MetrANOVA

A Consortium for Advancing Network Observation and Analysis

Introduction and updates

Ed Balas ebalas@es.net July 16th 2024

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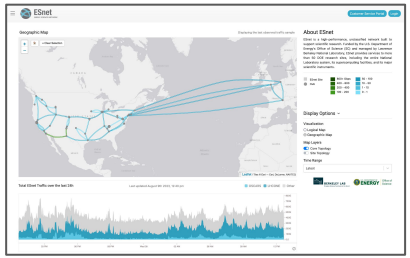
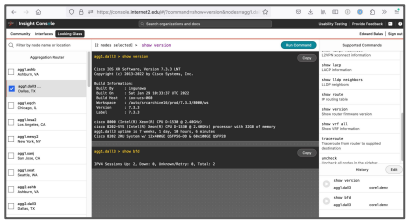
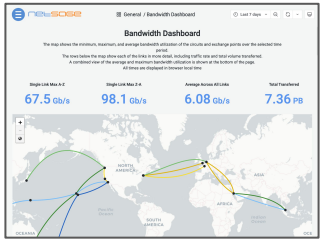
What is Measurement and Monitoring?

- Measuring the network over time, and creating useful things with the observations
  - maps, dashboards, capacity plans, operational alarms, annual reports
  - Whatever helps improve situational awareness, and lets you tell the story
- Typically involve a handful of data types
  - Ports stats, Network Flow Summaries, Optical Performance, Routing Tables, End to End Perf
- Includes systems many of you use today
  - perfSONAR, Nagios, Prometheus, TICK, Stardust, Netsage, Kentik, Arbor Networks, Deepfield

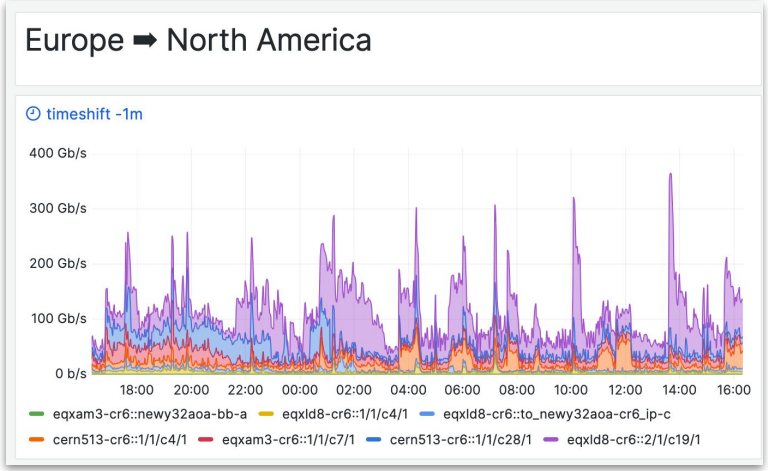


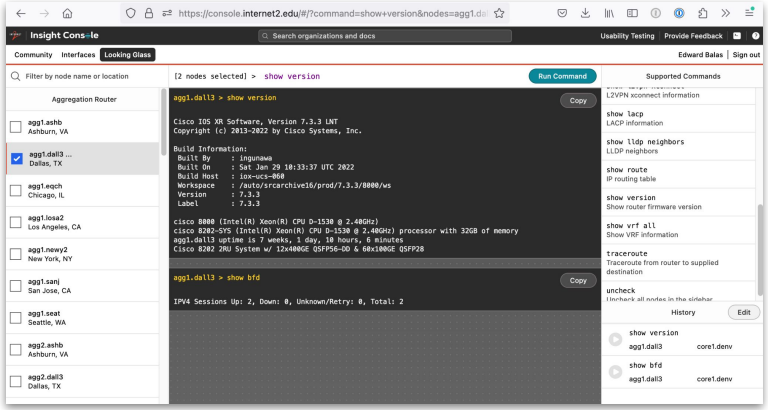




Where we want to be

1. **Neworks will employ data-driven design and operations**
2. Diverse Measurements will be combined with metadata to provide a more detailed understanding of the network
3. Composite / End to End views of the R&E infrastructure will give stakeholders appropriate awareness





