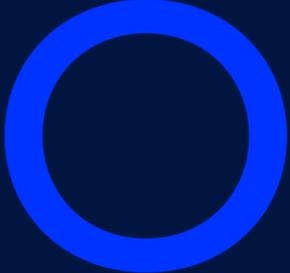




CSIT985

Strategic Network Design



Spring 2023



UNIVERSITY
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AUSTRALIA



Lecture week 3:

Strategic Network Design and Requirement Analysis Concepts



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Outline

- ❑ Part A: Plan for the Strategic network design
- ❑ Part B: Requirement Analysis Concepts

Part A:
Plan for the Strategic Network Design

Prior to the Network Analysis

- Defining scope
- Strategic network plan

Defining scope

- Identify the scope of the design is the initial and very important step of the network design.
- It is critical to determine:
 - If we design a green field (new) network
 - Or if the network is existing and it needs to be optimized, expanded, integrated with other external networks, etc.
- Defining the design scope will affect gathering information for the design

The Strategic Network Plan

- The Strategic Network Plan
- To Plan...or Not?
- The Crouch Diagram
- Six Tips for Strategic Planning
- Ten Pitfalls of Strategic Planning
- Factors in Selecting Strategies
- Planning Teams
- Who Should Be Involved in planning?

To Plan...or Not?

- The most basic question to ask before starting a strategic planning process is whether to develop a strategic plan
- The question of whether or not to develop a strategic plan may be based on answers to the following questions:

To Plan...or Not?

- What purpose will the strategic plan serve?
- How will it help the organization?
- Will it be better than the system we use now?
- Are those in leadership positions committed to strategic planning?
- How much will it cost in terms of time and personnel effort?

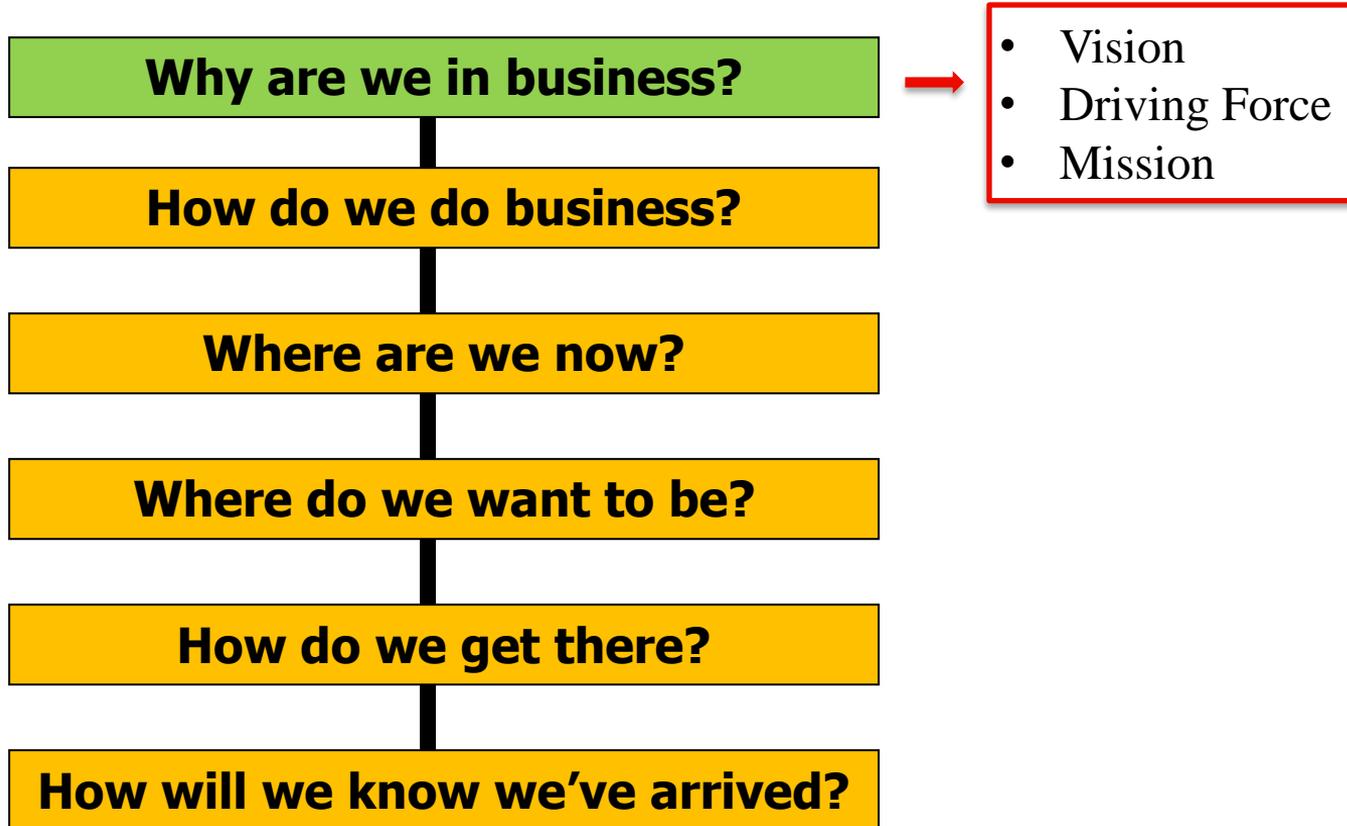
To Plan...or Not?

- Who should be on the planning team?
- Does anyone have experience with strategic planning?
- Do we think we can do it?
- Are we willing to make decisions about our future?
- Will we actually use the plan?
- What overriding crises would inhibit our ability to plan?

