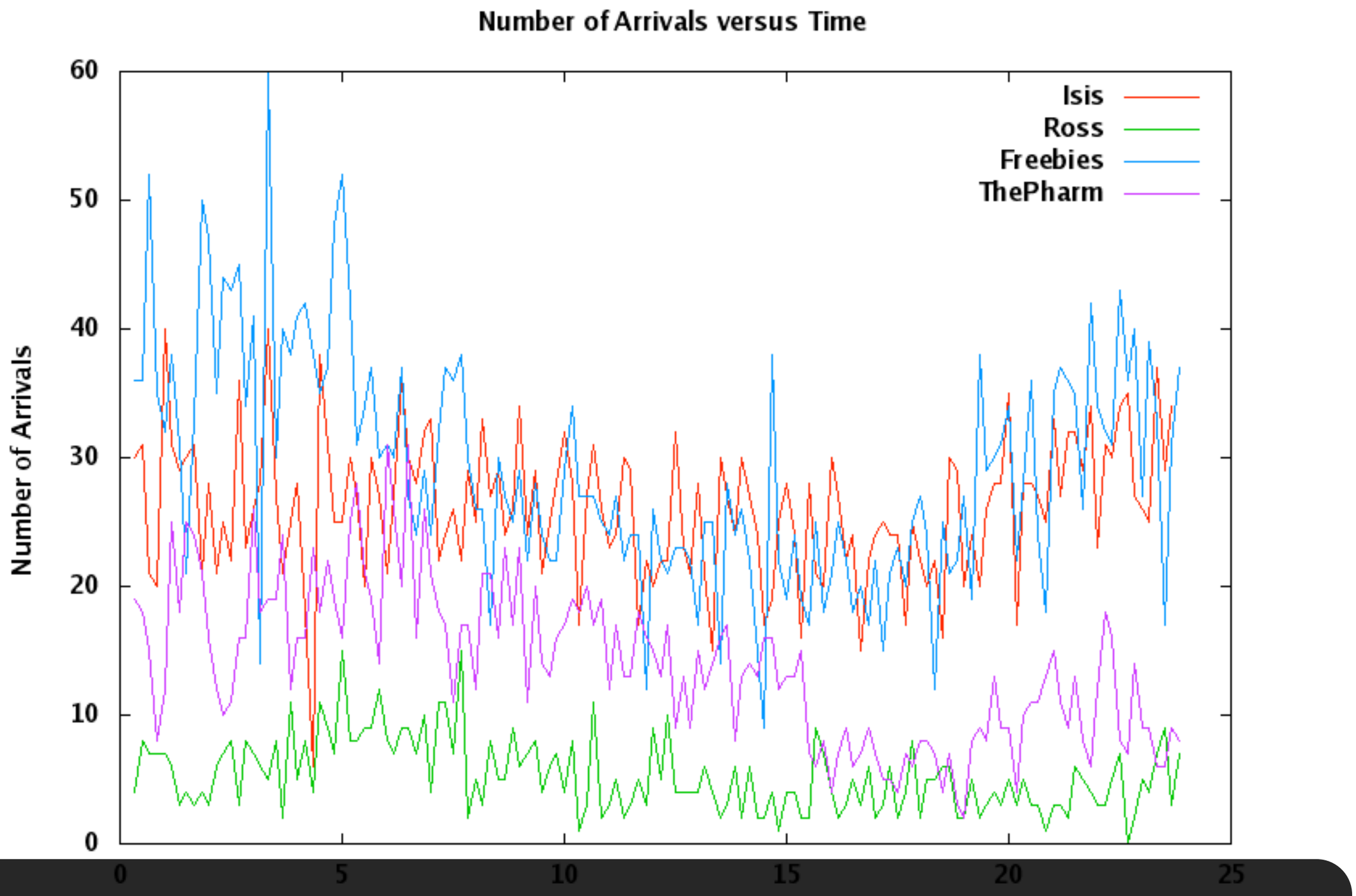


Isis: average speed in a cell

