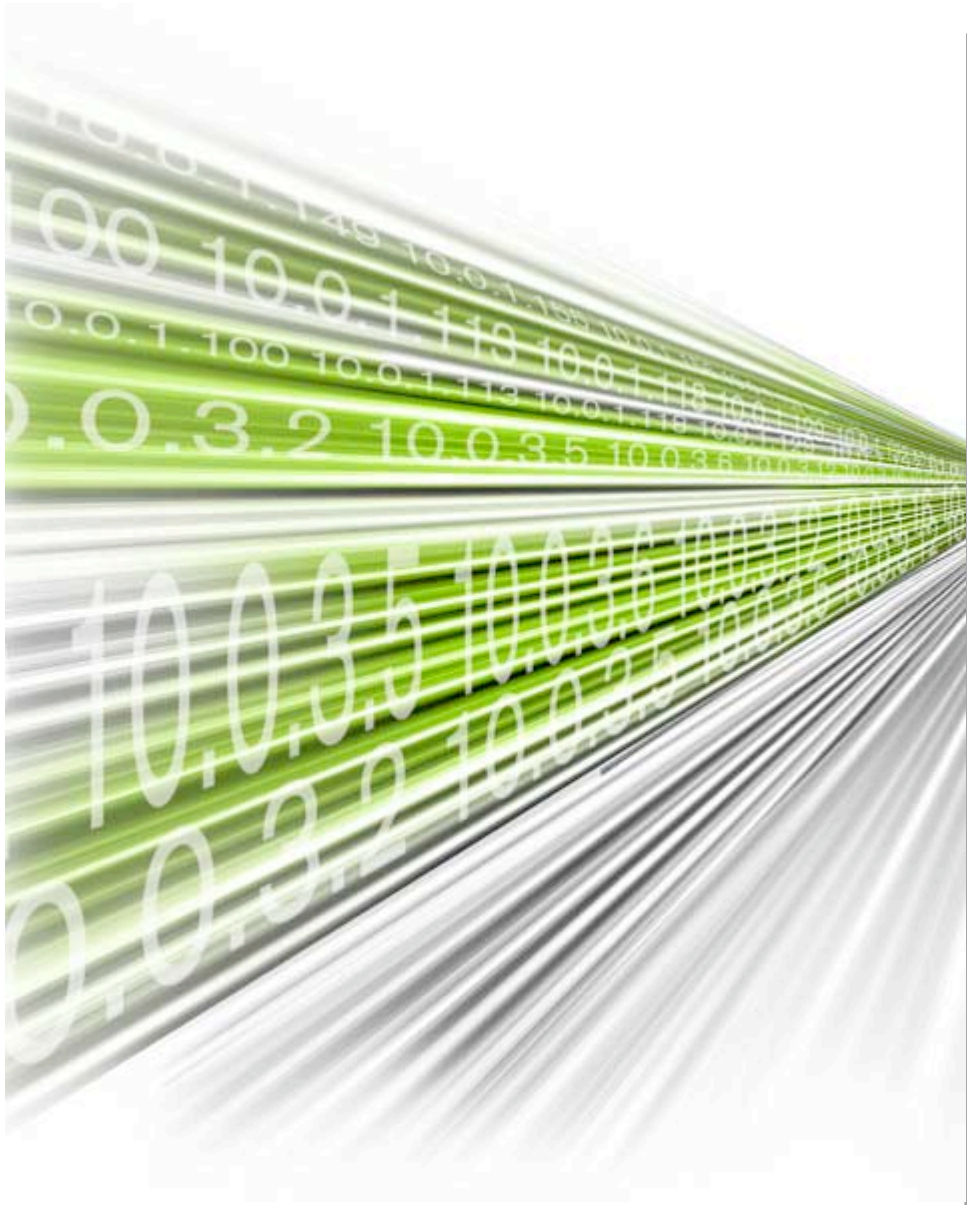

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PRINCETON UNIVERSITY

A One-Year Study of IPv6 Internet Traffic

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Outline of Presentation

1. Goals and background
2. Methodology
3. Key results
4. Conclusion and discussion

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Goal: Global and longitudinal perspective on Internet IPv6 traffic