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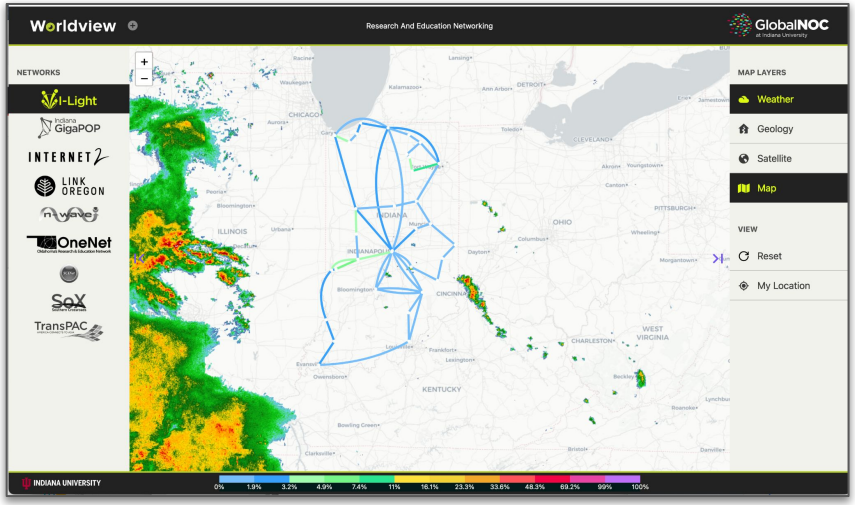

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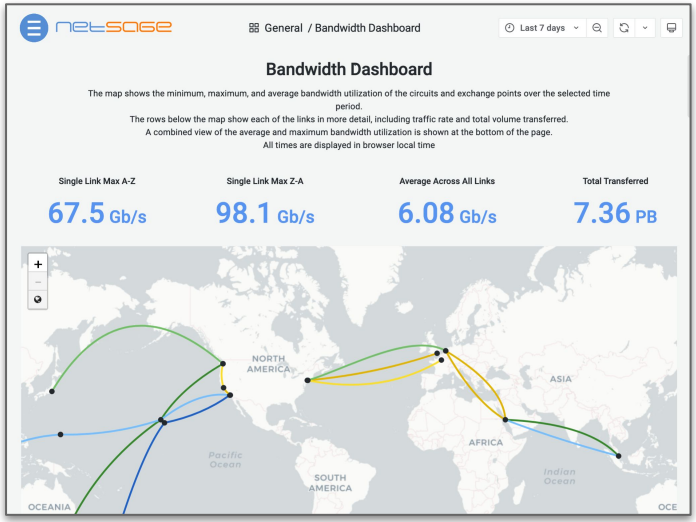
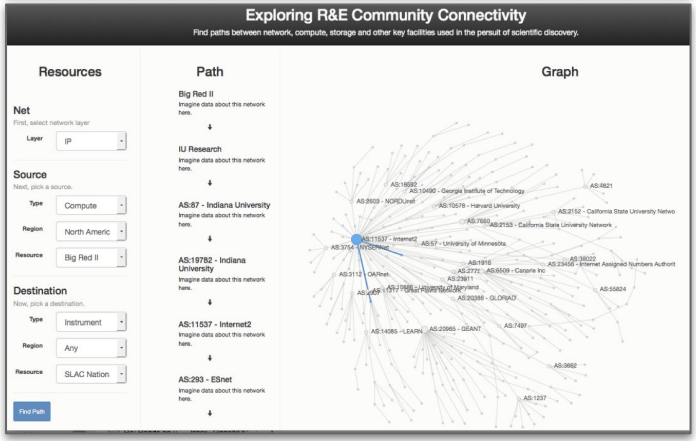
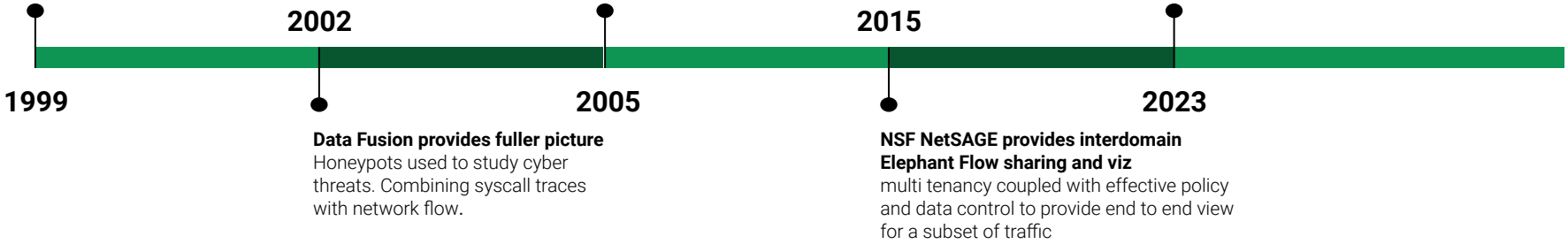
2. Diverse Measurements will be combined with metadata to provide a more detailed understanding of the network
3. **Composite / end to end views of the R&E infrastructure will give stakeholders appropriate awareness**
    - Recent examples include:
        - International Networks @ Indiana University, NetSAGE, TACC and EPOC
        - GlobalNOC and Global Research Map
        - PerfSONAR





Is this a solved problem?



