A Modular Systems Engineering Approach to Advanced Fuze Design and Development

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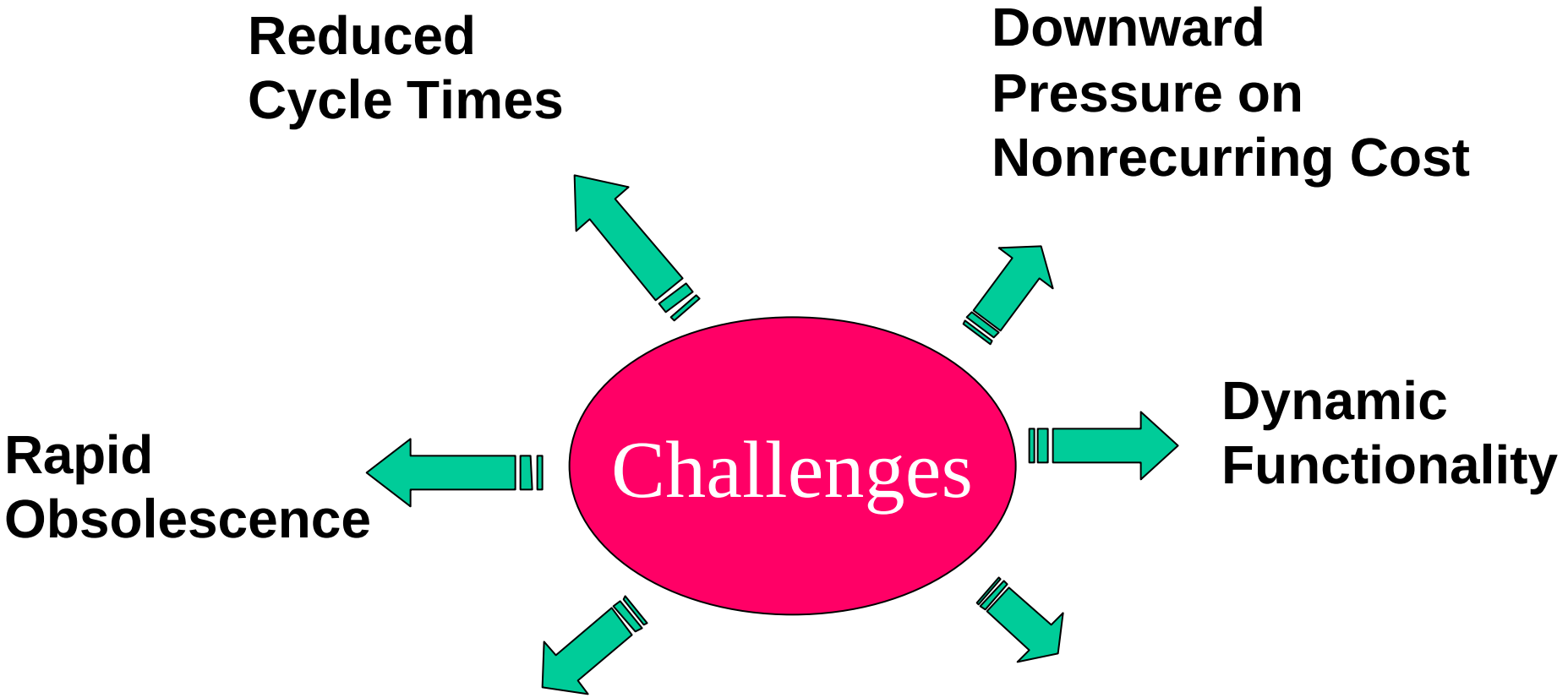
Overview

- Fuzing Challenges
- Case Study in Bomb Fuzing
- Modular Fuzing Approach/Benefits
- Systems Engineering applied to modular bomb fuze approach
- Critical Success Factors
- Summary

