

# Lecture 4:

# Requirement Analysis Process



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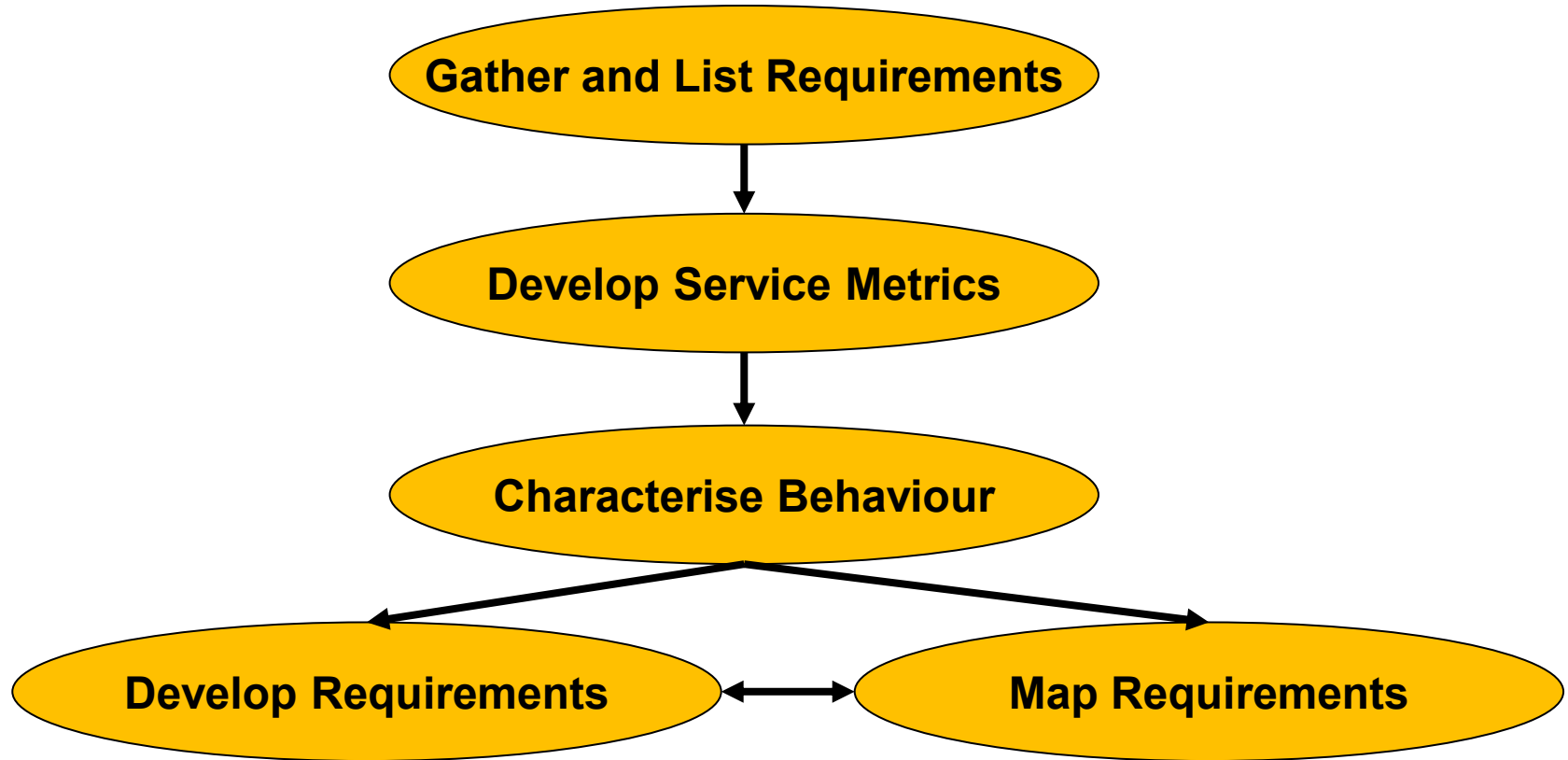
# Overview

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- ❖ Gathering and Listing Requirements
- ❖ Gathering Initial Conditions
- ❖ Taking Performance Measurements
- ❖ Service Metrics
- ❖ Characterizing Behavior
- ❖ RMA Requirements
- ❖ Procedures and Documentation

# Requirement Analysis Process

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# Gathering and Listing Requirements

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- Service requirements are gathered and developed with
  - Initial conditions on the architecture and design
  - Input from the users, management and other stakeholders
- Then refined by the analysis process

# Gathering Initial Conditions

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- These are the basis for the start of the analysis process
  - Provide reasons for making architectural and design choices
  - Describe the current state of the network
- They include
  - Type of network project
  - Scope of architecture and design
  - Initial design/architecture goals
  - Known outside forces

# Gathering Initial Conditions

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- Knowing the type and scope of the project will help you to focus your efforts and identify constraints
  - E.g. replacing an old network with an entirely new network would usually have less constraints than a project that requires you to modify an existing network
- Initial conditions may also act as constraints on the design
- Many of these will be known before starting the analysis process
  - The following lists are NOT exhaustive

# Types of Network Projects

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- New network
- Modification of an existing network
- Analysis of network problems
- Outsourcing
- Consolidation
- Upgrade

# Scope of Network Project

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- Network size
- Number of sites
- Distance between sites



# Initial Architecture/Design Goals

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- Upgrade technology/vendor
- Improve performance to part or all of the network
- Support new users, applications or devices
- Solve perceived problems within the system
- Increase security
- Support a new capability

# Outside Forces

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- The details of outside forces may not been known at the start of the project but they may include the following areas
  - Political
  - Administrative
  - Financial