Most of the key ingredients are available however…

- Scaling still difficult at intranetwork level
- Metadata tends to be variable
- Interdomain sharing is limited
- Required domain knowledge a barrier

Imagine the following scenario

- An Engineer gets a report that a customer is seeing poor performance moving data as part of a scientific pipeline
  - checks their measurement systems and local PerfSONAR results and find all clear
  - Presumes issue is likely at far end of the path close to last mile

- To support the customer effectively, the Engineer needs access to more data

Where does the engineer do next?

- **Best Case:**
  - **External networks have established measurement collections**
  - **federated auth and enough structure and documentation exit to support self service**
- More often:
  - External network has established measurement collections
  - Low fidelity data is externally accessible
  - The data needed is private, the engineer however knows his peers and can make a wetware request
- Worst case:
  - External network might itself be decentralized with no ubiquitous measurement approach
  - Multiple human interactions required to find the right engineer
  - The external engineer has to log into the router or other device to debug with you

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MetrANOVA was created to help

- Advocate for quality ubiquitous collections with appropriate access within all of R&E
  - Provide training and policy guidance
  - Create knowledge base articles and howtos
- Lower the barriers through technical and policy collaboration
  - Reduce need for bespoke solutions
  - Amortize software sustainment costs through collaboration.
- Retain Network Measurement as a core competency through the next generation
  - Requires ongoing care and feeding
  - Deep domain knowledge in networking, systems, and to an extent stats
  - Support next generation of R&E engineers

The Secret Sauce of Research and Education

- **Timeless design constructs**
  - Ubiquitous Access
  - Loose Coupling
  - Vendor Neutrality
  - Open Standards
  - Rough consensus and working code

- **Combined with community focus**
  - We are a not for profit community
  - Our values differentiate us
  - Its how we apply these technologies to address needs and facilitate scientific and educational endeavors.

- Technology != differentiator
  - Same software and hardware used in R&E and in Commodity Internet
  - It's how you use it, not what you use
  - like an artist and a paintbrush

- Additional Considerations
  - Collaboration and trust are key
  - Ubiquitous access tempered with appropriate access control
  - We need: Design Patterns, Service Definitions, and Policy Guidance

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Consortium Details

Goals

- Tools, Tactics and Techniques
- Develop and Share
  - Open Architectures
  - Technical Components
  - Design Patterns
  - Best Practices
  - Policy Recommendations.

Executive Committee

- Provides governance and oversight.
- Decides on new membership organizations.
- Representatives from each member.
  - Inder Monga - ESNet
  - Ivana Golub - PSNC/GÉANT
  - James Deaton - Internet2
  - Luke Fowler - Indiana University GlobalNOC
  - Nathaniel Mendoza - TACC
  - Ed Balas - Consortium Lead

Vision

- https://github.com/MetrANOVA/.github/blob/main/profile/vision.md
- A collaboratively developed ecosystem exists
- Open Source, loosely coupled, without cloud service dependence
- Solid foundation for production services and innovation
- Facilitate data driven design in engineering and operations

Participation Model

- Member Organizations
  - Requires >= 1 Full Time Staff Equivalent
  - Participates in governance process
- Affiliates
  - Any organization or individual able to contribute.
  - Lower bar to participate, more flexibility

What have we been up to this year?

- Internal member survey
- community survey launched
- Established near term roadmap
  - Vetted technical stack
  - Policy guidance for appropriate data sharing

- Technical work in progress
  - Elasticsearch Time Series Data Stream evaluation
  - SNMP vs Streaming assessment
  - Data Store evaluations
    - Elasticsearch, Opensearch
    - Clickhouse, mongo, timescaledb
  - Science Registry refactor / up keep (TACC)