- **Part of Arbor Networks project providing global perspective on *all* Internet traffic**
  - Across geographic regions
  - And types of providers (content, higher ed)
  - Leveraging > 2k Arbor probe deployments
- **Key insights**
  - Growth in traffic for applications and services
  - Pervasiveness of unwanted traffic (*e.g.*, DDoS)

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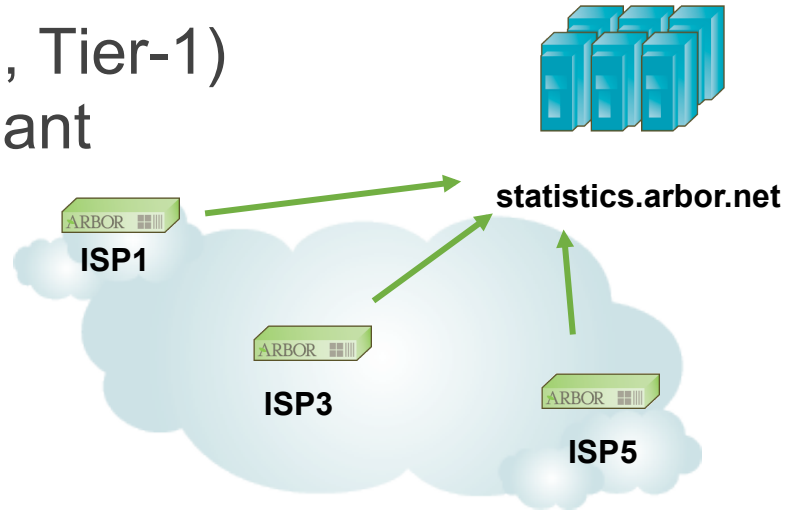
Data Set

Source

- ~100 voluntarily participating ISPs
- Self-categorization of type (*e.g.*, Tier-1)
- Self-categorization of predominant geographic region



Description

- One year period
- Traffic in/out network into 5-min samples
- Across top protocols, ports, ASNs, etc
- Largely based on IP flow measurements