# Constraints

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- Studying the initial conditions will allow you to identify, understand, remove or work with constraints
- Common constraints include
  - Funding limitations
    - Budgets, choices of architecture etc
    - Solution MUST fit the funding constraints
  - Organisational constraints
    - Who you will be working with or how groups interact
  - Political constraints
    - Political desires of users management or staff
  - Existing components may act as constraints
    - User inertia
    - Customised software

# User Requirement and Performance

# Setting Customer Expectations

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- At this stage it is important to begin setting customer expectations
  - Determine if customers are correct in
    - Their definition of the problem
    - Expectations of the final result
  - If necessary realign the customers expectations and inform them when expectations are unrealistic

# Working with Users

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- A sometimes painful but necessary part of the process
  - Better understanding of the behaviour patterns and environment
- Some techniques for communicating with users
  - Surveys
  - One-on-one follow ups to surveys
  - Face-to-face meetings with selected groups or individuals
  - Whiteboard sessions with users
  - Spend time and talk to the users
- This has to traded off with the amount of time required to do this

# Red-Flag User Requirements

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- Warning signals in the gathering process generally indicate that there is a lack of precision and clarity in requirements
- Warning signals may include
  - Misuse of the term real-time
  - Availability solely as a percentage (99.9%)
  - “High-performance” without any verification of need
  - Highly variable, inconsistent requirements
  - Unrealistic expectations from the customer

# Performance Targets

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- During this phase you may need to determine performance targets
- Multi-tier performance
  - Networks with applications, users/groups, devices with much higher performance needs
  - Hard threshold between low and high performance
- Single-tier performance
  - No distinctive set
  - No threshold



# Taking Performance Measurements

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- Measurement of peak application and device performance can be used to determine
  - Current levels of degradation
  - Capacity requirements for the new network

# Taking Performance Measurements

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- These can be conducted on
  - A test bed network
    - Useful to see interaction of new technology and the organisations suite of applications
  - The existing network
    - Useful for modelling user and application behaviour
    - Can be used to validate performance problems on the existing network

# Tracking and Managing Requirements

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- The growing list of requirements should be kept
  - Up-to-date
  - Where everyone involved has access to them

# Tracking and Managing Requirements

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## ■ Paragraph form

- Requirement is changed within its original paragraph
- Additions, deletions and modifications are left in the original paragraph with Track Changes
- This allows us to see what changes to requirements have already been attempted and rejected

## ■ Tabular form, e.g., spreadsheets

- Requirements kept in their original form
- Changes added to the table

## ■ Other online tools, e.g. Jira, Xebrio, etc.

# Tracking and Managing Requirements

## Jira (software)

Article Talk

Read Edit View history Tools

From Wikipedia, the free encyclopedia



This article **may rely excessively on sources too closely associated with the subject**, potentially preventing the article from being **verifiable** and **neutral**. Please help **improve it** by replacing them with more appropriate citations to **reliable, independent, third-party sources**. (November 2015) *(Learn how and when to remove this message)*

**Jira** (/ˈdʒiːrə/ JEE-rə<sup>[4]</sup>) is a **proprietary** product developed by **Atlassian** that allows **bug tracking**, **issue tracking** and **agile project management**. Jira is used by a large number of clients and users globally for project, time, requirements, task, bug, change, code, test, release, **sprint** management.

## Naming [edit]

The product name comes from the second and third syllables of the Japanese word pronounced as *Gojira*, which is Japanese for **Godzilla**.<sup>[5]</sup> The name originated from a nickname Atlassian developers used to refer to **Bugzilla**, which was previously used internally for bug-tracking.<sup>[5]</sup>

## Description [edit]

According to Atlassian, Jira is used for issue tracking and project management.<sup>[6]</sup> Some of the organizations that have used Jira at some point in time for bug-tracking and project management include **Fedora Commons**,<sup>[7]</sup> **Hibernate**,<sup>[8]</sup> and the **Apache Software Foundation**, which uses both Jira and Bugzilla.<sup>[9]</sup> Jira includes tools allowing migration from competitor Bugzilla.<sup>[10]</sup>



<b>Developer(s)</b>	Atlassian <sup>[1]</sup>
<b>Initial release</b>	2002; 22 years ago <sup>[2]</sup>
<b>Stable release</b>	9.17.1 <sup>[3]</sup> <span><span></span></span> (2024-07-18; 1 month ago) <span>[±]</span>
<b>Written in</b>	Java
<b>Operating system</b>	Cross-platform
<b>Type</b>	Bug tracking system, project management software
<b>License</b>	Proprietary
<b>Website</b>	<span>www.atlassian.com/software/jira</span> <span><span></span></span>



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## All-in-One Requirements Management Tool