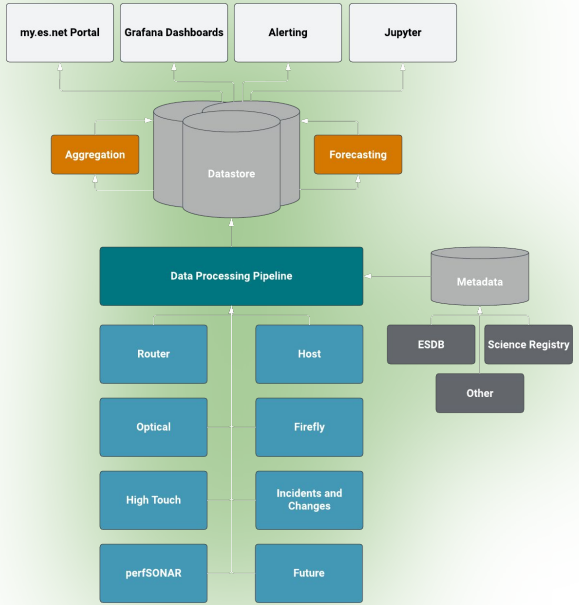
Value Engineering of Elasticsearch Datastore

Broad Elastic Adoption:

- Elasticsearch and OpenSearch used within most member networks and with in PerfSONAR
- Flow, SNMP, Optical, Open Telemetry, Streaming

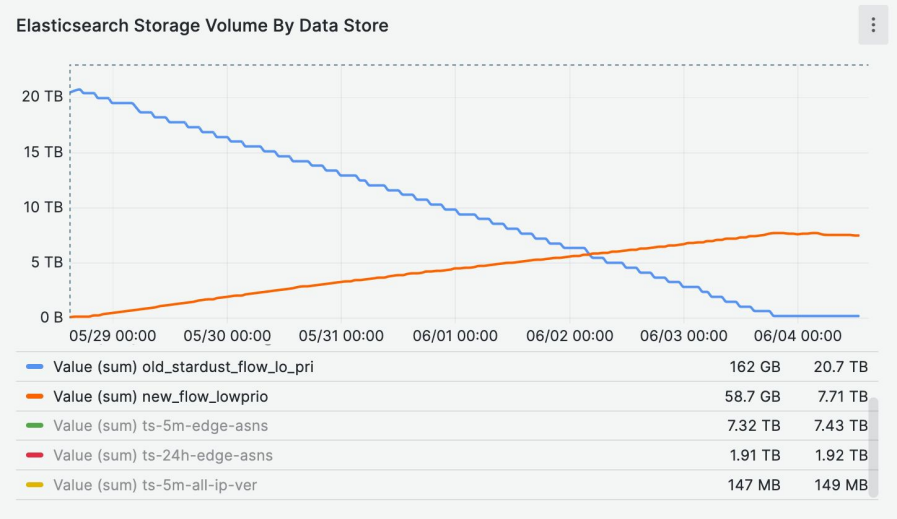
A few members motivated to explore improved scaling

- scale of > 50 nodes
- new features since adoptions to improve costs / scaling



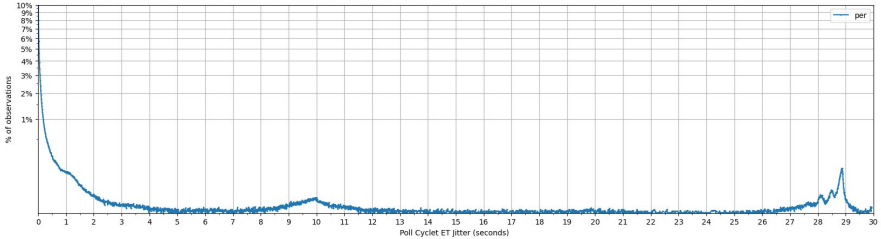
Elastic Time Series Data Stream (TSDS)

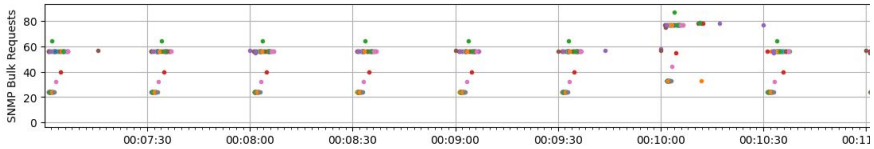
- https://www.elastic.co/guide/en/elasticsearch/reference/current/tsds.html
- As of version 8.9
- Reported savings of up to 70%
  - https://medium.com/squareshift/up-to-70-metrics-storage-savings-with-tsds-enabled-integrations-in-elastic-observability-4cf8b6217c1
- We are evaluating this in particular for both Flow and Port metrics with encouraging results
- ESnet has deployed this at scale a few weeks ago
- We have observed **~63% data reduction** for single packet flows