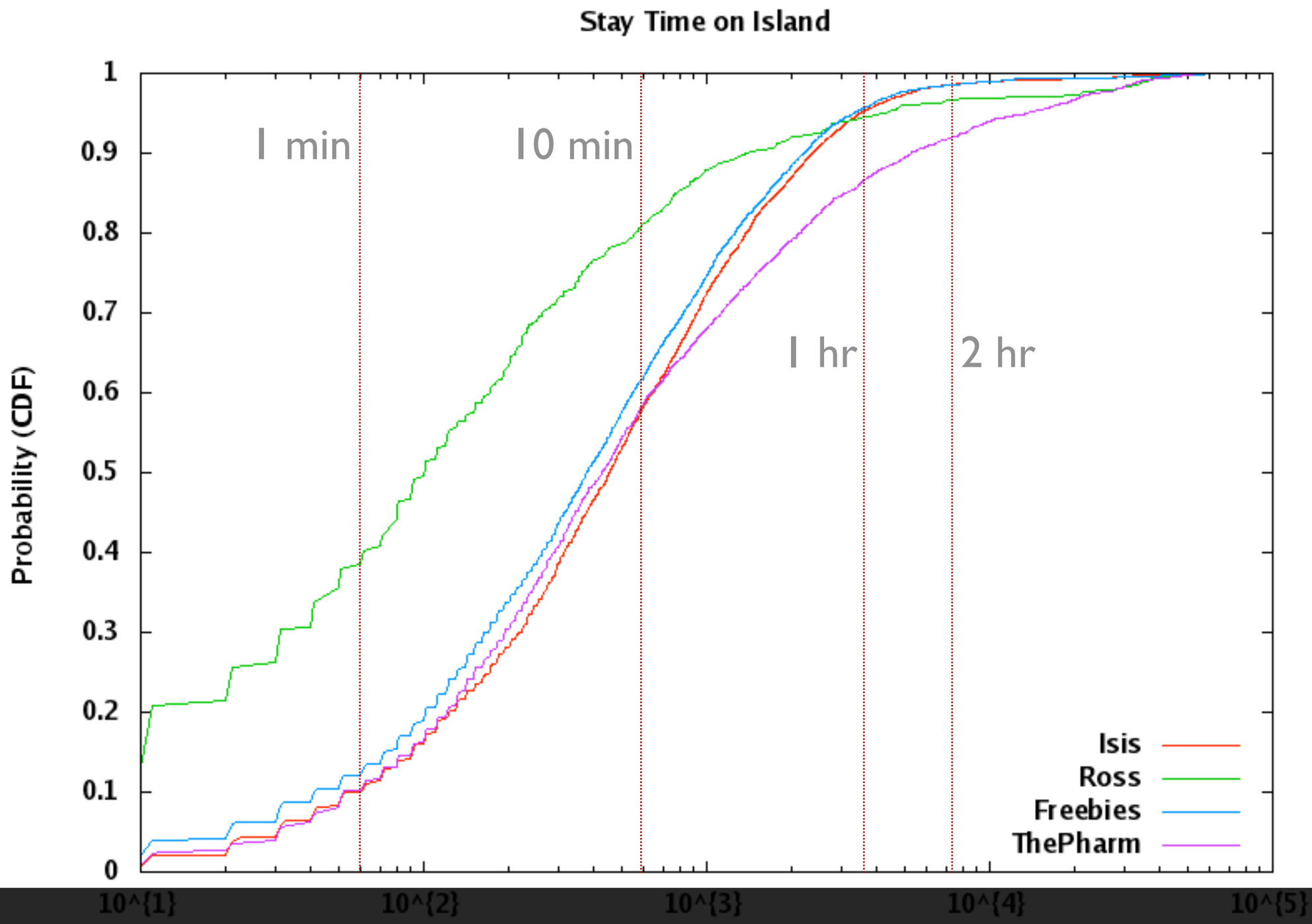
mobility model:

random walk +

pathway ?