For Software and Hardware Teams

**A modern tool for managing requirements, tasks, tests, and projects improving productivity**

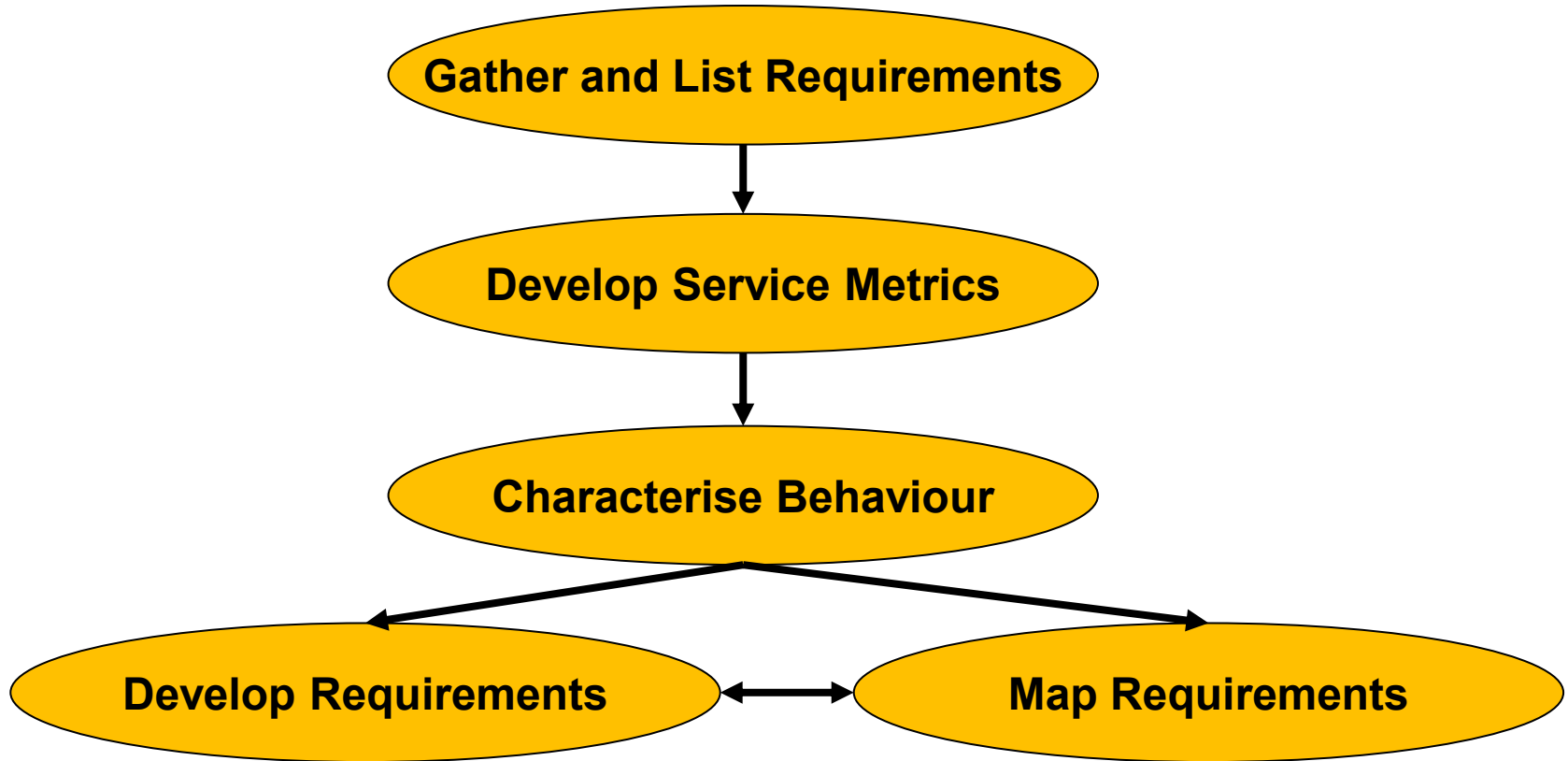
Get started

Watch video



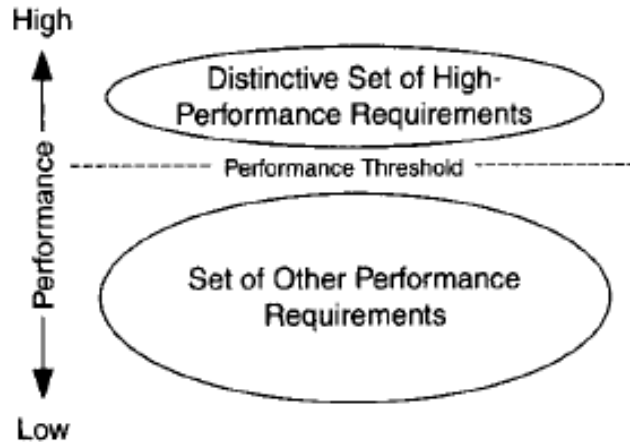
# Tracking and Managing Requirements

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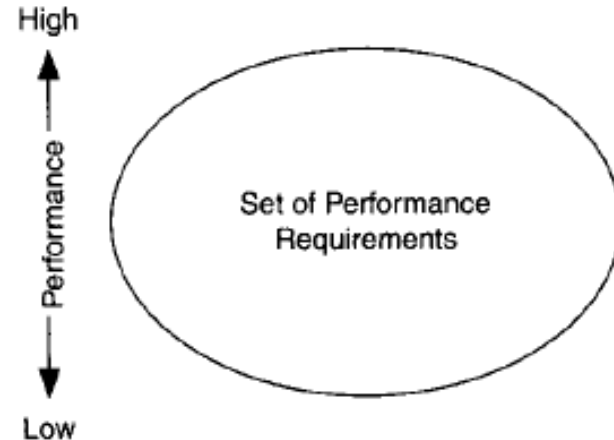


# Tracking and Managing Requirements

**Multi-Tier Performance Network:** Where one or a few applications, users/groups, and/or devices whose performance requirements are significantly greater than other performance requirements for that network



**Single-Tier Performance Network:** No distinctive set of applications, users, or hosts that have significantly greater performance requirements for that network.