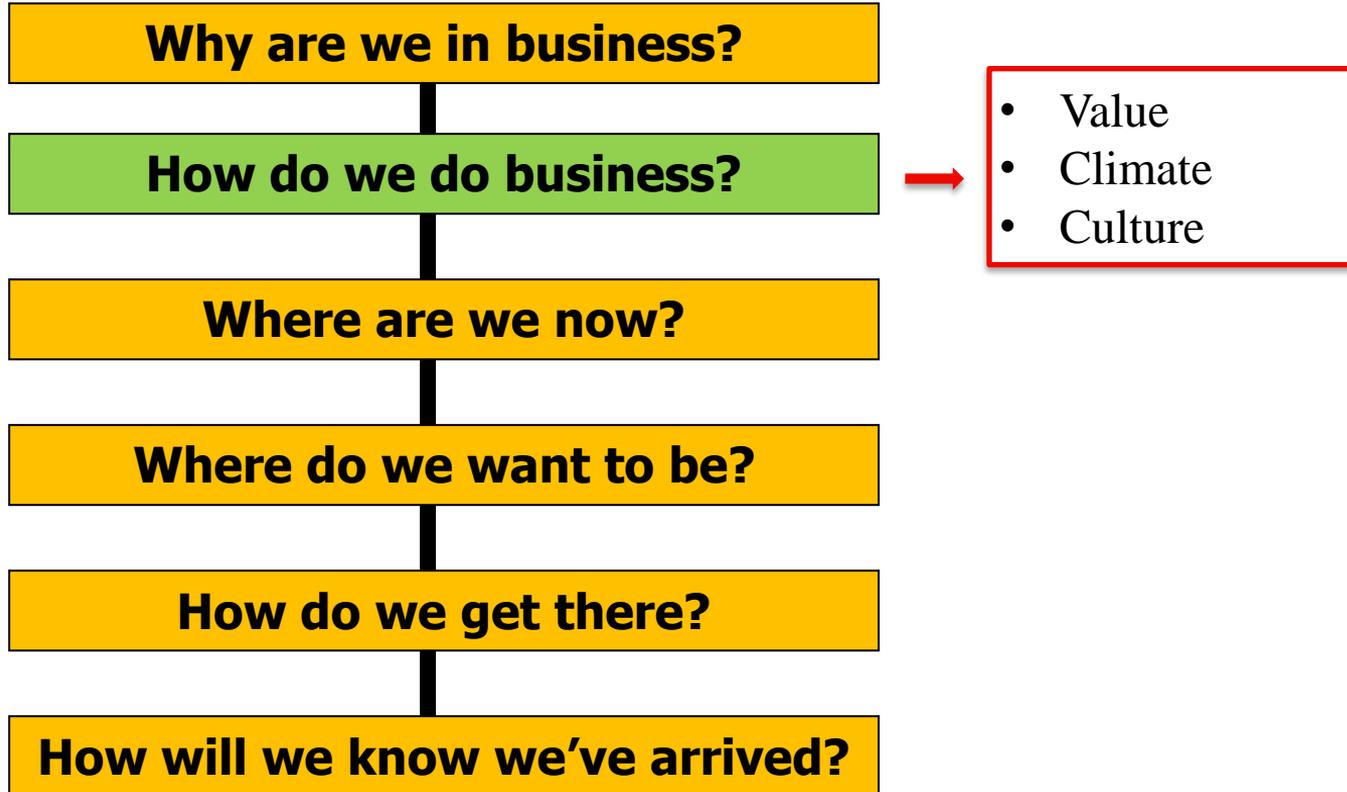
The Crouch Diagram



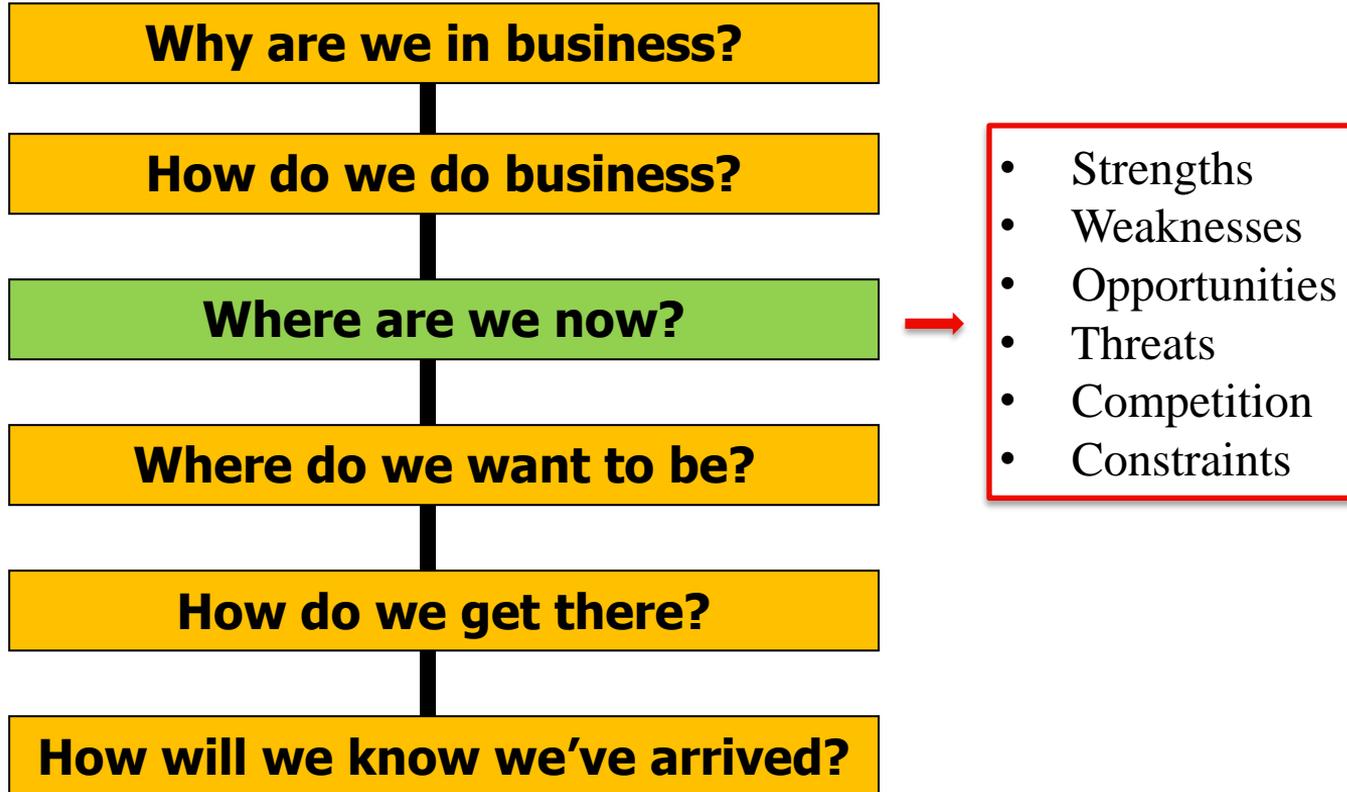
The Crouch Diagram



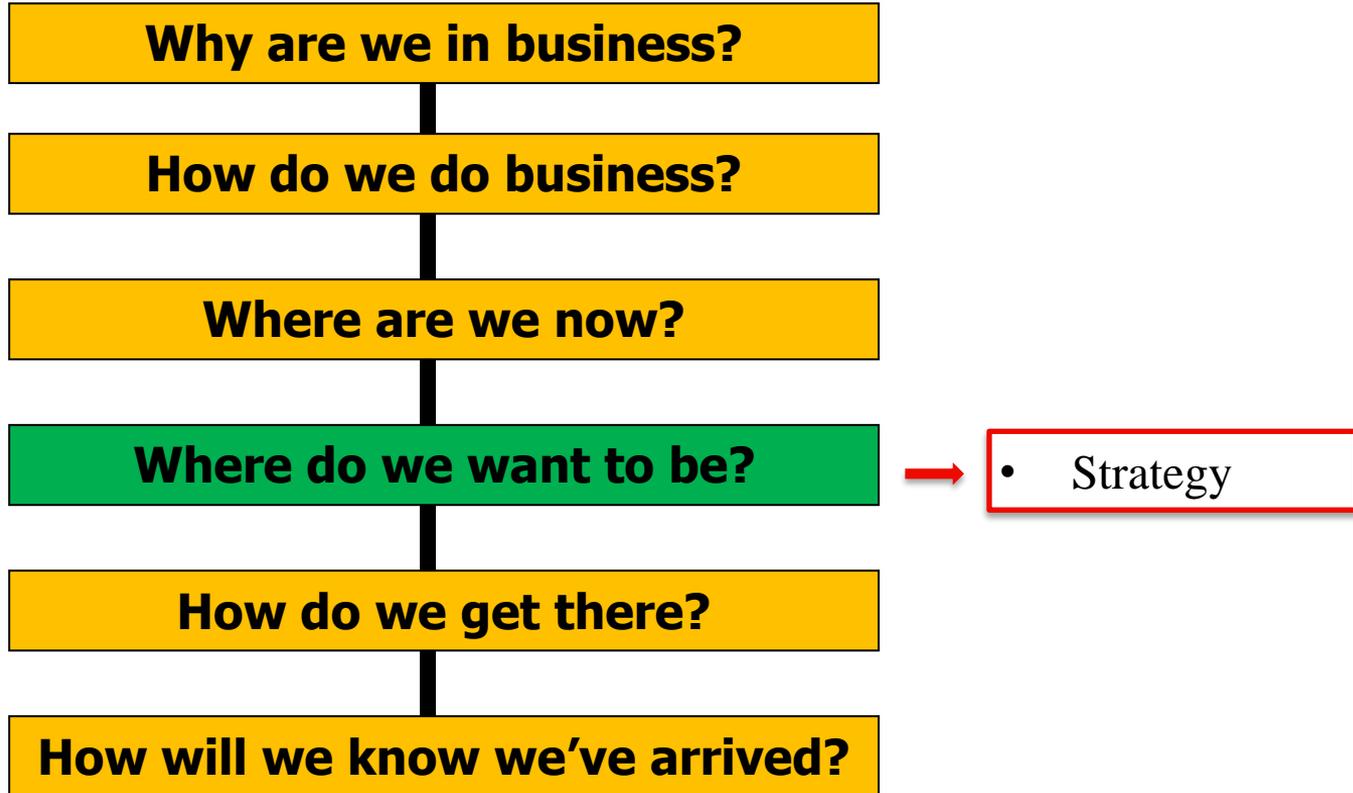