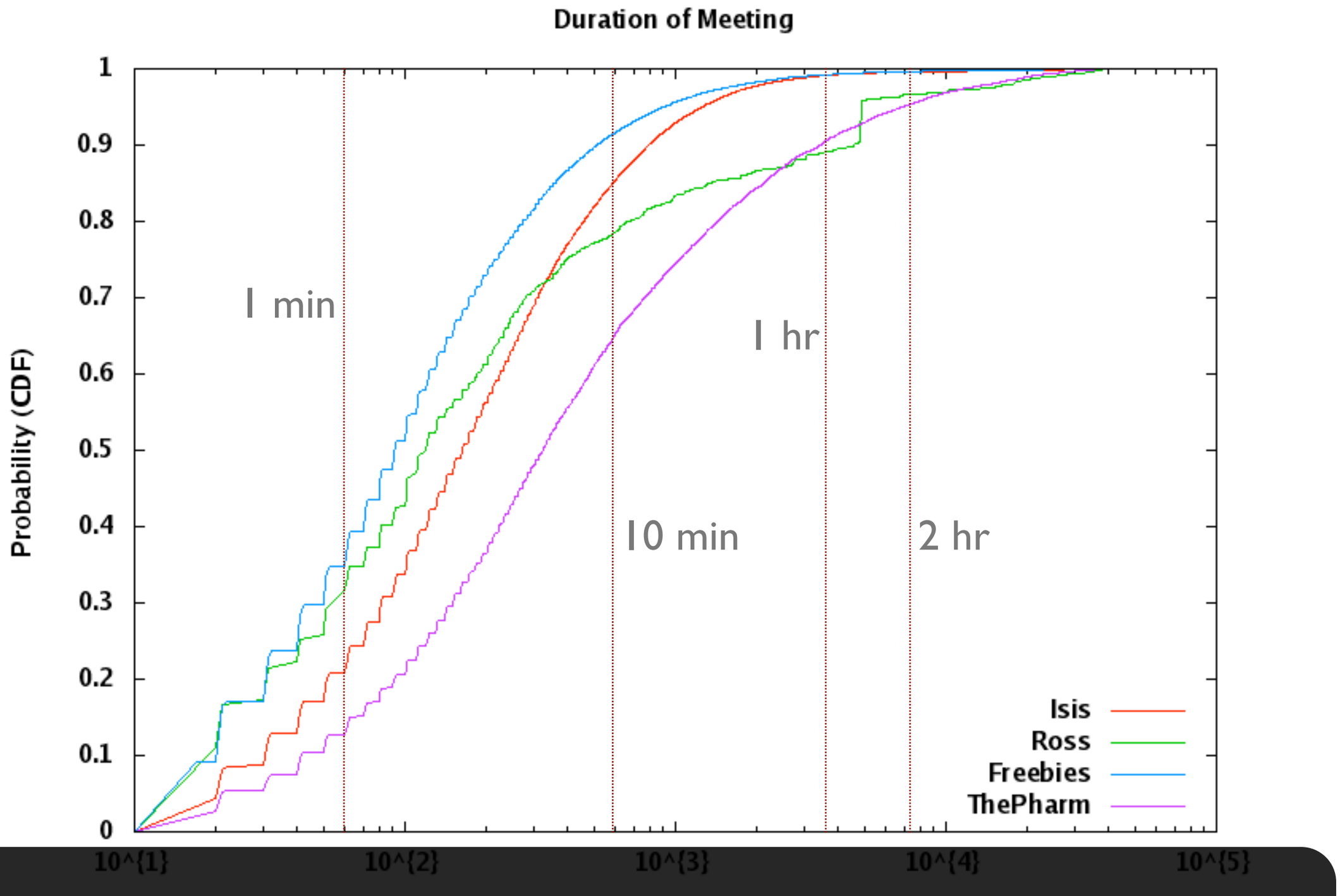
Reasonably high churn (up to 6/min)



