Complexities of Operating Advanced Rail and Transit Communications Systems in the Era of New Wireless Technologies, Intelligent Transportation (and Rail) Systems and Positive Train Control

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Warren S. Meyers

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Introduction

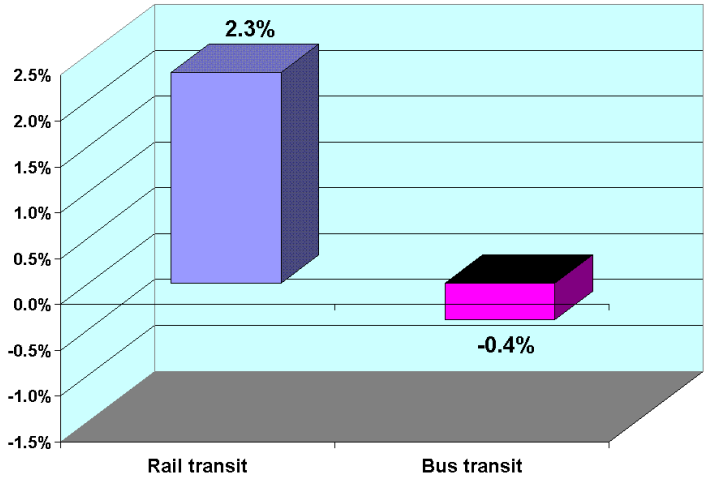
- Since 1980 the telecommunications industry went from analog to digital, with data rates of 1.2 kbps now to multiple gigabit
- Rail growth has increased gradually
- Now recognize a convergence of advanced telecommunications systems with that rail systems, with
- Design and construction of Positive Train Control in the US and elsewhere in the world
- Continued growth of Intelligent Transportation Systems
- Integration of advanced technology with national security, management of the power grid, SCADA systems and improved systems to manage these technologies with a coherent infrastructure management methodology, a formulated strategic and technology plan

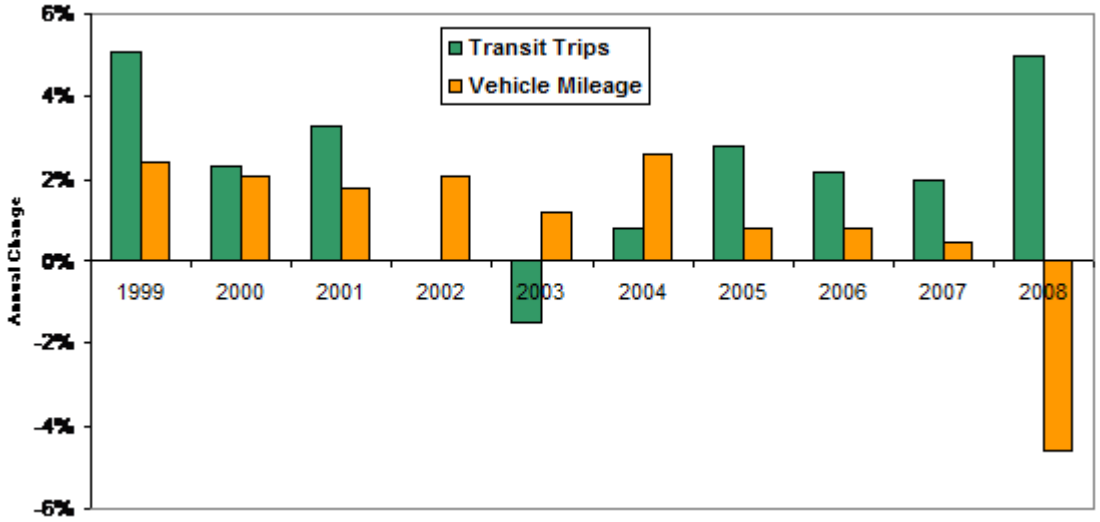
Some Prior Trends in North American Pubic Ridership

