

# Monitoring and Prediction of Transport Protocols Throughput for Complex Networks

Aleksandr Sannikov, Olga Bogoiavlenskaia, Iurii Bogoiavlenskii

Petrozavodsk State University  
Department of Computer Science



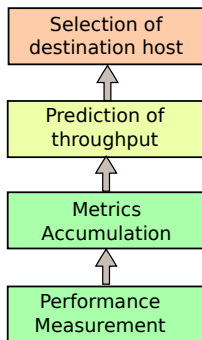
9<sup>th</sup> FRUCT Conference, April 24–29, Petrozavodsk, Russia

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# Aim of work

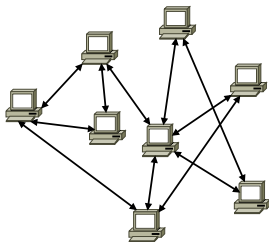


- Prediction of throughput to several hosts
- Selection of host according to results of prediction

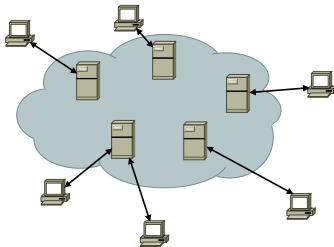


# Use Cases

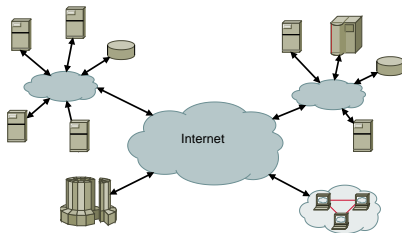
## ■ Peer-to-Peer Networks



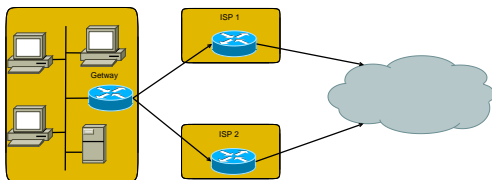
## ■ Content Delivery Networks



## ■ Grid Computing



## ■ Multihoming



# Performance

Requirements to modern networks:

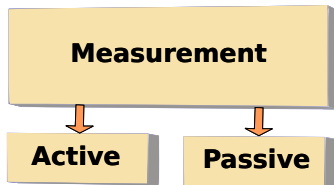
- Performance
- Availability
- Reliability
- Security

Common performance metrics:

- Throughput
- Delay
- Loss rate



# Measurement



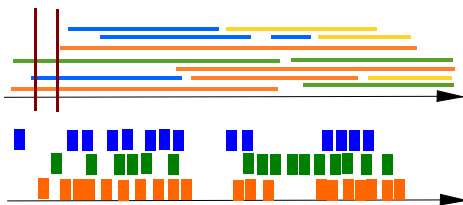
## Active

- Additional workload
- We always have metrics
- Time for initial measurement

## Passive

- Needs data interchange
- Information already exists



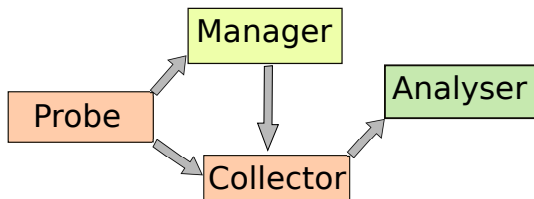


- Per-flow aggregated information
- Extraction of information directly from TCP implementation
  - ▶ Deep integration with TCP/IP stack
  - ▶ Linux-oriented system
- Location:
  - ▶ End hosts
  - ▶ Intermediate hosts (if necessary)
  - ▶ One side





# Hi-Level Architecture



- Scalability
- Extensibility
- Four subsystem according to RFC 2722 ( Traffic Flow Measurement: Architecture)
  - ▶ Probe
  - ▶ Collector
  - ▶ Manager
  - ▶ Analyzer



# Probe

Subsystem for extraction of information about TCP-flows from OS kernel.