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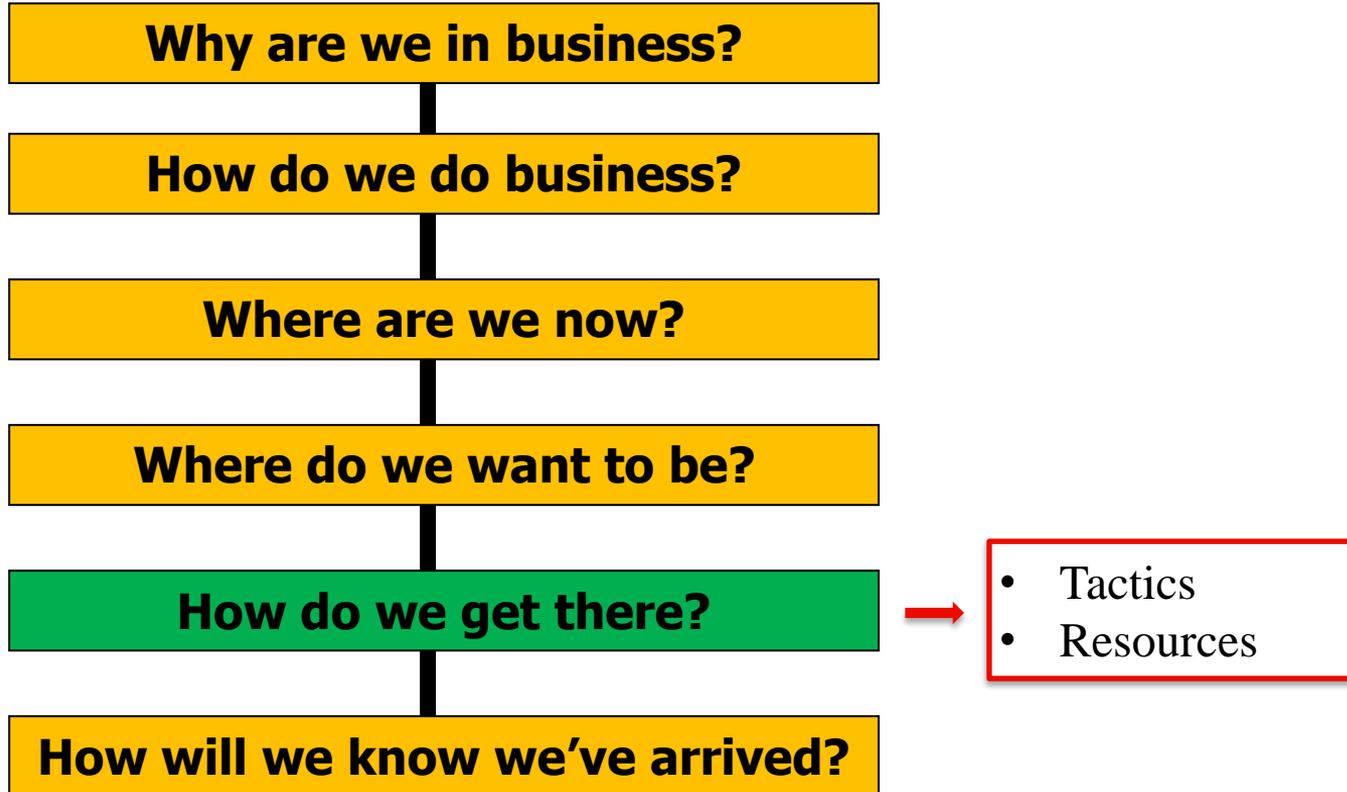
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