The COMO Project

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Disclaimer

• This presentation focuses on COMO v2.0 that is currently under development (unstable-release available on sourceforge.net).

• COMO v2.0 stable release is expected by the end of June 2009 for pilot deployment on Onelab2.

• COMO is currently supported by Intel Research, UPC Barcelona and Quantavis.
Motivation

• Developing and deploying new network monitoring apps is **unnecessarily time-consuming**

• Familiar challenges
  – Need deep understanding of data sets (including details of the multitude of network devices)
  – Need tools to extract information of interest and evaluate accuracy and resolution of data (e.g., timestamps, completeness of data, etc.)
  – Need to efficiently perform computation across multiple data streams coming from different locations

• ...and all this prior to building the actual applications!
Motivation (cont’d)

• Familiar consequences
  – Developers tend to find shortcuts
  – Develop ad-hoc solutions for each application
  – Slow development and even slower deployment
  – Hard to maintain and operate
  – Hard to validate that new monitoring service does not interfere with existing infrastructure
What is COMO?

• Platform for Fast Prototyping Network Monitoring Applications
  – Rich API for quick deployment
  – Support for many different monitoring devices
  – Efficient handling of available system resources
  – Query engine to retrieve data, connect multiple monitors and perform distributed measurements
Features

1. Abstract away device internals
   - Applications can run *without modification* over a variety of network devices and data formats
   - Support for netflow/sflow/radio/DAG/etc.

2. Automated Resource Management
   - System handles overload through packet/flow sampling
   - Applications notify system of maximum sampling rate they can sustain (if any)
   - Applications will be informed of sampling applied to packet stream and may correct results accordingly
   - Applications are turned off if sampling is not an option
3. Easy Distribution and deployment
   - Applications come in stand-alone plugins
   - Can be deployed on any monitoring device
   - The system will run them if the data the application needs is available
     (e.g. wireless-specific monitoring app on a netflow stream...)

4. Support for many programming languages
   - Plugins written in C if performance is important
   - Otherwise, they can be written in any language (with some restrictions)
   - In June we will release python-specific API
EXPORT/STORAGE can be replicated for load balancing

CAPTURE is the main choke point. It periodically discards all state to reduce overhead and maintain a relative stable operating point
How it works (for developers)

• Write a COMO plug-in module per application
  – Five components: 
    init, capture, transform, store, query
  – capture operates on real-time “packet stream”
    • It receives packets as input and generates tuples out
    • “packet stream” is a common representation of incoming network data (it may be IP packets, 802.11 frames, netflow records, ascii log entries or the output of other modules)
    • capture must be efficient. It’s always written in C.
    • Being on the critical path of the system it may be turned off if too expensive
    • Library of pre-defined, optimized capture modules will be available (e.g., flow classification, pattern search)
How it works (cont’d)

• Other components can be in other languages
  – transform receives periodic set of tuples from capture and generates tuples out to store
  – store generates/selects the set of tuples to be saved on disk
  – query reads tuples from disk (or directly from store) and returns a representation as requested by the user (e.g., ASCII, graph, script to plot a graph, etc.)
Example: how to compute top-k destination addresses

- **init** reads config (to set k and the measurement interval)
- **capture** aggregates traffic by destination and periodically sends a stream of \{destination, bytes\} tuples
- **transform** aggregates the tuples over the measurement interval and outputs a ranked list of \{destination, bytes\} tuples
- **store** select the first k tuples and saves on disk one tuple with the timestamp and the original \{destination, bytes\} pairs
- **query** fetches the tuples by timestamp and returns a JSON representation of the top-k destinations

... but this is just one way to do it
Onelab Deployment

• Monitoring facility for Planetlab Europe
  – Deploying over 20+ institutions across Europe
  – Onelab users can test monitoring applications on traffic generated by Onelab/Planetlab nodes.

• *Infrastructure for demonstrating, testing and sharing monitoring applications before deployment in production environments*
Onelab Usage Model

• Users can deploy monitoring apps everywhere

• Users can monitor only the traffic *their own* applications generate or receive
  – Not possible to monitor other users’ traffic
  – Requires registration of experiments with Onelab monitoring service.

• COMO modules undergo review from Quantavis before deployment if written in C.
  – Other languages don’t need review
  – Review process is confidential
Onelab web interface to register users
Users register experiment and receive list of allowed port numbers (i.e. UDP/TCP packets on those port numbers will be monitored)
Users can upload modules to (and receive results from) all COMO nodes from the web interface.
Documentation

• Badly lacking... sorry.
• First draft will come with June 2009 release
• Visit http://como-project.org for updates (launch date: June 2009)
References

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