**FIGURE 3.2** Determining Performance Targets: Single or Multi-Tier Performance

# Tracking and Managing Requirements

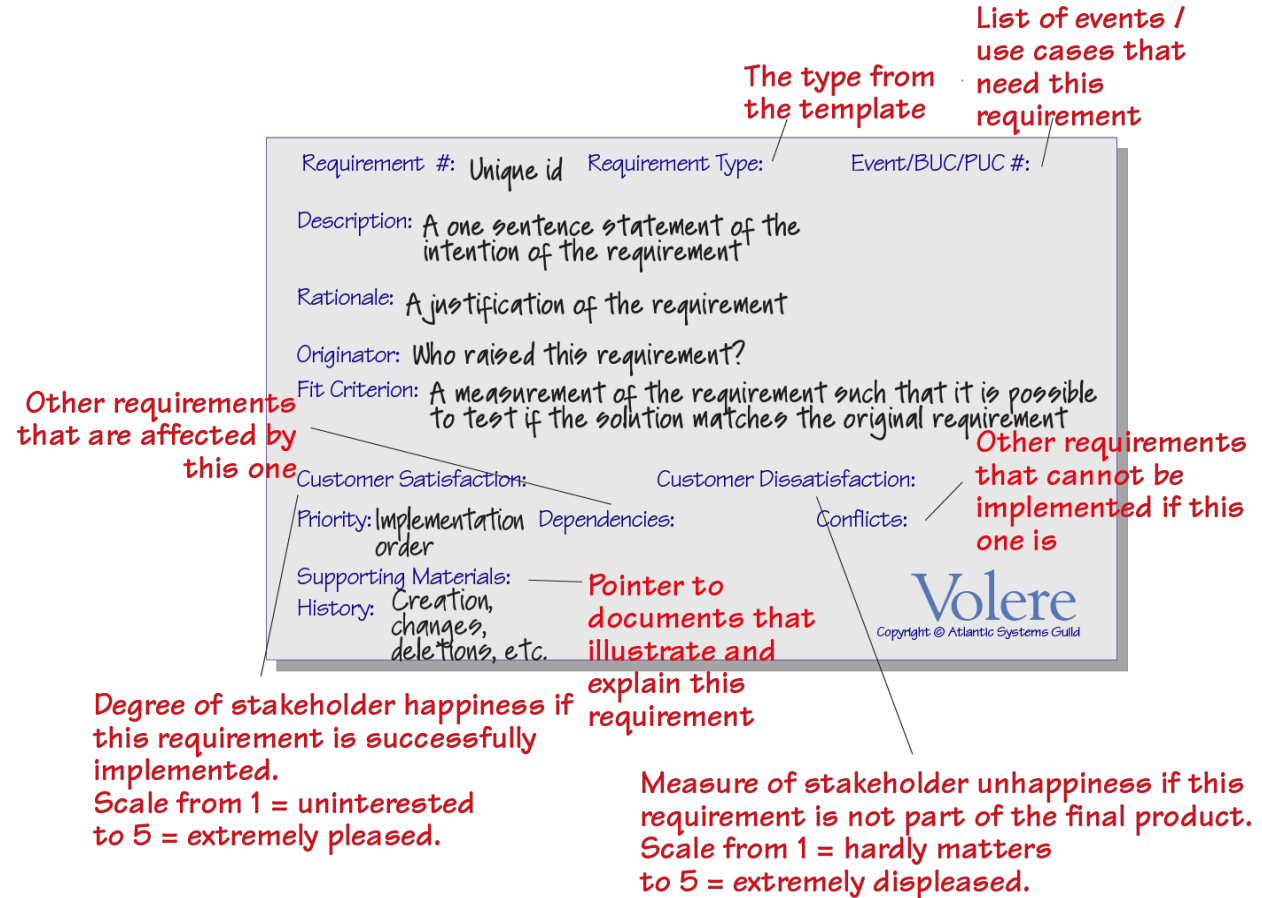
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- Volere Shell
  - Volere is the result of many years of practice, consulting, and research in requirements engineering and business analysis of Atlantic Systems Guild Ltd. The Volere website contains articles about the Volere techniques, experiences of Volere users and case studies, and other information useful to requirements practitioners.
  - The Volere requirements process is described in the excellent book Mastering the Requirements Process by Suzanne and James Robertson.



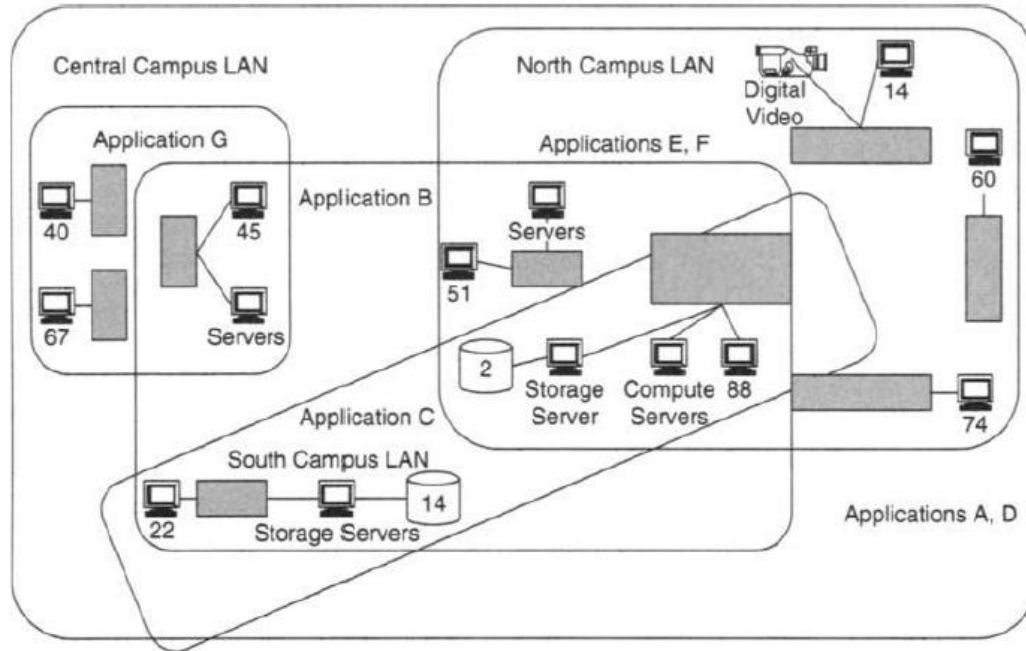
# Tracking and Managing Requirements

## ■ Volere Shell



# Mapping Location Information

- Now we need to know the location and number of servers, users and specialized devices