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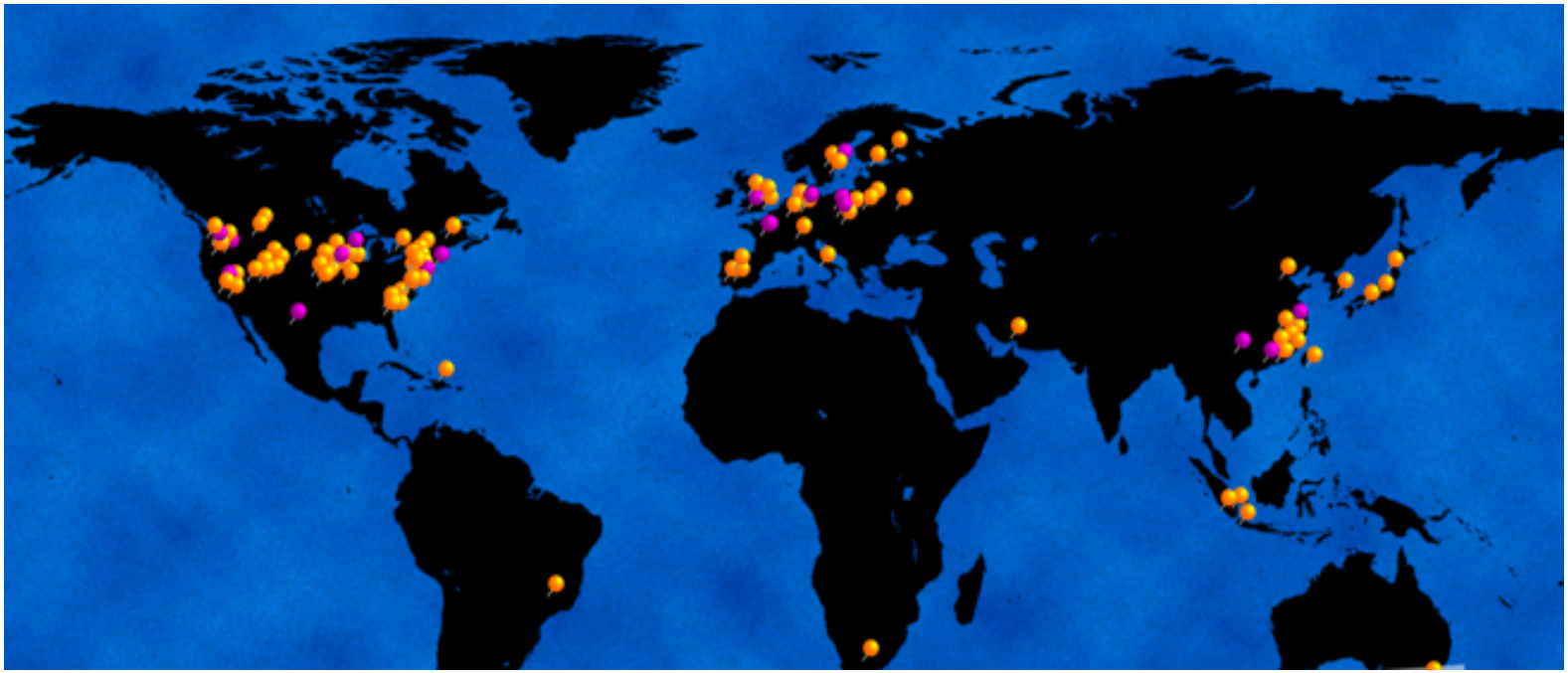
Global Footprint



- Global and longitudinal perspective
- 65 Americas, 27 EMEA, 6 AsiaPac
- Exceeding 5tbps of inter-domain traffic

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IPv6 Context

- **Imminent IANA IPv4 address exhaustion**
  - Widely predicted to happen within next few years (*e.g.*, by CAIDA, Geoff Huston)
- **IPv6 has many more available addresses**
  - 28 orders of magnitude should be sufficient
- **There have been some government pressure to make the transition**
  - OMB mandate IPv6 to be available on routers
  - China's Next Generation Internet Initiative

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IPv6 Transition

- **How much IPv6 *traffic* is on the Internet?**
- **Various indirect estimates published**
  - % ASNs with IPv6 BGP announcements - 3%[1]
  - %Internet2 sites w/passing IPv6 grade - 1%[2]
  - % Alexa Top 500 websites using IPv6 - 0.4%[1]
  - IPv6 DNS queries as % IPv4 DNS load - 0.2% [3]
- **IPv6 as % of all Internet traffic - 0.002%**

[1] http://bgp.he.net/ipv6-progress-report.cgi, [2] http://www.mrp.net/IPv6_Survey.html,
[3] http://www.potaroo.net/presentations/2008-06-18-ipv6-deployment.pdf

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IPv6 Measurement Methodology

- **Inter-domain IPv6 traffic**
- **Native IPv6 traffic**
  - Requires that routers support NetFlow v9
- **Multiple forms of IPv6-over-IPv4 tunneled**
  - Tunneled over IPv4 protocol 41
  - Teredo traffic, tunneled over UDP port 3544