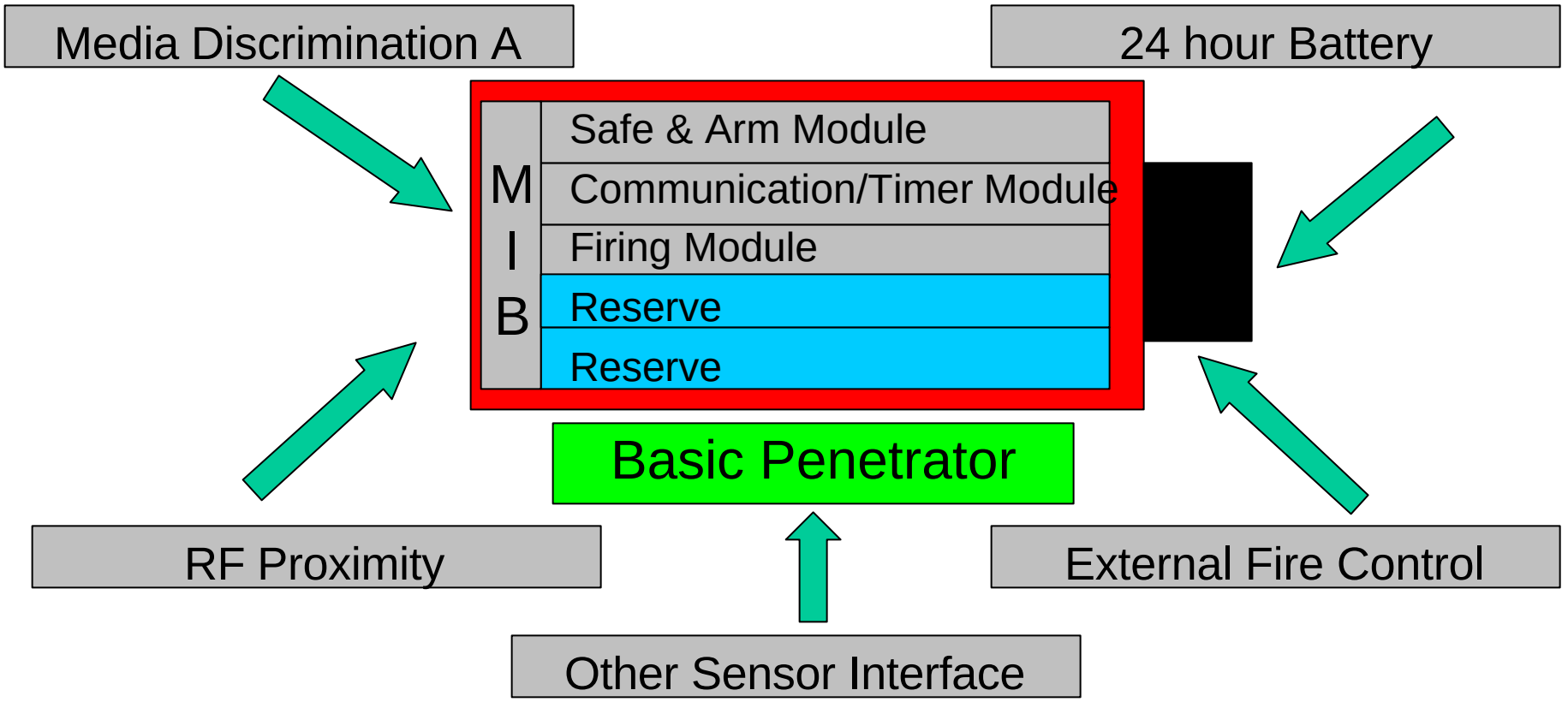
Challenges to New Fuze Development Initiatives