**FIGURE 3.5** An Example Metropolitan-Area Map

# Service Metrics

# Developing Service Metrics

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- Once requirements have been gathered they need to be analyzed
- Used to distinguish between performance levels in the network
  - High and low performance
  - Guaranteed and predictable performance

# Service Metrics

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- Service metrics can be used to determine
  - If the network (including external suppliers) is delivering what it promised
- Can be described in terms of variables in network devices
  - Bytes in/out
  - IP packets in/out
  - Dropped ICMP packets
  - SLA metrics
  - Capacity limits
  - Burst tolerance
  - Delay
  - Downtime ... etc

# Service Metrics for RMA

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## RMA (Reliability, Maintainability, Availability)

- Reliability
  - Mean time between failures (MTBF)
  - Mean time between mission critical failures (MTBCF)
- Maintainability
  - Mean time to repair (MTTR)

# Service Metrics for RMA

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- Availability
  - MTBF, MTBCF, MTTR
- Also
  - Up-time
  - Down-time
  - Error and loss rates

# Service Metrics for Capacity

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- Data rates in terms of
  - Peak data rate
  - Sustained data rate
  - Minimum data rate
- Data sizes
  - Burst size and duration



# Service Metrics for Delay

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- End-to-end delay
- Round trip delay
- Latency
- Delay variation (jitter)

# Measurement Tools

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In addition to management protocols and MIBs (Management Information Base), some common tools can be used to measure service metrics

- **PING (Packet InterNet Groper)**

- A computer network administration software utility used to test the reachability of a host on an Internet Protocol (IP) network.
- Can be used to measure delays and packet losses

- **Traceroute**

- Diagnostic command-line interface commands for displaying possible routes (paths) and transit delays of packets across an Internet Protocol (IP) network.
- Combines delay measurements, per link capacity measurements with path traces

# Characterising Behaviour

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- How users and applications use the network
- Types of behaviour include
  - User behaviour
  - Application behaviour
  - Network behaviour

# Characterising Behaviour

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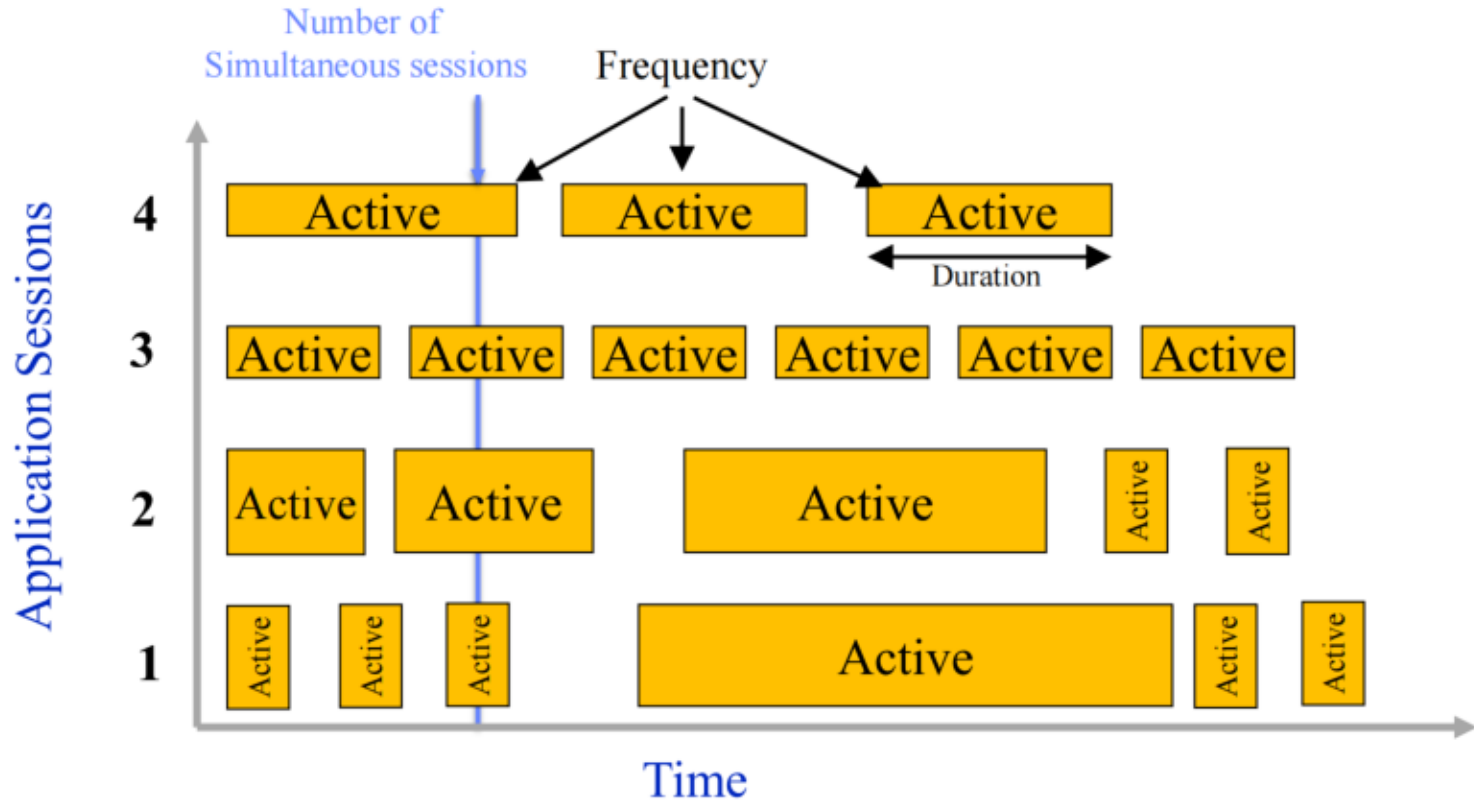
- Can be modelled using simulation to predict or determine
  - Requirements
  - Data flows
  - Simulations can range from simplistic approximations to complex representations