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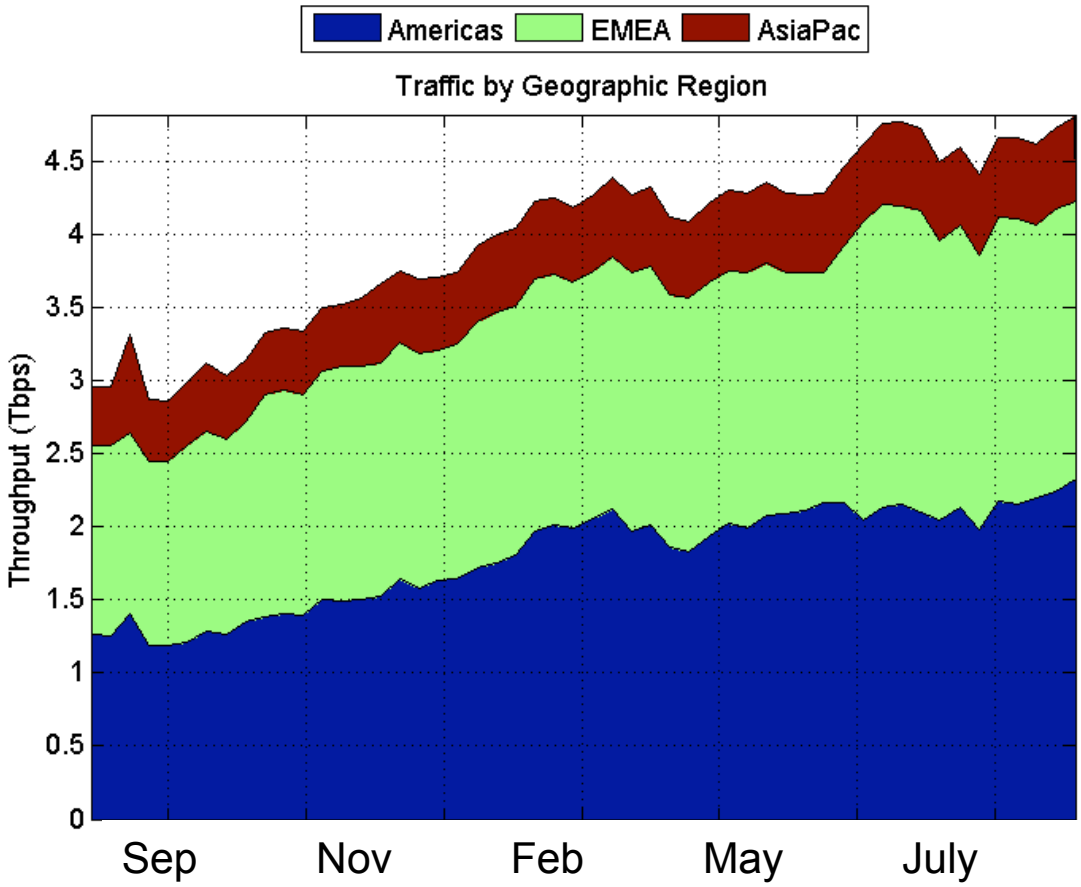
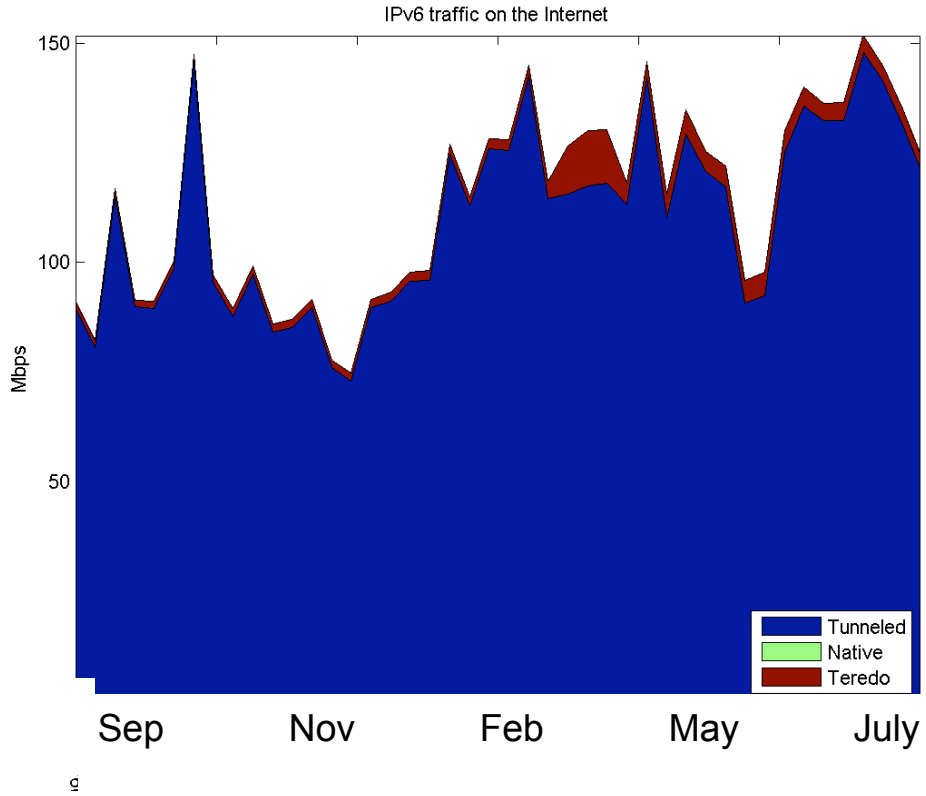
Global and longitudinal traffic dataset



