

# TELE302/INFO334 Lecture 16

## Requirements Analysis II

Jeremiah Deng

TELE / InfoSci, University of Otago

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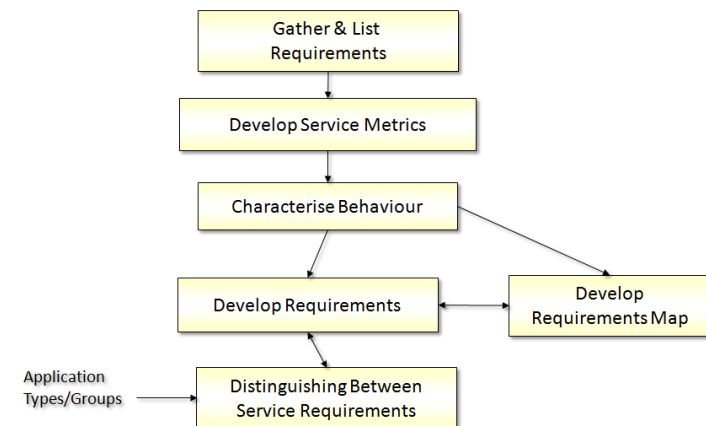
## Review

- ‘Services’ is the word.
- First thing first: Requirements Analysis
- Applications Categorization
- Location information important for planning.
- Future-proof: sizing, migration, security etc.

## Lecture Outline

- 1 Review
- 2 Guidelines
- 3 Working out Specifications
- 4 An Example

## R.A. Process Model



## Determining Initial Conditions

- Type of design project
  - New design
  - Upgrade of an existing network
  - Outsourcing contract
- Scope
  - Network size
  - Geography
  - Financial
- Locate constraints
  - Funding limits
  - Policies and organizational regulations
  - Existing system components

## Gather Requirements

- Work with users
  - Establish on-going relationship
  - Develop surveys and questionnaire
- Compile an easy-to-use list of requirements
- Use tables as worksheet to specify
  - Initial conditions
  - Requirement metrics
  - Application types or groups etc.
  - Location information of hosts, devices, and applications ...
  - Other constraints

## Developing Service Metrics ...

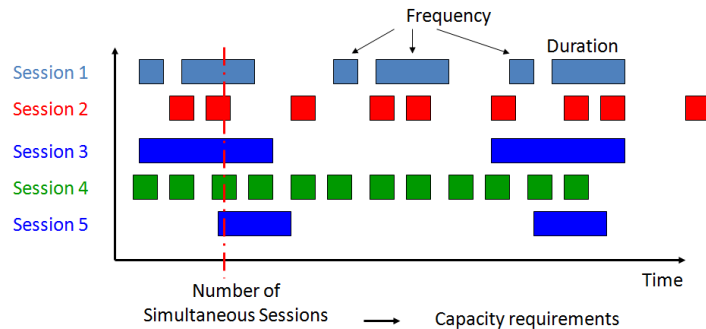
- Metrics for Reliability
  - Availability
    - Ranges in meaning from basic connectivity, ability to run application, to QoS levels.
    - Defined by MTBF and MTTR
    - To measure/verify, it needs a time factor (“measured monthly/weekly” etc.)
  - Transmission characteristics
    - Bit Error Rate
    - Frame/Packet Loss Rates

## Developing Service Metrics.

- Capacity Metrics
  - Data Rates (Peak data rate, Sustained data rate)
  - Data Size
    - Burst size and duration
    - Average and Maximum Frame/Packet Size
    - Packet size distributions
    - Transaction size
- Delay metrics
  - End-to-end / Roundtrip delay
  - Host system response time
  - Delay variation (jitter)
  - Variations with changing network conditions

## Characterizing Behaviour

- Usage Patterns



## Application Behaviour

- Data flow characteristics
  - Data sizes
  - Frequency and duration of data processing
  - Flow directions
    - Client-server
    - Peer-to-peer
  - Degree of multicasting
    - One-to-one, one-to-many, many-to-many
- Host response time
  - Minimum/Average/Maximum

## Delay Requirements

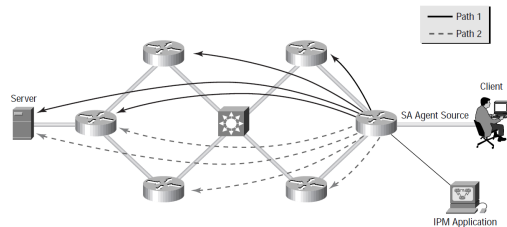
- Interaction delay (INTD)
- Human response delay (HRD)
  - Approximately 100 – 200ms
- Network propagation delay
  - Dependent on distance and Technology
- Analysis on delay requirement helps to distinguish interactive burst and bulk applications, and real time applications
- Helps to flow analysis and logical design
- Network measuring tools can be handy in developing requirement specifications.