- Kernel-space and User-space components
- Stability
- Large volume of data for transmission from Kernel to user space
- Low latency
- Low number of changes in kernel



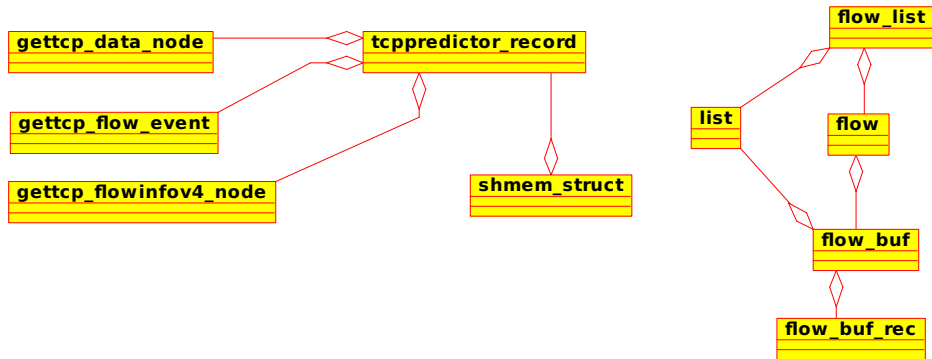
# Collector

Subsystem for storage and preprocessing of information about network performance.

- High performance
- Processing of big data flow “on fly”
- Long term data storage in well-detailed form
- Per-flow aggregation



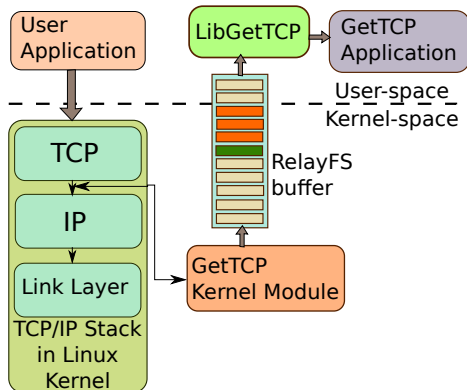
# Structures and Data Types



- Fields in structure ***tcp\_sock***
- Per-packet data structure ***tcppredictor\_record*** combined into a buffer
- Per-flow data storage ***flow***



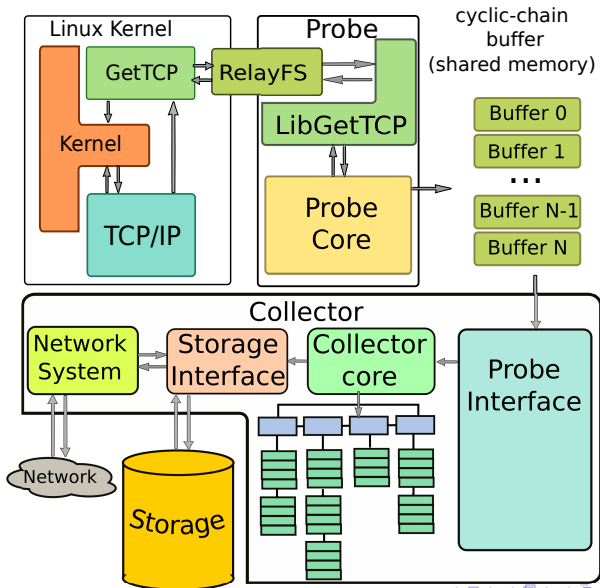
# GetTCP



Ponomarev V. A., Bogoyavlenskaya O. Yu., Bogoyavlenskiy Yu. A. Configurable Kernel-Level Monitoring System of the TCP Behavior “Information Technologies”, issue 1 2010.



# Architecture of Probe and Collector



# Analyzer

The tool is targeted to end-user. Implements final data analysis and performance forecasting. Also it generates report in user-acceptable form.

- High level of “intelligence” in contrast to other subsystem
- Platform independence
- Well accuracy
- Different types of analysis



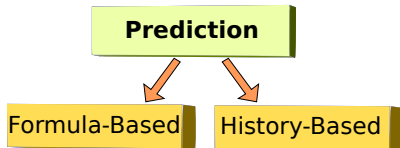
# Approaches in Data Analysis

## Formula-based

- Easy for estimation
- Small amount of input data
- Gives expectation of throughput

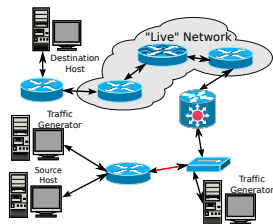
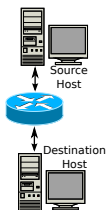
## History-based

- A lot of estimation model (MA, EWMA, Holt-Winters etc.)
- Needs heuristics for detection of outliers and level shifts





# Testbed



- Testing and debugging of system
- Empty channel testing
- Constant-rate background traffic

- Constant-rate background traffic in bottleneck
- "Live" network traffic



# Conclusion

## Results:

- Architecture of system
- Ability to use whole methods of time series analysis
- Implemented prototype
- Testing of prototype in testbed

## Aims:

- Improvement of system
- More tests in different conditions
- Improvement of mathematical models for prediction



# Thank you