IPv6 traffic is growing…



- > 30% increase between first and last quarter
- Approaching 150 Mbps of inter-domain IPv6

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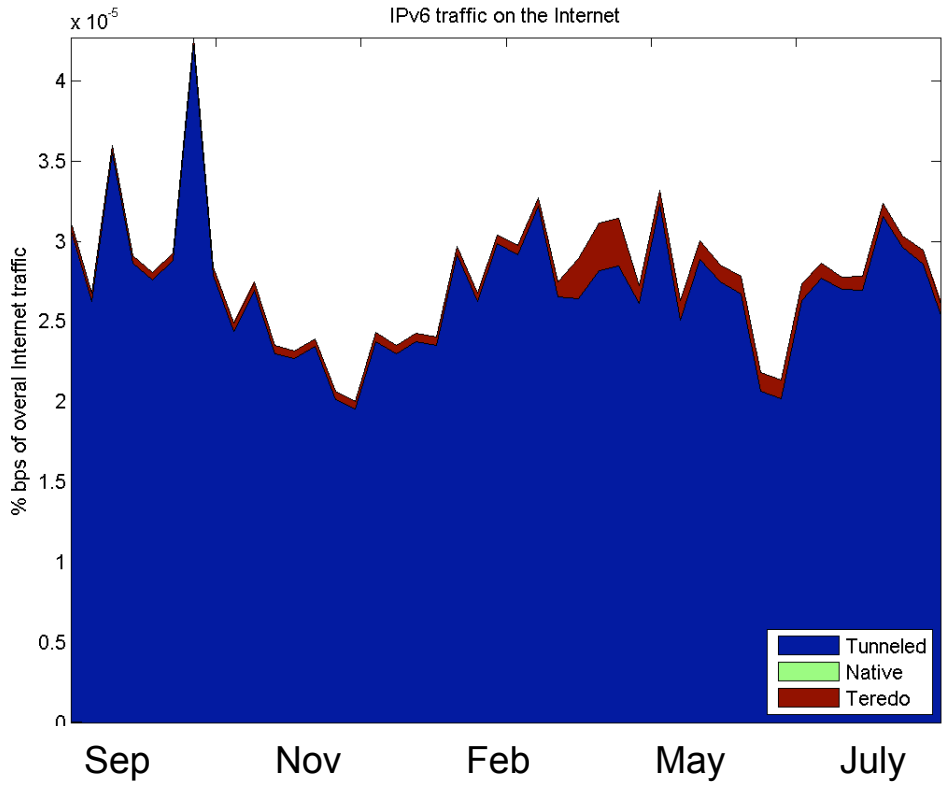
IPv6 as fraction of Internet traffic



- **< 3 *thousandths* of 1 *percent* average**
- **Growing more slowly than IPv4 inter-domain**