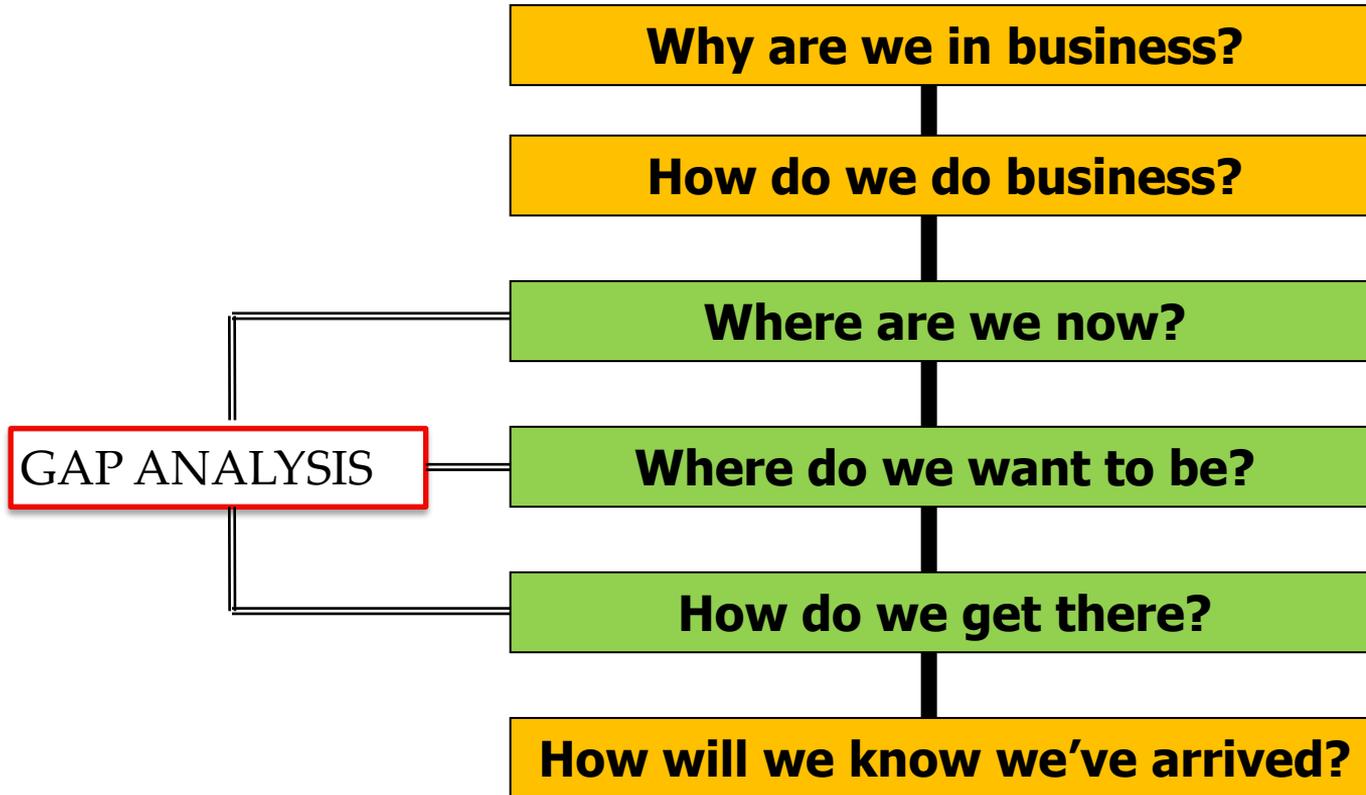
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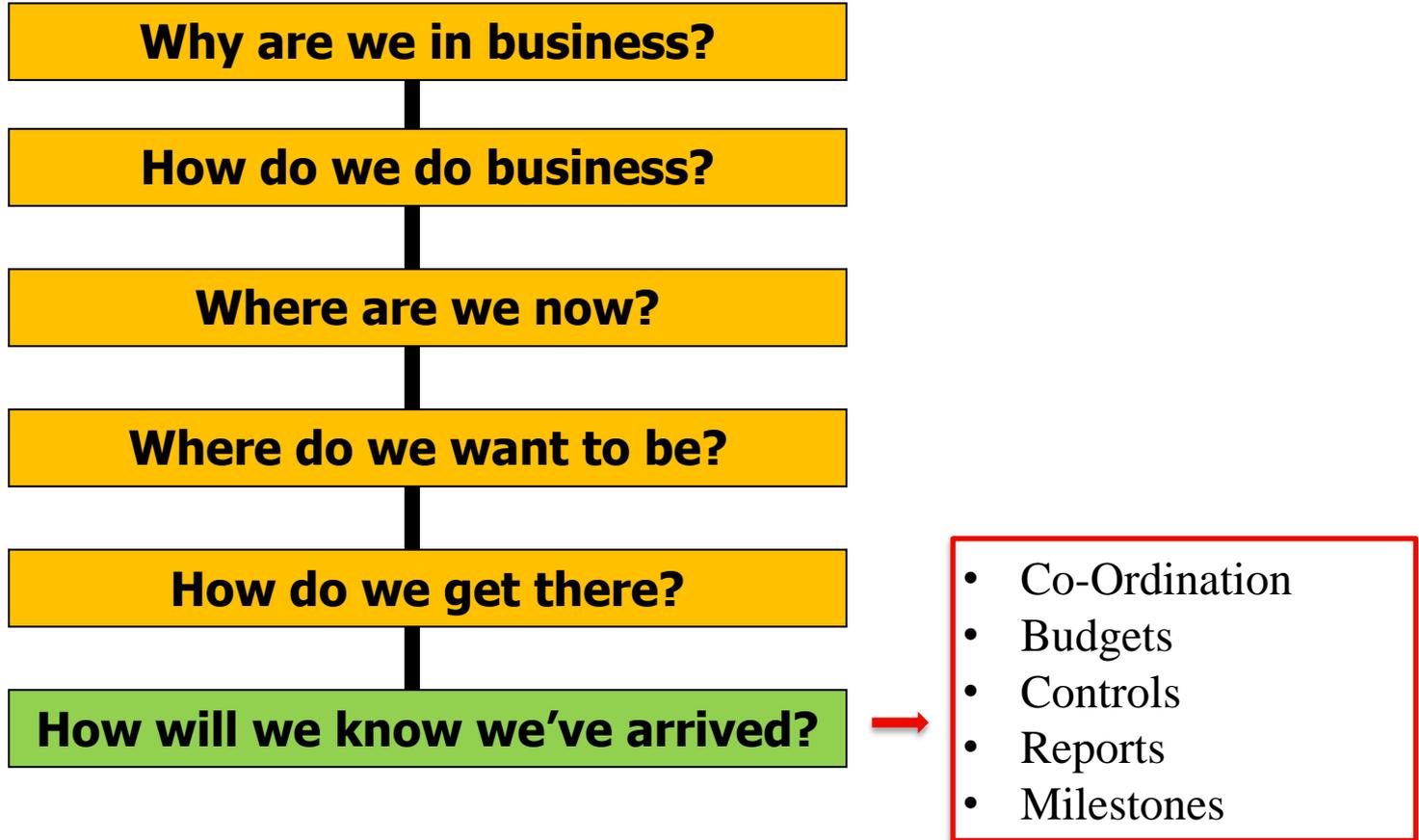
The Crouch Diagram