Case Study – Needs of Bomb Fuzing

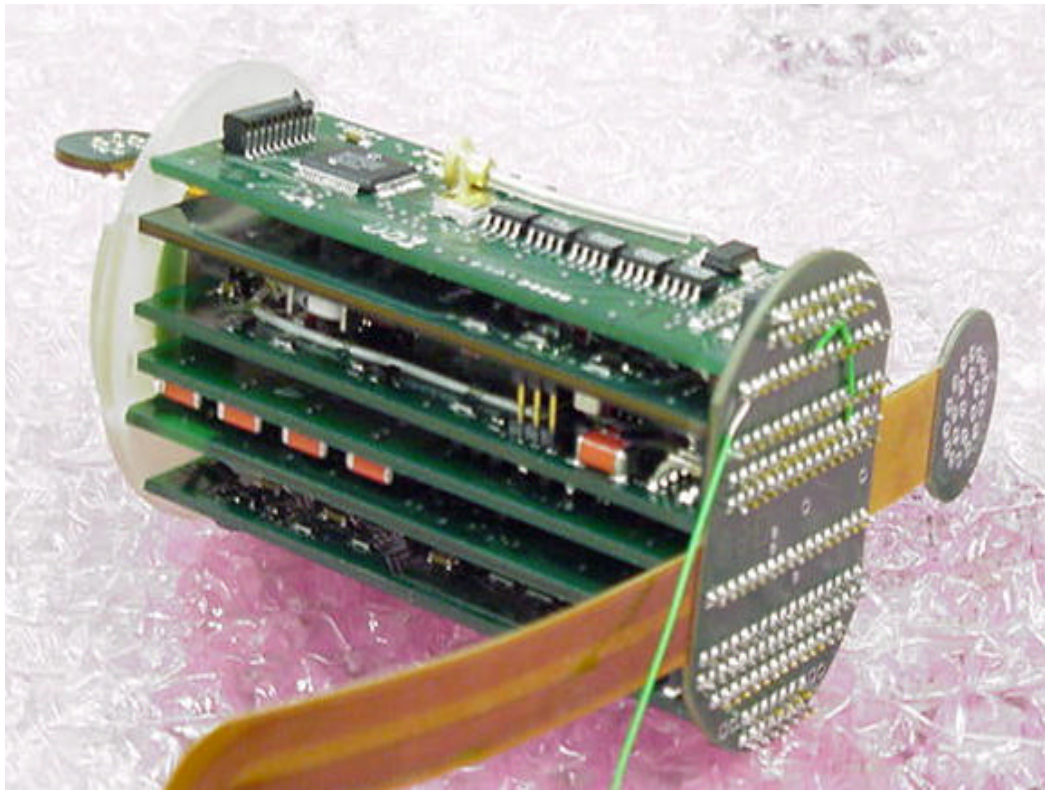
- Target Sets are becoming much more complex – Hardened
- New weapons systems in development require additional functionality which is not provided in presently qualified fuzes
- Capability is needed quickly and is conflict specific
- Increased fuze intelligence for precision
- Expansion of ordnance envelop
- Smaller quantities of fuzes required, but larger quantity price desired.

Application of Approach to Bomb Fuzing



- Qualify the architecture and components
- Allows customers to pick and choose modules