# User Behaviour

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- Can include
  - User work times and duration
  - For each application
    - Number of users
    - Frequency of usage
    - Average length of usage session
    - Estimation of number of simultaneous session
- Provides us with a heuristic for scaling expected performance

# User Behaviour



# Application Behaviour

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- Need to consider
  - Data sizes to be processed and passed through the network
  - Frequency and time duration
  - Traffic flow characteristics
  - Multicasting requirements

# RMA Requirements

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- Reliability (R)
  - A statistical indicator of the frequency of failure
  - For complex systems MTBCF is more useful as it captures only significant failures
  - Often calculated by adding failure rates and then inverting the sum



# RMA Requirements

# RMA Requirements

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- Maintainability (M)
  - Statistical measurement of the time taken to restore system to full operational status
  - Repair time may include
    - Detection and isolation of the failure
    - Delivery of required part
    - Replacement of component
    - Testing and restoration of service

# RMA Requirements

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- Availability (A)
  - Relationship between frequency of mission critical failures and time to restore service
    - $A = (MTBCF)/(MTBCF + MTTR)$  OR  $A = (MTBF)/(MTBF + MTTR)$
  - Does not necessarily reflect percentage of time that system is operational
    - Scheduled maintenance is NOT included
      - ✓ It can be performed at a time when the network is not required to perform critical functions
    - This can help increase reliability as components that tend to fail frequently can be replaced during scheduled maintenance periods

MTBF : Mean Time Between Failures

MTTR : Mean Time To Repair

MTBCF: Mean Time between Mission-Critical Failures

# Uptime and Downtime

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- Customers may talk in terms of percentages (99.999% or five-nines) but what does this mean
  - Usually measures on a weekly/monthly/yearly basis
  - Uptime is the time when the system is available to the user/application/device
  - Can range in meaning from basic connectivity to full operation of applications across the network
  - Can also be viewed as the amount of allowable downtime

# Uptime and Downtime

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Availability (% uptime)	AMOUNT OF ALLOWED DOWNTIME			
	Yearly	Monthly	Weekly	Daily
95%	438h	36.5h	8.4h	1.2h
99.5%	43.8h	3.7h	50.5m	7.2m
99.95%	4.38h	21.9m	5.05m	43.2s
99.98%	1.75h	8.75m	2.0m	17.3s
99.99%	53m	4.4m	1.0m	8.7s
99.999%	5.3m	26.3s	6s	0.86s

# Availability (1/4)

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- Most systems operate at 99.99% (four-nines)
  - 1 minute of downtime per week
    - Transients (a few seconds) such as rerouting or congestion
  - One minor interruption per month

# Availability (2/4)

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- Effort and costs to support higher availability can skyrocket
  - Some applications cannot tolerate any downtime during session
    - Remote control of vehicles
  - Times of high availability are known and planned for in advance

# Availability (3/4)

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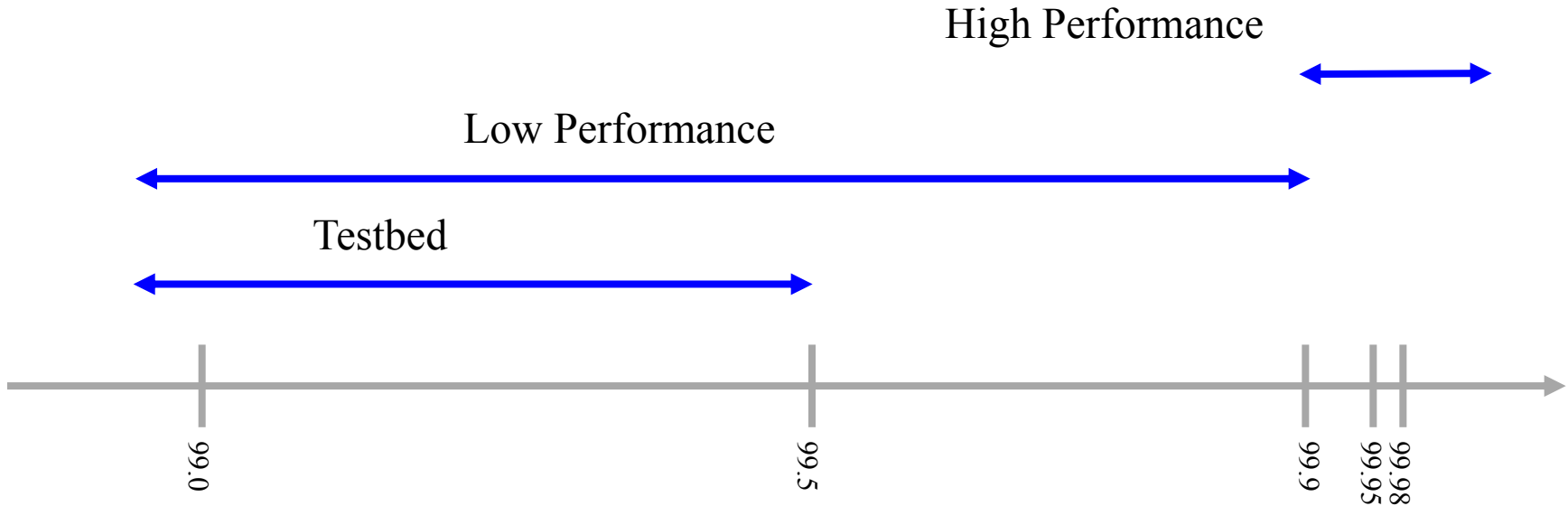
- Many system outages are brief
  - Applications stall for a few seconds
  - These still must be accounted for in overall availability



# Availability (4/4)

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- General reference thresholds



# Measuring Uptime

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- What does 99.99% uptime really mean?