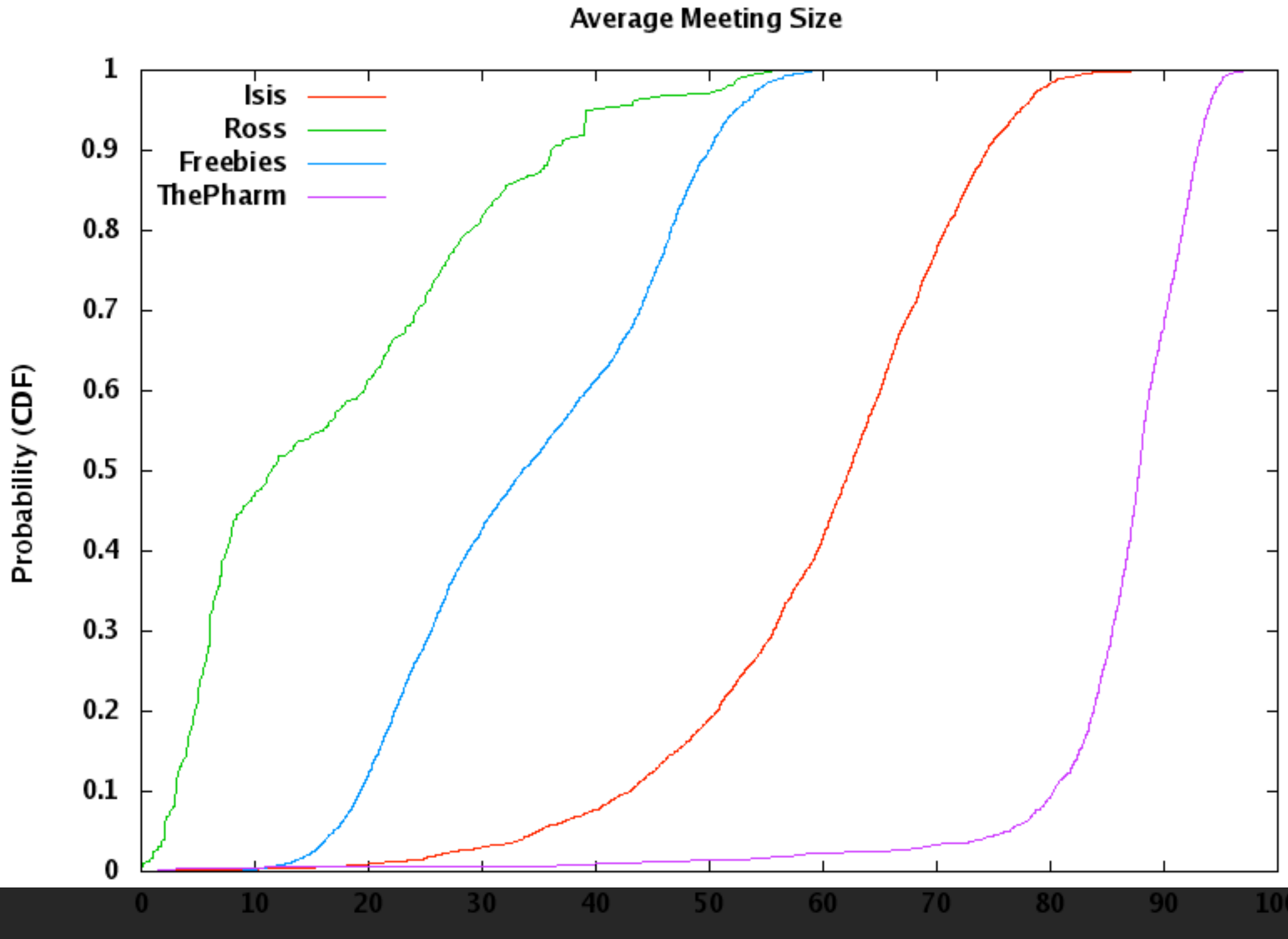
Highly skewed. Some stay for hours.

cannot pick supernodes uniformly

meeting: encounter between two avatars (within each other AoI)



Most meetings are short.



Meeting size is large.

high overhead in maintaining Aol neighbors

- very little temporal variations (predictable)
- avatars rotates 18% of time (SL's prefetching is wasteful)
- 25-35% revisits regions within a day (region-based caching?)

understanding how *real* avatars move is key to design and evaluation of NVEs.