Modular Bomb Fuze Architecture/Form Factor

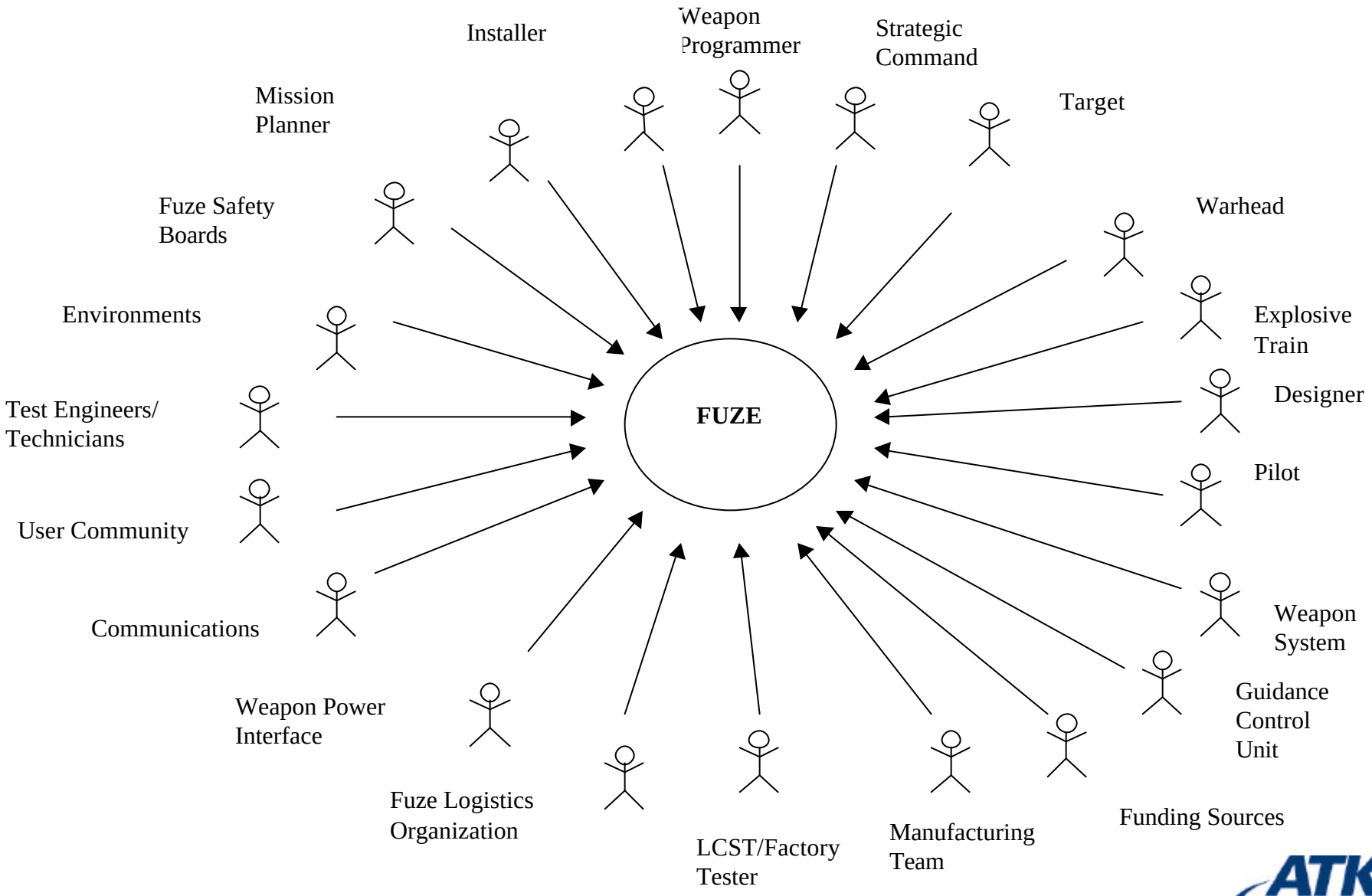


Modular fuze form factor would be optimized based on application requirements. Package could be in 2-3 inch form factor. (Small package desirable for survivability)

Benefits of Modularity

- Quick removal/additional of functionality
- Cycle Time to develop new configurations can be minimized by reusing existing modules and coupling with new modules
- Easy modification of any module without affecting other modules
- Configurations can be optimized for cost, performance, customer need
- Ability to grow or shrink size of fuze based on application requirements
- High degree of component reuse driving down parts costs
- Modules can be built and tested as complete stand alone assemblies prior to integration into final potted configuration
- Can be fully tested as a fuze system prior to potting

Identify key stakeholders (Stakeholder Diagram)



Approach to Defining Modular Fuze Requirements

Elicit Customer/Stakeholder wants and desires

Define Key Fuze Performance Characteristics

Determine Fuze Features

Allocate Fuze Features into HW, SW or COTS

QFD

Product: Modular Fuze
Team:
Date: August 15, 2002
Revision:

Importance Key
1 - Low
2 - Tie Breaker
3 - Medium
4 - Tie Breaker
5 - High

	Requirements Reference	Importance													Low Functionality	Medium Functionality	High Functionality	Application Spec #1	Application Spec #2
Volume																			
3 " Diameter																			
2 " Diameter																			
2.x" with 3 " adaptor																			
Impact Velocity																			
<1000 ft/sec																			
1000-2000 ft/sec																			
2000-3000 ft/sec																			
3000-4000 ft/sec																			
> 4000 ft/sec																			
Programmable Post Impact Fire Delay Times																			
0 - 25 mSec(1 mSec Res.)																			
0 - 255 mSec (1 mSec Res.)																			
250 mSec - 1 sec																			

FMEA

Process Step	Failure Mode	Effect	Sev	Cause	Occ	Control	Det	RPN	Corrective Action	Sev	Occ	Det	RPN