- In particular, how do we measure and verify it?

- Need to know

- When should it be measured?
- Where should it be measured?
- How should it be measured?

- Frequency

- 99.99% uptime could be
  - 53 minutes per year
  - 4.4 minutes per month
  - 1 minute per week
- Allows for one major outage per year
  - Network may cope with a number of smaller outages but NOT one big one
- Need to state a time factor along with total time
- E.g. 99.99% measured weekly

- Where

- Does downtime ANYWHERE on the network count?
- If so need to explicitly state this
- Normally uptime to servers or specialised devices is more important

- How

- Two guidelines for availability measurements
  - Availability is measured end-to-end
  - A loss of availability in any part of the system is counted in overall availability
- Availability may be measured selectively between particular users, hosts or networks

# Example Requirements

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- The 99.99% availability is measured weekly at every router interface and user device in the network
- The 99.999% uptime requirement is measured weekly for access to the server farm network, measured at the router interface at the server farm, at the server network interface cards (NICs). The application ping will also be used to test connectivity between each user LAN and the server LAN
- Note that these requirements do NOT apply to scheduled downtime periods for maintenance

# Delay Metrics

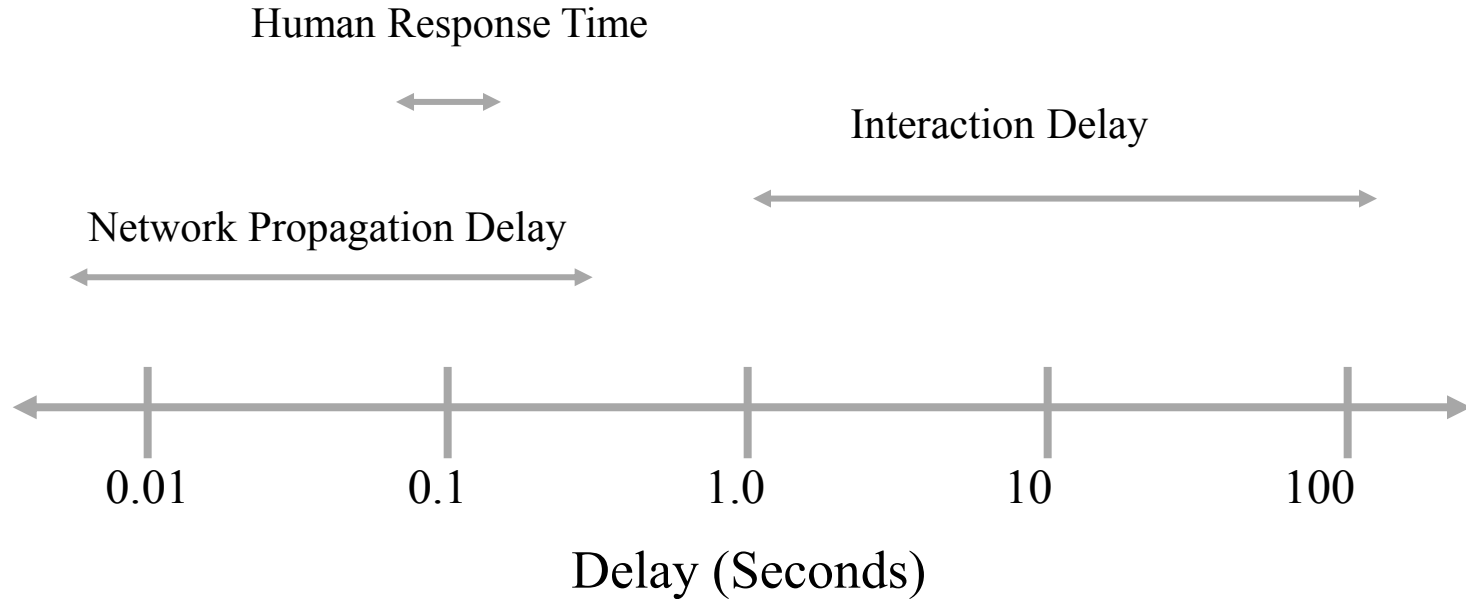
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- **Thresholds for delay**
  - Interaction Delay (INTD)
    - How long is the user willing to wait for a response
    - Aim for 10–30 seconds
  - Human Response Time (HRT)
    - Time boundary when users begin to perceive delay
    - $\text{INTD} < \text{HRT}$  : Users do not perceive delay
    - Approximately 100ms
  - Network Propagation Delay
    - Depends on distance and technology

# Delay Metrics

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- Thresholds for delay



# Capacity Metrics: Estimating Data Rates

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- Based upon
  - How much you know about the transmission characteristics of application
  - Accuracy of estimation
- Types of estimations
  - Peak data rate
  - Minimum data rate
  - Sustained data rate