The Crouch Diagram



The Crouch Diagram



Strategy in General

- Strategy, in general, refers to how a given objective will be achieved
 - Hence strategy in general is concerned with the relationships between ends and means
 - Strategy and tactics are both concerned with formulating and then carrying out courses of action intended to attain particular objectives
 - Strategy is concerned with deploying the resources at your disposal
 - Tactics is concerned with employing them
 - Together, strategy and tactics bridge the gap between ends and means

Strategy in General

- The table below summarizes some of the more important differences

Aspects	Strategy	Tactics
Scale of the Objective	Grand	Limited
Scope of the Action	Broad and General	Narrowly Focused
Guidance Provided	General and Ongoing	Specific and Situational
Degree of Flexibility	Adaptable, but not hastily changed	Fluid, quick to adjust and adapt in minor or major ways
Timing in Relation to Action	Before Action	During Action
Focus of Resource Utilization	Deployment	Employment

Six Tips for Strategic Planning

1. Strategic planning is a way of thinking, an ongoing process
 - The plan is never perfect or complete
2. Keep the planning simple and manageable
3. Involve the organization's leaders
 - Don't give away the planning task to support staff or consultants

Six Tips for Strategic Planning

4. Emphasize creativity, innovation, and imagination rather than blindly following a set of planning steps
5. Don't adopt strategies without careful consideration of how they will be implemented
6. Strategic planning is not an end in itself
 - It is a tool to help the organization accomplish its mission

Ten Pitfalls of Strategic Planning

1. Planning the future primarily on the basis of statistical and financial projections or forecasts
2. Over-nighting a thick packet of forms to every branch to complete and return them to the corporate office in 10 business days

Ten Pitfalls of Strategic Planning

3. Giving strategic planning lip-service, but not giving time or support necessary to develop or implement a credible plan
4. Rolling out a new company-wide, long-term planning process and leaving incentive packages tied to short-term results unchanged
5. Blaming competitors, customers, payers, regulators, or the sales force for the poor strategic performance of the agency or company

Ten Pitfalls of Strategic Planning

6. Investing in training all line managers in techniques to build an exciting agency future and then downsizing
7. Adopting a strategy inherited through the acquisition of a former rival or simply imitating a current competitor

Ten Pitfalls of Strategic Planning

8. Starting with a vision or mission that fails to capture the imagination and ownership of the grunts in the field
9. Letting the bean counters in the business office or in accounting or finance reduce the future to a series of monthly bottom lines
10. Trying to step into the future with both feet planted firmly in past because of a myopic view of tomorrow as what we like about today

Four Basic Strategies

Rational -Empirical	People are rational and follow self interest change based on communication of information and offering incentives
Normative -Re-educative	People are social beings and follow social norms change based on redefining and reinterpreting existing norms, & developing commitment to new norms
Power -Coercive	People are mostly compliant, do as they're told change based on the exercise of authority and the imposition of sanctions
Environmental -Adaptive	People oppose loss/disruption but adapt readily change based on building a new organisation and gradually transferring people to the new one

Factors in Selecting Strategies

- There is no single perfect strategy ... please consider:
- Degree of Resistance
 - Strong: Power-Coercive & Environmental-Adaptive
 - Weak: Rational-Empirical & Normative-Re-educative
- Target Population
 - Large populations need all four strategies in a mix
‘something for everyone’

Factors in Selecting Strategies

- The Stakes
 - High stakes need all four strategies in a mix ‘nothing left to chance’
- The Time Frame
 - Short: Power-Coercive
 - Longer: Rational-Empirical & Environmental-Adaptive & Normative-Re-educative

Factors in Selecting Strategies

- Expertise
 - Mix the strategies according to the expertise of the Change Agents
- Dependency
 - If organisation is dependent on its people, managements ability to lead is limited
 - If people are dependent on the organisation, their ability to resist or oppose is limited
 - Mutual dependency requires negotiation

Planning Teams

- The planning design frequently calls for a small team to direct efforts and develop the written document
 - Input should come from the entire organization so that each member has a stake in the process and outcome
- Team members should
 - Work well together
 - Be committed to the process
 - Be respected by their peers

Planning Teams

- Team Leader
 - Should understand planning well enough to help others through the process
 - If this is a first-time experience for everyone involved, outside expertise may be useful to provide an initial orientation or a jump start

Who Should Be Involved in Planning?

- Establish clear guidelines for membership, for example
 - Those directly involved in planning
 - Those who will provide key information to the process
 - Those who will review the plan document
 - Those who will authorize the document
 - Etc.

Who Should Be Involved in Planning?

- The chief executive and board chair should be included in the planning group
 - Should drive development and implementation of the plan

Who Should Be Involved in Planning?

- A primary responsibility of a board of directors is strategic planning to effectively lead the organization
 - Therefore, insist that the board be strongly involved in planning
 - Including assigning a planning committee (often, the same as the executive committee)

Who Should Be Involved in Planning?

- Always include in the group, at least one person who ultimately has authority to make strategic decisions
- Ensure that as many stakeholders as possible are involved in the planning process

Who Should Be Involved in Planning?

- Involve at least those who are responsible for composing and implementing the plan
- Involve someone to administrate the process, including
 - Arranging meetings
 - Helping to record key information
 - Helping with flipcharts
 - Monitoring status of pre-work, etc.

Who Should Be Involved in Planning?

- Phases in Team membership
- Strong board involvement in determining the organization's strategic direction
 - Mission
 - Vision
 - Values

Who Should Be Involved in Planning?

- Then more staff involvement in determining the organization's strategic analysis to determine its current issues and goals
- Then primarily the staff to determine the strategies needed to address the issues and meet the goals

Who Should Be Involved in Planning?