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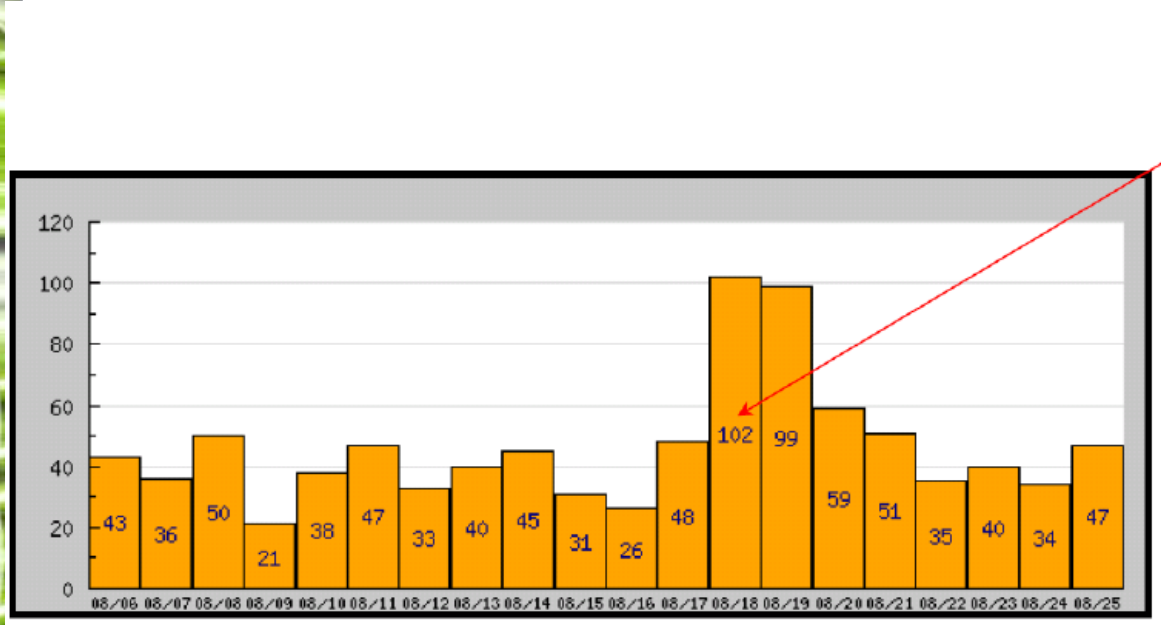
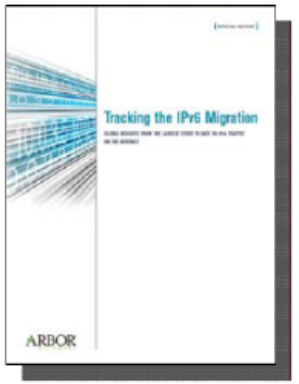
Immediate IPv6 Report Impact!



Arbor Networks "Tracking the IPv6 Migration" report released



Daily tunnel broker account signups for HE

Hurricane Electric Tunnel Broker – http://tunnelbroker.net/

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IPv6 Methodology Objections, I

- **Not monitoring *your* network**
  a) Please sign up today!
  b) 5tbps of inter-domain traffic is representative
- **North American / European bias to networks participating in study**
- **Focused on inter-domain traffic**
  – Intra-domain not studied
- **Data set primarily flow based**
  – More DPI measurements needed for future work

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IPv6 Methodology Objections, II

- **Undercounting native IPv6 traffic**
  - Monitoring requires NetFlow v9
  - Many networks have not yet deployed NetFlow v9
- **Undercounting Teredo traffic**
  - Data traffic need not traverse UDP 3544
  - Teredo relays and servers listen on 3544
  - Only 2 deployments saw more than an occasional few kbps of UDP 3544 traffic

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Why So Little IPv6 traffic?

- **Findings**
  - There is growth in IPv6 traffic
  - But stagnant compared to overall Internet traffic
  - And very little percentagewise
- **Why? Some thoughts:**
  - Money: high costs, no added revenue
  - Chicken/egg problem: no users, no content
  - IPv4 is working well, why mess with it?