Ridership Growth or Loss Rate

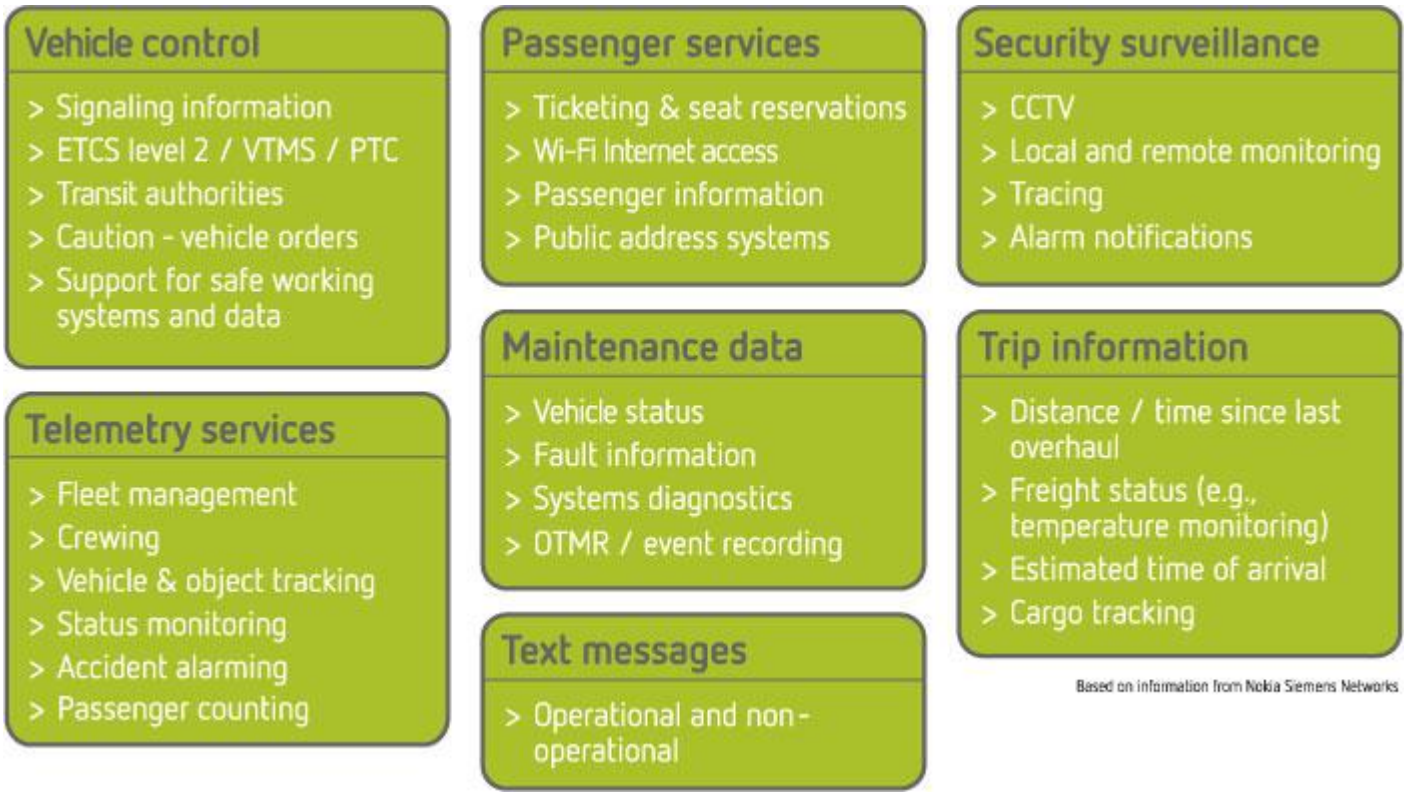
USA & Canada, Quarters 1-2, 2004

Light Rail	4.6%
Rapid Rail	2.1%
Regional Rail	0.1%
Urban Bus	-0.2%
Cable Car, Monorail, AGT, DPM	-2.5%
Trolley Coach	-9.7%