- In general, where there's any doubt about whether a certain someone should be involved in planning, it's best to involve them

Part B: Requirement Analysis Concept

Requirement Analysis

- Why do we need requirement analysis?
 - Results of requirements analysis
 - Requirement analysis payoff
- Network services
 - User requirements
 - Application requirements
 - Device requirements
 - Network requirements

Requirement Analysis – background

- Requirements are description of network functions and performance that are needed for network to successfully supports its
 - Users,
 - Applications,
 - Devices

Requirement Analysis – background

- Gathering and deriving requirements in order to understand system and network behaviour
- Activities include
 - Identifying, gathering, deriving and understanding system requirements and their characteristics
 - Developing thresholds and limits for performance
 - Determining where best-effort, predictable and guaranteed services apply in the network

Requirement Analysis - Results

- Requirement specification
 - A document that lists and priorities requirements
- Requirement map
 - Show location dependencies between applications and devices
 - Used in Flow analysis and User Requirements

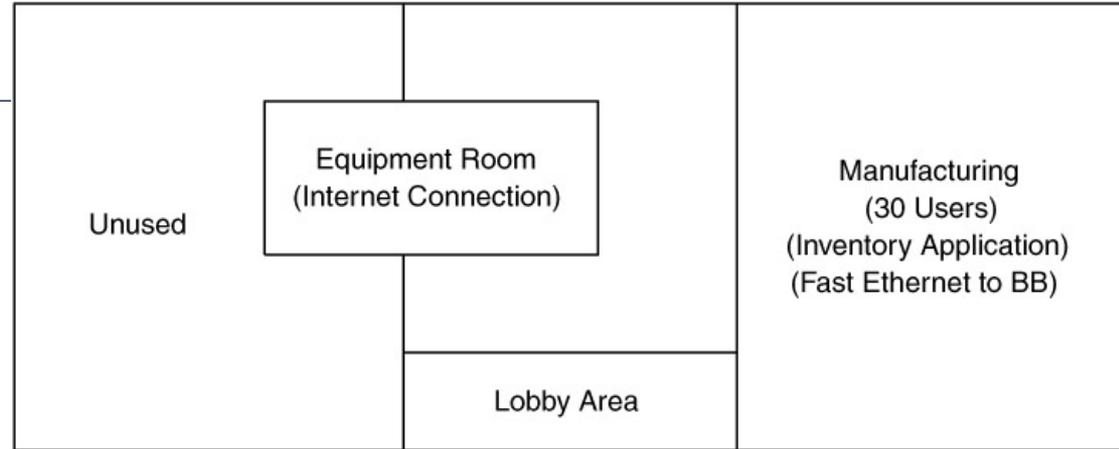
Requirement Specification

Requirements Specification

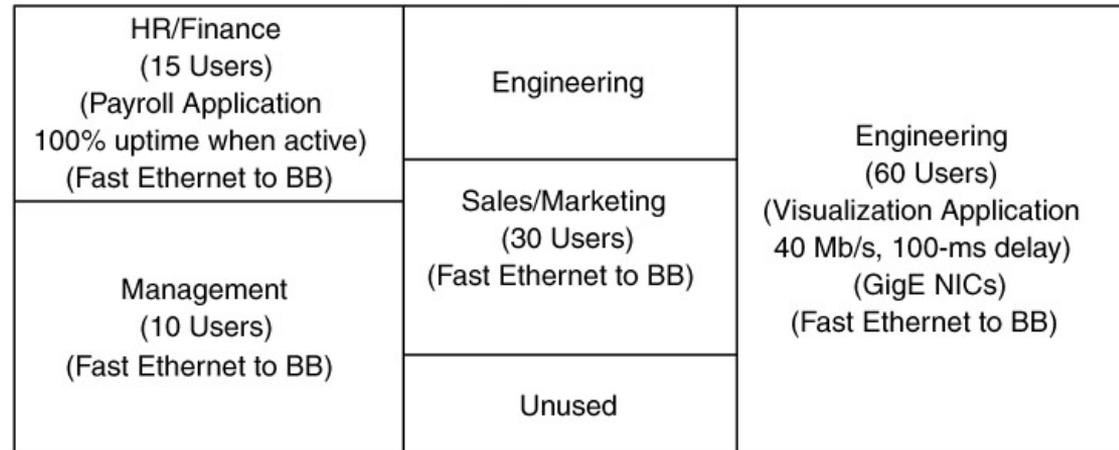
ID/Name	Date	Type	Description	Gathered/Derived	Locations	Status	Priority
1	14Jan03	User	User distribution is 60 engineers, 15 HR and Finance, 30 Manufacturing, 10 Management, 30 Sales/Marketing, 5 Other.	Gathered from Management	See Map	Info	TBD
2	12Jan03	Network	Each area of the building must support Fast Ethernet connections to the backbone. Database, Visualization, Manufacturing,	Gathered from Management	All Bldgs	TBD	TBD
3	12Jan03	Application	and Payroll applications are considered mission-critical for this company. More information needed. Inventory application (INV1) for	Gathered from Management	See Map	TBD	TBD
4	20Jan03	Application	manufacturing requirements not determined at this time.	Gathered from Users (MAN)	See Map	TBD	TBD
5	14Jan03	Application	Database application (DB1) requires a minimum of 150 Kb/s per session.	Gathered from Various Users	TBD	TBD	TBD
6	02Feb03	Device	Engineering users have workstations with GigE NICs. Visualization application (VIS1) for finance	Gathered from Users (ENG)	See Map	TBD	TBD
7	20Jan03	Application	requires up to 40 Mb/s capacity and 100-ms round-trip delay. Payroll application (PAY1) requires 100%	Derived from Application	See Map	TBD	TBD

Requirement Map

Building A—1st Floor



Building A—2nd Floor

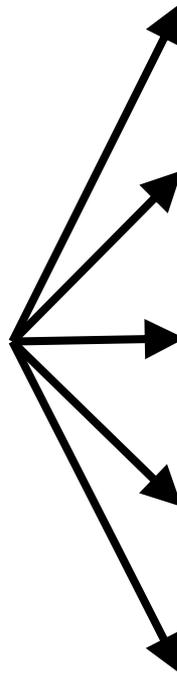


Categorizing requirements

Requirements Gathered
And Derived from Users,
Management and Staff



Analysis of
Requirements



**Core Requirements for
the network**

**Features for
the network**

**Requirements for Future
Revisions/Upgrades**

Rejected Requirements

**Informational
Requirements**

Requirement Types

- Core requirements are features that are deemed **necessary**
- Features that are **desirable** but could be installed at a **later** date
- **Rejected** requirements are either not really necessary or not desirable
- Requirements are normally categorized during the analysis phase

RFC 2119 keywords

- The IETF's RFC 2119 identifies the following keywords to describe relative importance

Keyword	Type of Requirement
Must/Shall/Required	Core
Must Not/Shall Not	Core
Should/Recommended	Feature or Future
Should Not/ Not Recommended	Feature or Future
May/Optional	Feature, Future or Rejected

Requirement Types

<u>Requirements Specification</u>							
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Requirement Status and Priority

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Why do we need requirement analysis?