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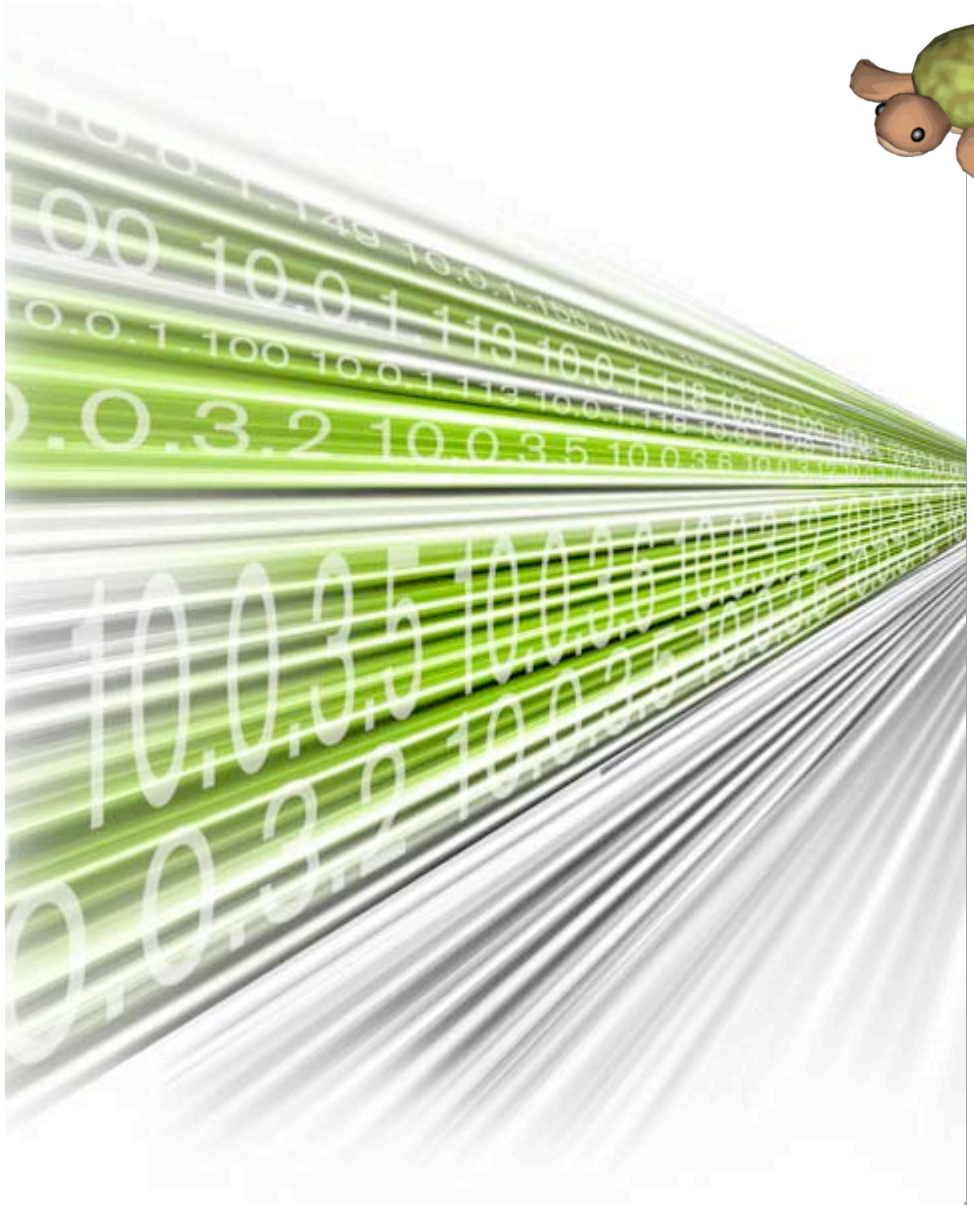

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Thanks!
Questions?

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