Modern Telecommunications and IT Services



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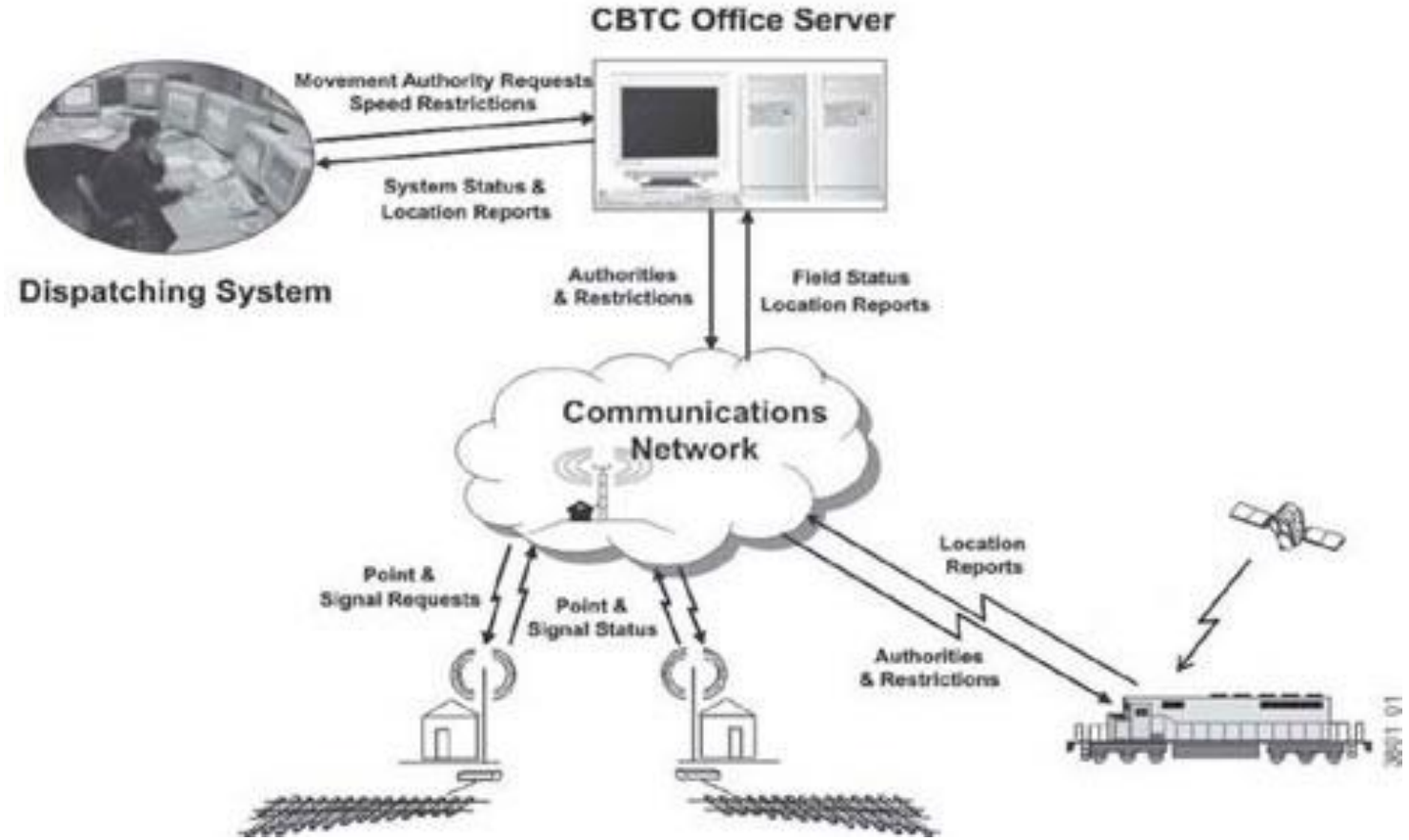
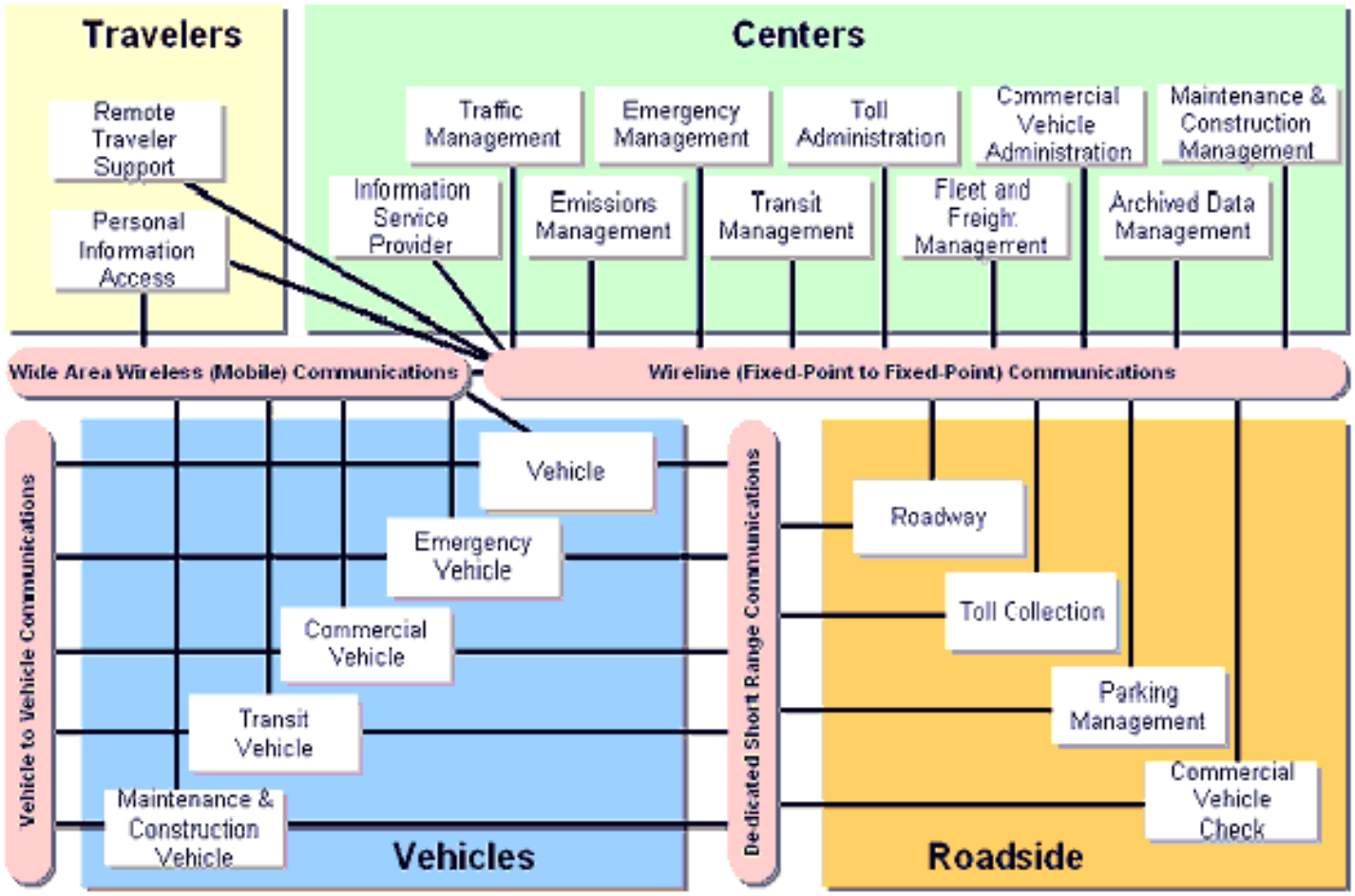
Typical Communications Infrastructure for a typical Positive Train Control System