## Network Measuring Tools

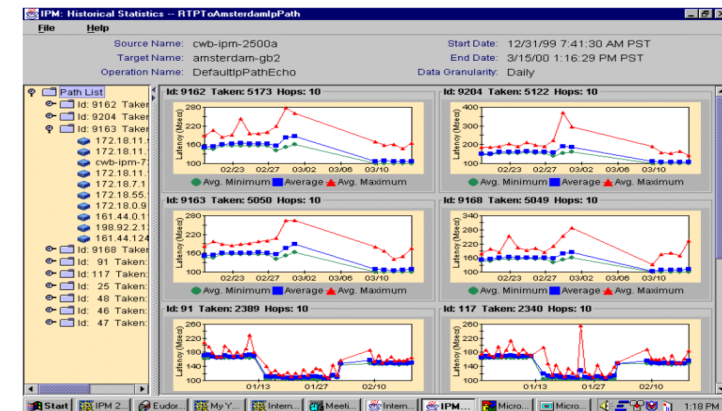
- SNMP counters in hubs/switches
  - Packets forwarded
  - Packets dropped
  - Errors (runt, giant, out of buffers)
- External monitors
  - Remote MONitoring
  - Special CSU/DSUs
- Software
  - Ping, traceroute (subject to manipulation by host OSs & router protocols, used as indicators)
  - pathchar (ee.lbl.gov), netperf (HP)
  - Analysis toolkits (CISCO Netsys, Sniffer, IPTraf)

# Internetwork Performance Monitor

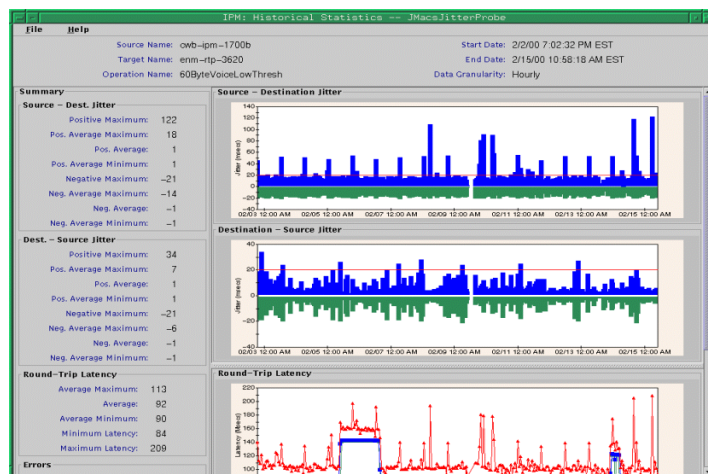
- Localize performance bottlenecks
  - Hop-by-hop performance analysis
- Proactive performance management
- Performance trend analysis
- Redundancy, security, and verification
  - Identifies redundant paths and estimates their utilization



# IPM - Latency analysis



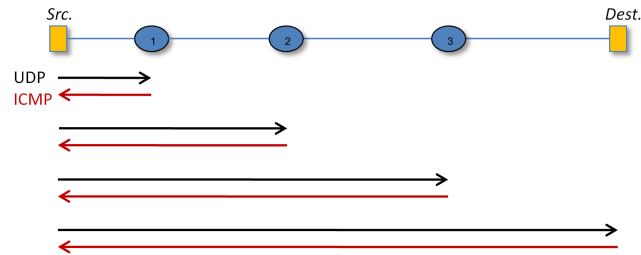
# IPM - VoIP jitter analysis



# pathchar

- Similar to 'traceroute', also by Van Jacobson
  - Uses sequence of packets per TTL value
- Infers per-link metrics
  - Queue length and packet loss rate per hop
  - Delay
  - Link capacity
- Operator
  - Detecting bottleneck & diagnosing performance problems
  - Measure delays
  - Check link capacity

## pathchar – how it works



- Send UDP packets along path, wait for ICMP responses
- Vary IP TTL to control how far into network packets can travel on the path
- Varying packet sizes to infer bandwidth and latency
- Multiple repetitions give queuing and loss information