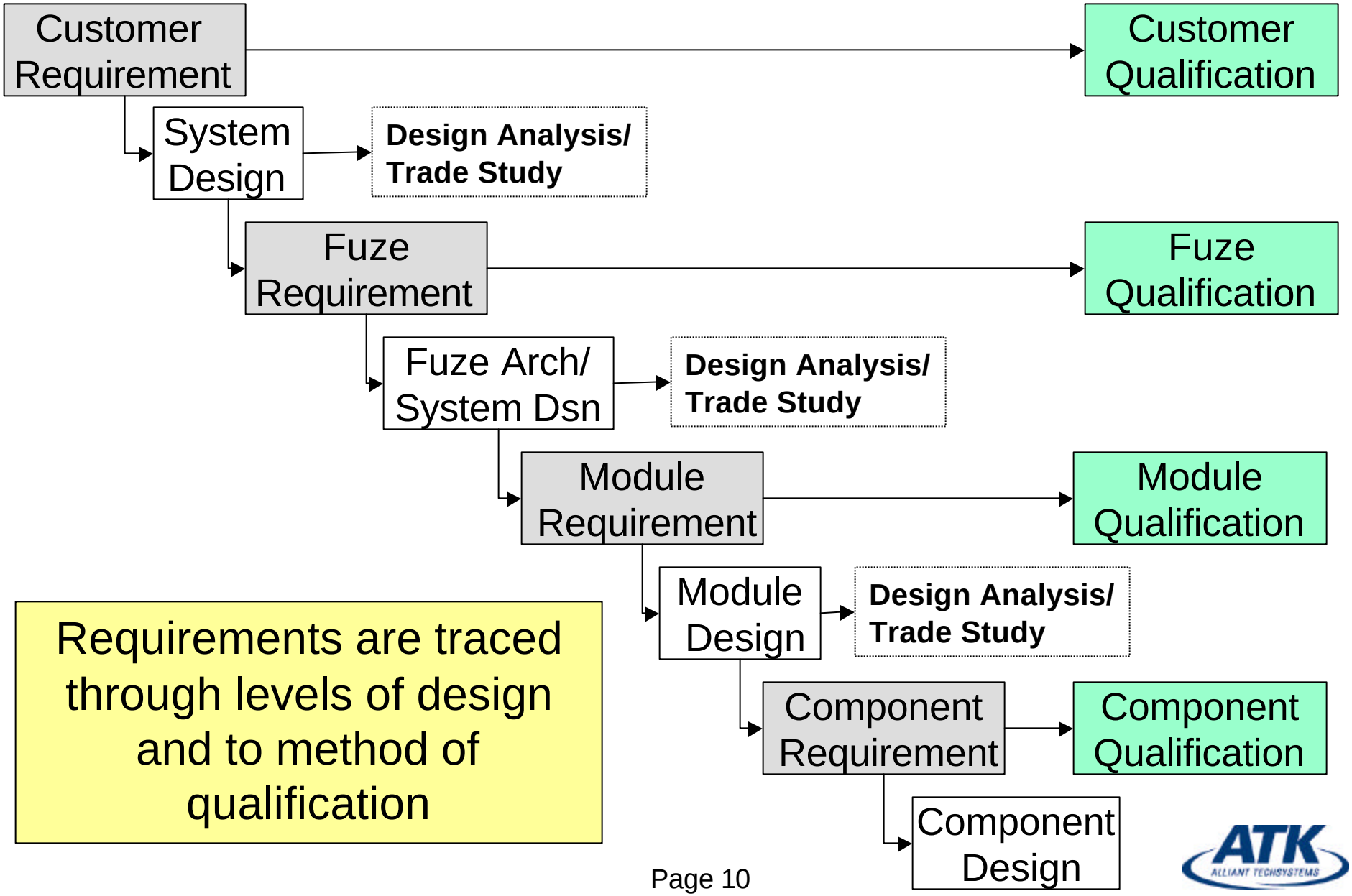
Partition Features Into Physical HW/SW Modules