- Requirement analysis is often overlooked
 - Talking to N users MAY result in N+1 sets of requirements
 - Network personnel and managers are often distanced from the users
 - Requirement analysis appears to have no immediate payoff

Why do we need requirement analysis?

- The result of NOT doing proper requirement analysis
 - A design based on factors other than what the users, applications or devices need
 - Examples
 - A network based on a technology the designer is comfortable with
 - A network based on a particular vendor
 - These types of choices are NOT objective

Requirement analysis payoff

- Objective, informed choices of network technologies and services
- Ability to match interconnection strategies to networks
- Networks and elements sized to users and applications
- Understanding of where and how to apply services in Network
- Tradeoffs made with the Big Picture in mind
- Ability to identify high and low level performance applications

Network Services

Network Services

- Sets of network capabilities that can be configured and managed within the network
 - Levels of performance and function offered
 - Sets of requirements expected
- For services to be useful and effective they need to be provisioned end-to-end

Network Services

- Services need to be
 - Configurable
 - Measurable
 - Verifiable
- Ensure end users are getting the services they what they requested
 - Accounting

Network Services

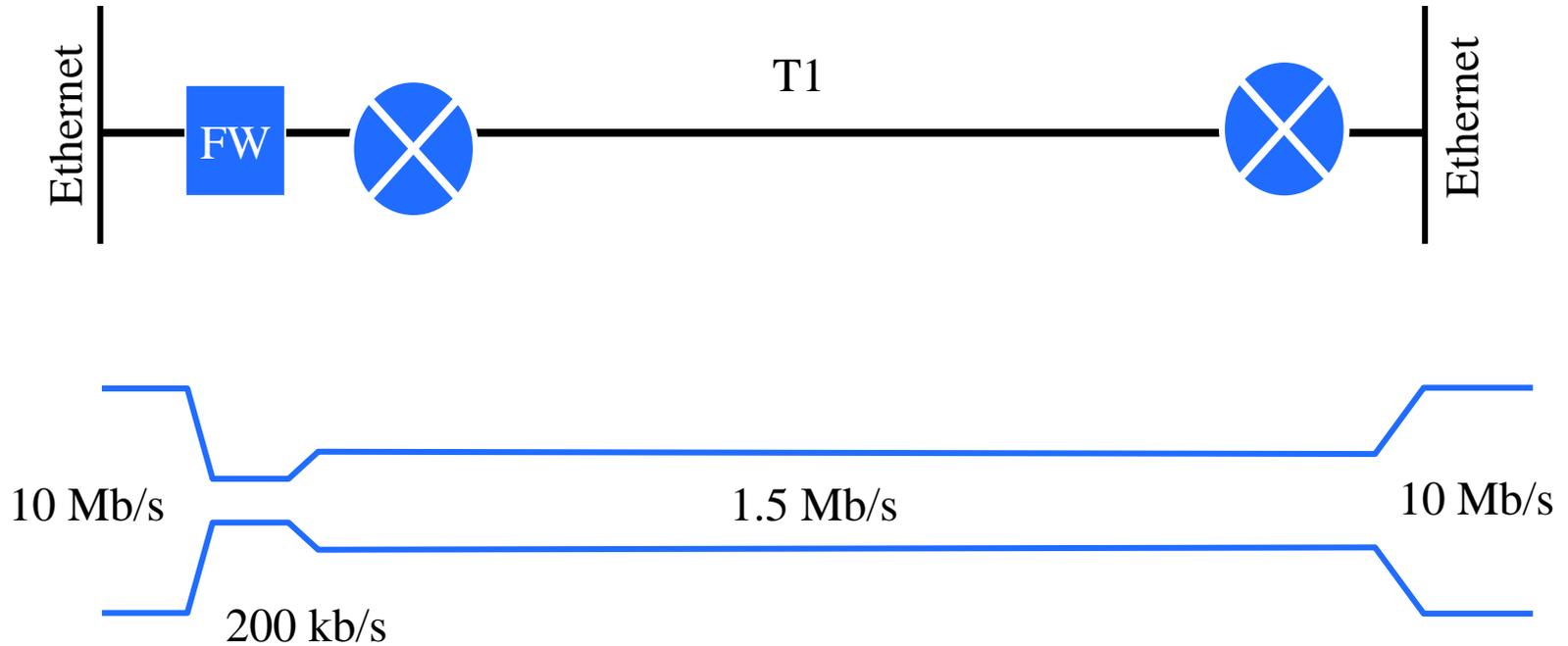
- Services are generally hierarchical
 - General services in the backbone
 - Specific services close to users
- Network services are derived from the requirements of all entities within the network
 - They describe what is expected by/from each entity

Network Services

- Service offerings need to be configured end-to-end
 - Requirements add to each other filtering from user to network
- In addition to providing performance and function to users they support design and operation of the network

Network Services

- Mismatches in services can result in network bottlenecks



Network Services

- Network service requirements include
 - User requirements
 - Application requirements
 - Host requirements
 - Network requirements

User Requirements

- They include
 - Timeliness
 - Interactivity
 - Reliability
 - Presentation quality
 - Adaptability
 - Security
 - Affordability
 - Functionality
 - Supportability
 - Future Growth
- We also need to know how many users are expected to use the system and their locations

User Requirements

- **Timeliness**
 - User able to transfer, access or modify information in a reasonable time
- **Interactivity**
 - Focus on the response of the system

User Requirements

- Reliability
 - Availability from the user perspective
 - User must have access to the system most of the time and level of service must be consistent
- Presentation quality
 - The user perception of quality (e.g. audio and video displays)

User Requirements

- **Adaptability**
 - Ability of the system to adapt to users needs
 - E.g. distance independence and mobility
- **Security**
 - Guarantee of confidentiality, integrity and authenticity of users information and physical resources

User Requirements

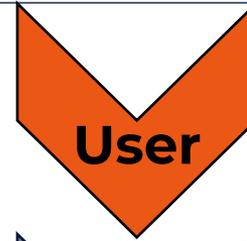
- **Affordability**
 - Purchases fit within a budget – completely NON-technical
- **Functionality**
 - Functions that the system will perform
 - Often tied to applications that will be used on the system

User Requirements

- Supportability
 - How well can the network keep operating through the full range of mission scenarios described by customer
- Future Growth
 - Depends on knowledge of the users plans for future deployment of new applications etc.