# Capacity Metrics: Estimating Data Rates

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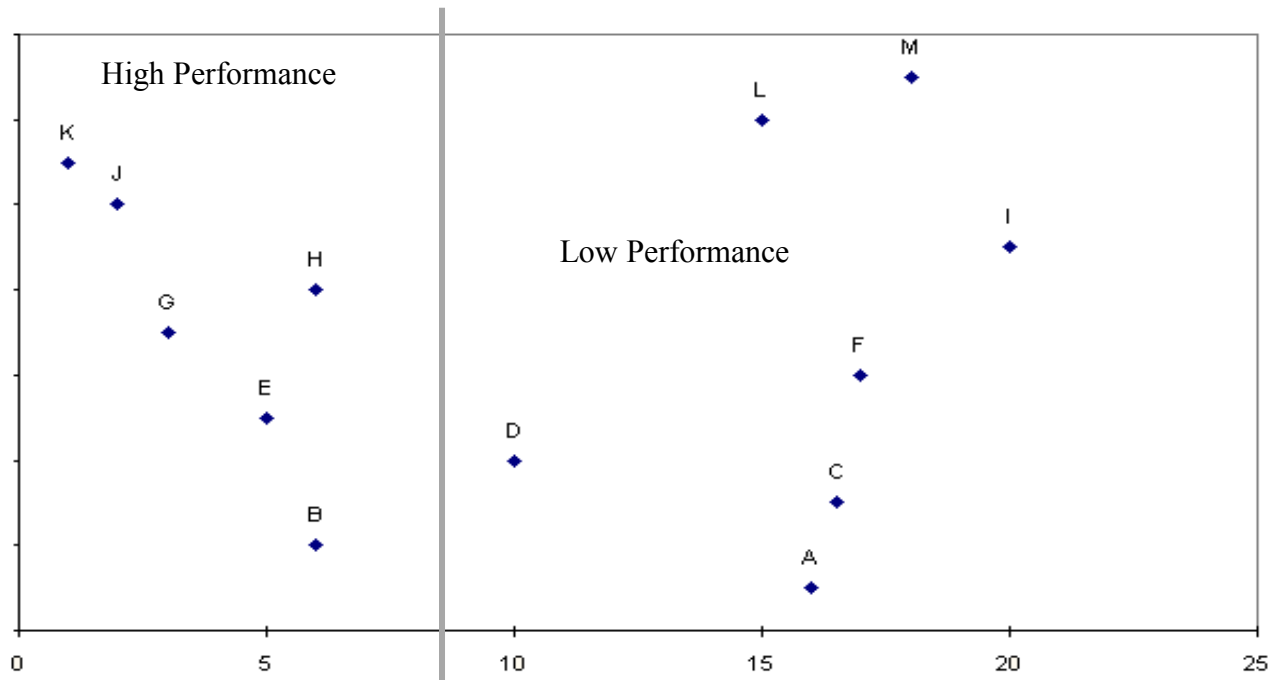
- Consideration must be given to applications with
  - Large capacity requirements
  - Specific capacity requirements
  - Task completion times (TCT) for applications
    - May be based upon user expectations or be set by the application

# Application Characteristics and Additional Requirements



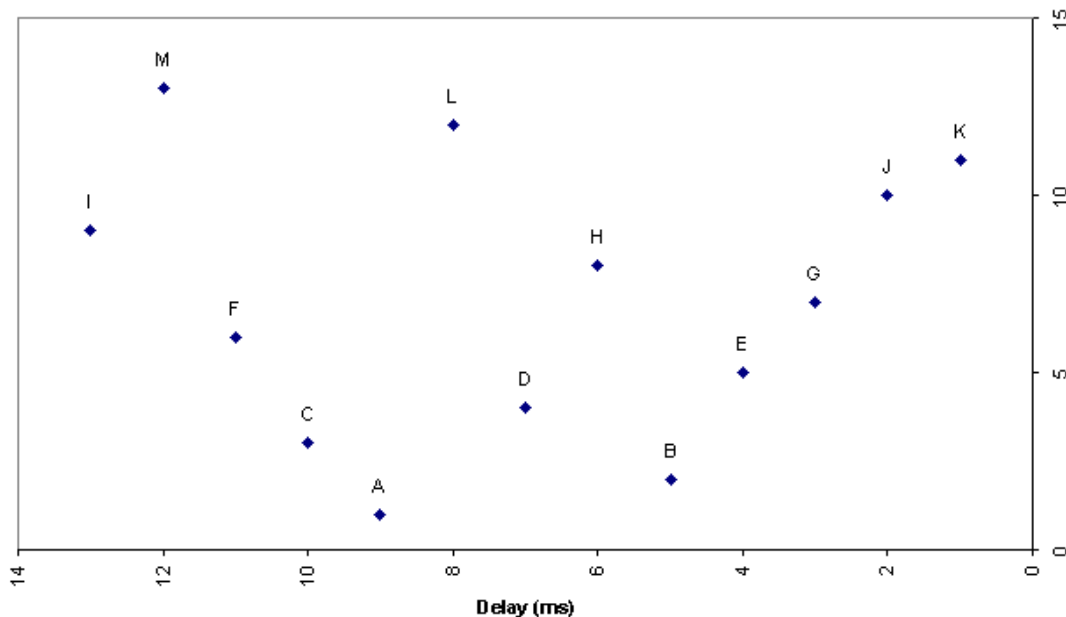
# Comparing Application Characteristics

- If application characteristics can be grouped then we can compare to determine thresholds



# Comparing Application Characteristics

- The threshold settings may be arbitrary
  - Particularly if applications form a continuous range of delay



# Procedures and Documentation

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- In general three classes required to support the network
  - System and component technical documentation
    - Usually provided by the vendor
    - Describes characteristics, parts etc
  - Maintenance documentation
    - Describes periodic preventative maintenance measures
    - E.g. procedures for reconfiguring components during scheduled maintenance times
  - Casualty procedures
    - Describe the abnormal procedures to follow when system faults occur to allow service to be restored as soon as possible

# Additional Requirements

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- Requirements should also be listed for
  - Network Tools
  - Repair needs and procedures
  - Spare parts
  - Workforce
  - Support
  - Confidence in the networks ability to deliver

# Requirements for Predictable and Guaranteed Performance

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- Must also consider if any applications have a requirement for predictable or guaranteed performance
- Require more support for their traffic flows
- Flows need to be handled differently from best effort

# Requirements for Predictable and Guaranteed Performance

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- Indicators include
  - Mission critical, rate critical, real-time and interactive
  - Predictable or guaranteed capacity, delay or RMA
  - Application identified as high performance

# References and Reading

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- ❖ **Chapter 3** - McCabe, J. D. (2010). *Network Analysis, Architecture, and Design*. San Diego, CA, USA: Elsevier Science.

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Thank you  
Q&A ?

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