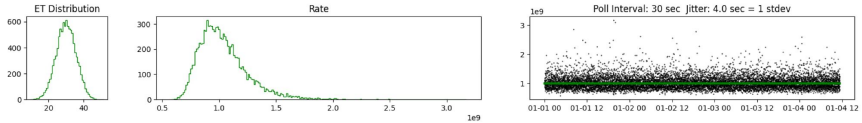


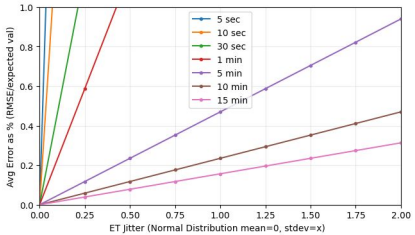
Impact of SNMP timing variance on measurement quality

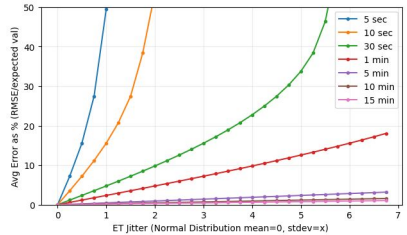
- Trying to create map of max instantaneous usage we noticed links with impossibly high values
- Exhaustive investigation found:
  - Telegraph SNMP Poller using same timestamp for all values in a getBulk sequence (based on goSNMP)
  - The variance in Elapsed Time is higher that anticipated: O(4) sec
  - **We estimate 30 second rate calculations have a 22% average error rate**
- Implications:
  - With our ET variance it does not make a great deal of sense to poll at 30 seconds
  - **To get < 2% we would need 5 min polling**
  - Moving to streaming telemetry we hope will provide qualitative improvements
  - There are ways to through rewriting pollers to improve SNMP
- Data and Scripts
  - Updates shared soon











Data Sharing, Federation, Anonymization, Policy

- Appropriate controls that respect each domains policies and constraints are a must for data sharing
- Having well defined policies is a precursor which today does not always exist
- We will be developing recommendations for the creation of functional policy
  - With technical means to enforce
- Example of constraints you are facing:
  - GPDR, FERPA, HIPPA.
  - NDAs and customers who which to remain low profile
  - Institutional policies, funding bodies, etc.

Supporting multiple levels of sharing

- Different data products have different levels of sensitivity
  - Raw measurements
  - API access to measurement repository with query language
  - Access to online dashboards and reports
- Clear policies let consumers and providers helps set expectations
  - What is and what is not shared and at what level of access
- An example:
  - International Networks at IU is an example
  - Supporter of IU's contribution to the consortium.
  - Vital for them to be able to collect/accept data from multiple sources
    - Display in a single pane of glass.
  - Policy constraints what is collected and what is shared

Laws, Rules, Policies, Guidelines, Best Practices

- MetrANOVA is not a substitute for legal advice.
- Just as we do with the technical elements, we aim to give people a set of documents/processes that they can use, or at least start with.
- Covering issues like…
  - How the data is collected and transported to the storage infrastructure?
  - How is it stored, and where? Is it encrypted at rest?
  - Anonymization - how, at what stage in the process?
    - Storage, collection, display?
  - Retention - how long will the data be kept?
  - Sharing - who is the data shared with, on what terms? For what purposes?

There is no “best” policy

- Technical, development, and engineering work (sometimes) have relatively clear-cut ways to define what the “right” solution is
  - Performance metrics, etc.
- There’s not a direct equivalent - there’s no “best” set of policies
  - We’re not trying to set a standard, more give people a starting point
- What we *can* do is document a set of policies that *can* work.
  - Based on the actual knowledge and experience of participants
- Reduce the amount of effort that people need to put into getting started.

Output

- What does the policy side want to produce?
- A set of documents that define policies re. Collection, transport, etc. etc.
- Align with a MetrANOVA-style architecture
  - But doesn't assume it
- Use as-is or adapt to specific legal/technical/institutional environment

Many Thanks!

Edward Balas

MetrANOVA Consortium Lead

ebalas@es.net

For more information:

- Github: https://github.com/MetrANOVA
- Web: http://www.metranova.org/

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Questions?

"Any opinions, findings, conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the Networking and Information Technology Research and Development Program."

The Networking and Information Technology Research and Development (NITRD) Program

Mailing Address: NCO/NITRD, 2415 Eisenhower Avenue, Alexandria, VA 22314

Physical Address: 490 L'Enfant Plaza SW, Suite 8001, Washington, DC 20024, USA Tel: 202-459-9674, Fax: 202-459-9673, Email: nco@nitrd.gov, Website: https://www.nitrd.gov