User Requirements

- Least technical and most subjective
- Technical component increases as you move toward the network.



Application Requirements

- Application needs determine many of the requirements of the network design
 - Applications couple users and devices to the network
 - Applications are often end-to-end → their requirements span the network

Application Requirements

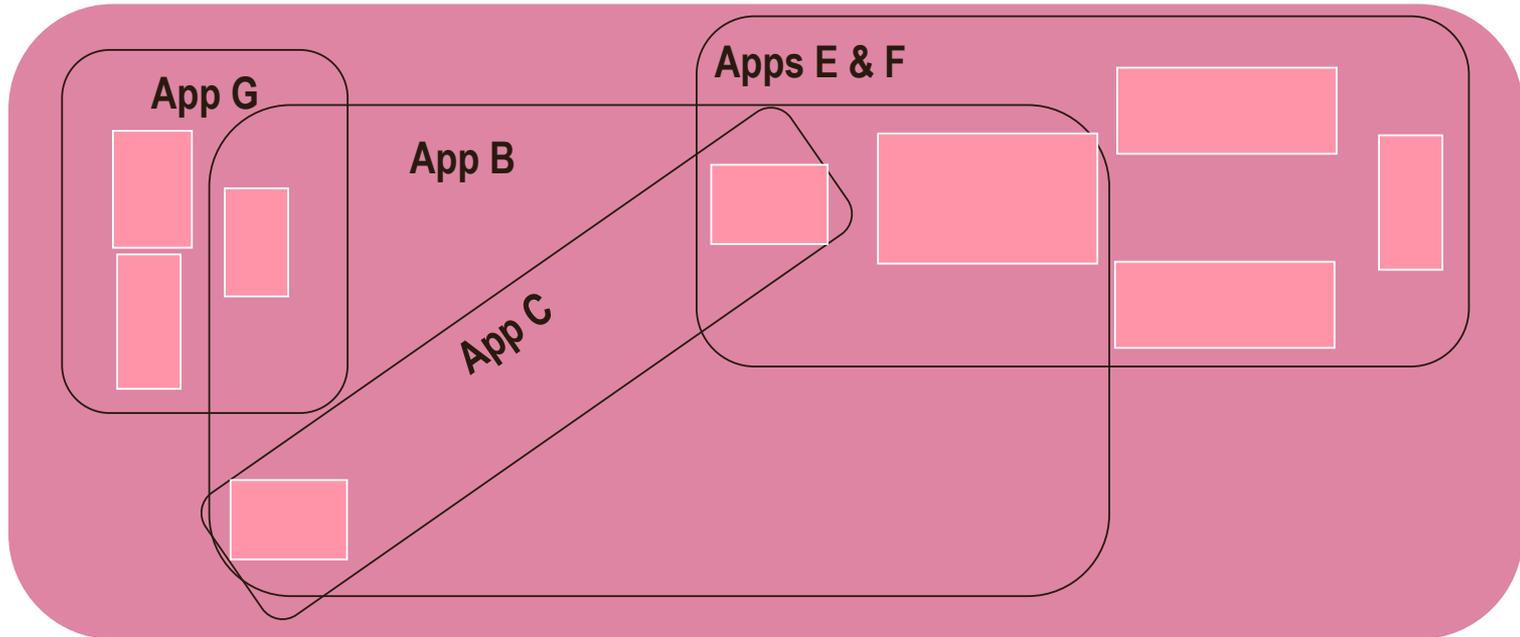
- Applications can be categorized based on their service and performance requirements
 - Mission Critical
 - Predictable, guaranteed and/or high performance [RMA](#) requirements
 - Rate Critical
 - Predictable, guaranteed and/or high performance [capacity](#) requirements
 - Real-time and Interactive
 - Predictable, guaranteed and/or high performance [delay](#) requirements

Mission Critical – Introducing RMA

- **Reliability** – statistical measure of frequency of failure; unscheduled outages
- **Maintainability** - statistical measure of the time it takes to repair the fault
- **Availability** – the relationship between R and M
 - R - how often does it break?
 - M - when it does break, how long does it take to get back on line?

Application Locations

- Once applications have been categorized and grouped it is useful to determine where the application lies in the network



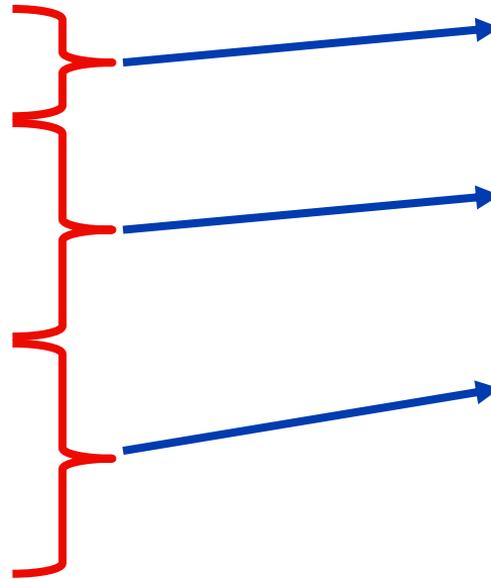
User vs Application Requirements

■ User Service Requirements

- Timeliness
- Interactivity
- Reliability
- Quality
- Adaptability
- Security
- Affordability
- User numbers
- User locations
- Expected growth

■ Performance Requirements

- Delay
- Reliability
- Capacity



Device Requirements

- Generic Computing devices
 - Desktops, laptops, handheld devices, WiFi
 - Form access points to network
 - Typically single user
 - End-to-end requirements
 - Tend to be overlooked...
 - ... but if we don't know what is on the end devices
 - Can't design for the "last foot"

Device Requirements

- Servers
 - Provide service to one or more users
 - Impact on information flow
- Specialized equipment
 - Supercomputers, mainframe, data gathering equipment
 - Location Dependent

Device Requirements

- Performance characteristics include
 - Storage performance
 - Processor performance
 - Memory performance (access times)
 - Bus performance
- Device location

Network Requirements

- We need to consider existing networks and include any dependencies and constraints in our design
 - Scaling dependencies
 - Location dependencies
 - Performance constraints
 - Network, system and support service dependencies
 - Interoperability dependencies
 - Network obsolescence

References and Reading

- ❖ **Chapter 2** - 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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