## pathchar output example

```
% pathchar ka9q.ampr.org
pathchar to ka9q.ampr.org (129.46.90.35)
mtu limited to 1500 bytes at local host
doing 32 probes at each of 64 to 1500 by 44
0 192.172.226.24 (192.172.226.24)
| 9.3 Mb/s, 269 us (1.83 ms)
1 pinot (192.172.226.1)
| 85 Mb/s, 245 us (2.46 ms), 1% dropped
...
3 qualcomm-sdsc-ds3.cerf.net (134.24.47.200)
| 8.8 Mb/s, 1 us (4.07 ms)
5 ascend-max.qualcomm.com (129.46.54.31)
| 53.2 Kb/s, 4.20 ms (243 ms)
6 karnp50.qualcomm.com (129.46.90.33)
| 12 Mb/s, -172 us (243 ms), +q 8.96 ms (13.0 KB) *3, 6%
dropped
7 unix.ka9q.ampr.org (129.46.90.35)
7 hops, rtt 11.1 ms (243 ms), bottleneck 53.2 Kb/s, pipe
4627 bytes
```

## Simplified RA: A Good Start

- Best-effort delivery only
  - Bases the design on capacity planning instead of service planning
  - Focuses on general requirements
- Focusing on highest-priority application
  - Builds upon best-effort delivery design
  - Picks one or a few applications of highest priority
  - Categorizes others into best-effort delivery
  - Works out in-depth requirements (metrics, thresholds etc.) for the selected applications

## A Small Business Example

- DCI Co. has a headquarter in Dunedin, a sales office in Christchurch, and a factory in Invercargill.
- Applications include
  - Sales transaction
  - A bursty database application, and
  - E-mail service.
- Goal: connect offices in a WAN.
- Project cost < \$250K.

## User Requirements

User Service Requirements	Descriptions
Locations / User numbers	DUD (30), CHC (15), INV (17)
Cost	Less than 250K

## Application Requirements

Applications	Application Categories (capacity/availability/delay if applies)	Application Locations
Application A: Database	Best-effort, Interactive burst (100Kbps)	Dunedin and Invercargill
Application B: E-mail	Best-effort, interactive (300 Kbps)	All locations
Application C: Sales	<i>Best-effort</i> Interactive Bulk (30 Kbps)	Dunedin and Christchurch

## Device Requirements

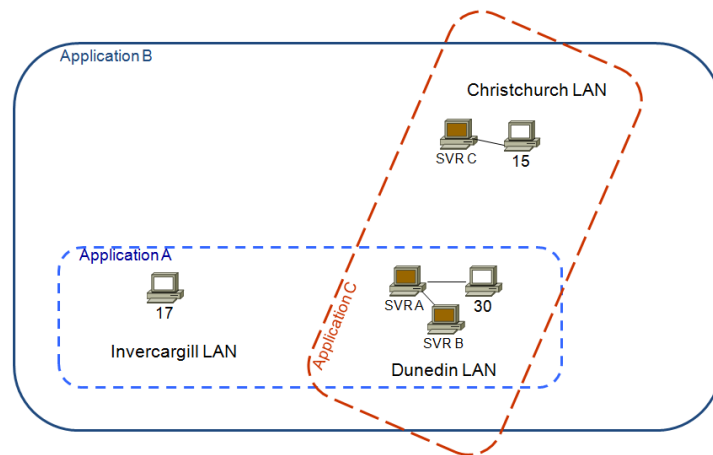
Hosts/Devices	Type of Hosts/Equipment	Numbers & Locations
Host A	PC	Dunedin (30), Christchurch (15), Invercargill(17)
Host B	Sales server (App C)	Christchurch
Host C	Database server (App A)	Dunedin
Host D	E-mail server (App B)	Dunedin

- Remarks:
  - No special services (all best-effort assumed).
  - No host-specific requirements.
  - Business growth not planned against.

## Making A Requirements Map

- Map requirements on applications, devices (servers and PCs etc.) to a geographic description of the environment.
  - Map contains useful location information for devices and applications.
- Graphics utilities that can be used:
  - Dia (Unix, Windows)
  - yEd (Windows, Unix/Linux, and Mac OS)
  - XFig (Unix/Linux, Cygwin)
  - Visio (Windows)

## Requirements Maps



## Application Requirements (Revised)

Applications	Application Categories (capacity/availability/delay if applies)	Application Locations
Application A: Database	Best-effort, Interactive burst (100Kbps)	Dunedin and Invercargill
Application B: E-mail	Best-effort, interactive (300 Kbps)	All locations
Application C: Sales	Specified Service Interactive Bulk (30 Kbps, 100ms)	Dunedin and Christchurch

## Summary

- Step-by-step:
  - Identify constraints
  - List requirements
  - Locate Applications
  - Identify application types
  - Develop performance metrics
  - Compose worksheets
  - Draw up the Requirements Map
- Refer to *McCabe Chapter 3*.
- Coming next: Flow Analysis
- Design Project