Define Resuable Module Requirements/Interfaces HW/SW

Define Fuze Family

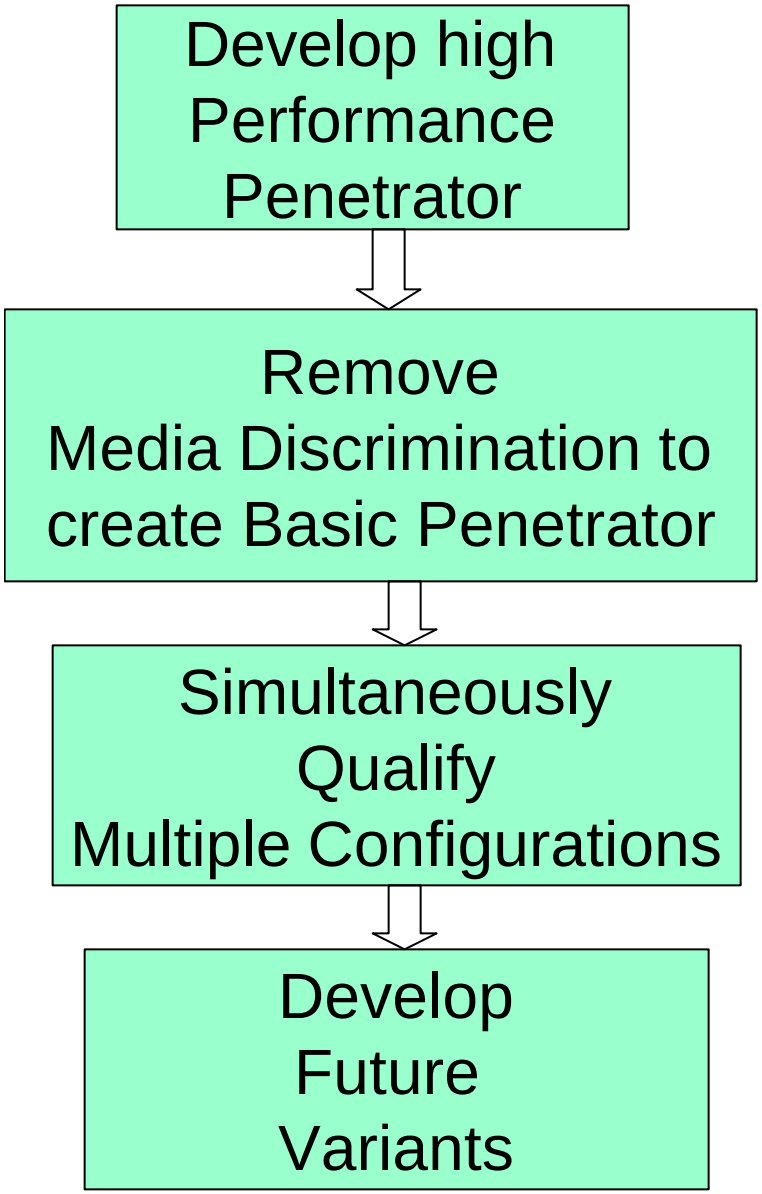
Qualify Fuze Family

Traceability



Requirements are traced through levels of design and to method of qualification

Approach to Qualification of Family of Fuzes



- One design cycle results in multiple qualified fuzes configurations
- Significant synergies of design, parts, software, processes, manufacturing and materials
- Reduced development cost and cycle time
- Increased reliability based on continuous improvement of common modules
- Low risk approach reuses already proven and qualified components
- Provides great baseline for growth

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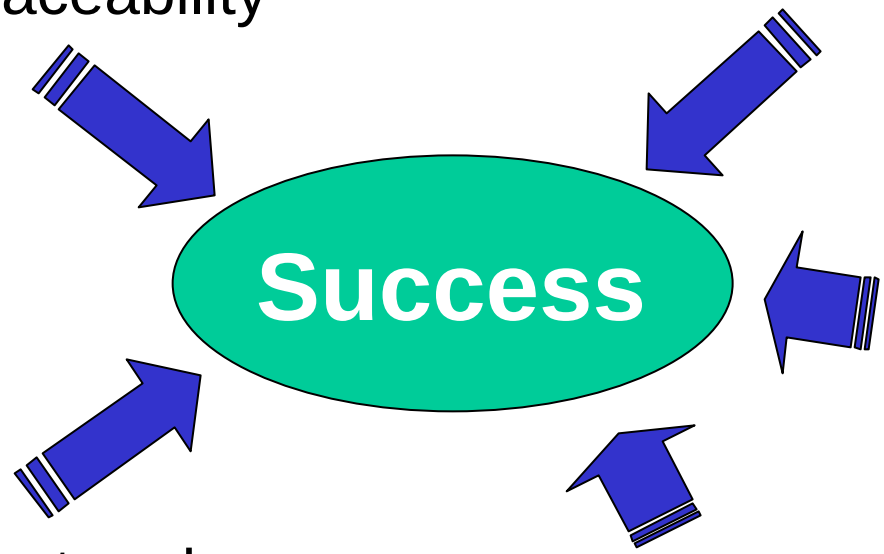
Critical Success Factors

Rigorous requirements development, allocation, flowdown and traceability to qualification

Tight relationship between designer and customers/stakeholders



Focus on Key Performance Parameters

Early involvement and buyin of safety community as a stakeholder in definition of fuze environments

Early application of Design for Six Sigma, Lean Design Principles

Summary

- Applications of sound systems engineering principles allows development of:
  - Modular fuzing with increased flexibility for developing future families of fuzes
  - Modular fuzing with decreased product development cycle time, nonrecurring development cost and providing path to low recurring costs
  - Modular fuzing providing increased flexibility to provide the diverse fuzing community needs.