Intelligent Transportation Systems Architecture



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Communications Consulting Trends in Transit Systems

- RF over Fiber for large transit operations
- Bidirectional Amplifiers
- High speed fiber services
- Digital land mobile radio
- Infrastructure changes with narrow banding
- Industrial, Scientific and Medical Band (ISM)
- Wireless dispatch systems
- Emergency and security related communications systems
- Hand held technologies
- Video Analytics
- Security

Complexities and Challenges of PTC Deployment

- **Spectrum acquisition**
- **PTC application and controls**
- **New wayside technologies**
- **Communications issues**
  - Radios
  - Communications Manager
  - Lack of network management tools
  - RF Coverage and EMI or other interference
  - Outside plant
  - Range of conditions
    - Tunnels
    - Terrain variations
  - Reliability
  - IP Infrastructure
  - Integration of equipment and systems.
  - Software Development

Issues of complexity in the transportation and telecommunications area

- **Reliability and Vulnerability of Critical Infrastructure- A system of systems**
- **Probability of events and consequence**
- **Identification of risks (magnitude and probability)**
- **Concept of nodal vs. link disruptions**
- **System complexity**
- **Linkage effects of separate but interconnected systems**
- **Issues of planning for worst case scenarios**
- **Readiness and training of responders**
- **Documenting and knowing the infrastructure**
  - Shifts in institutional knowledge and levels of expertise
- **Identifying the convergence of telecommunications and transportation systems**

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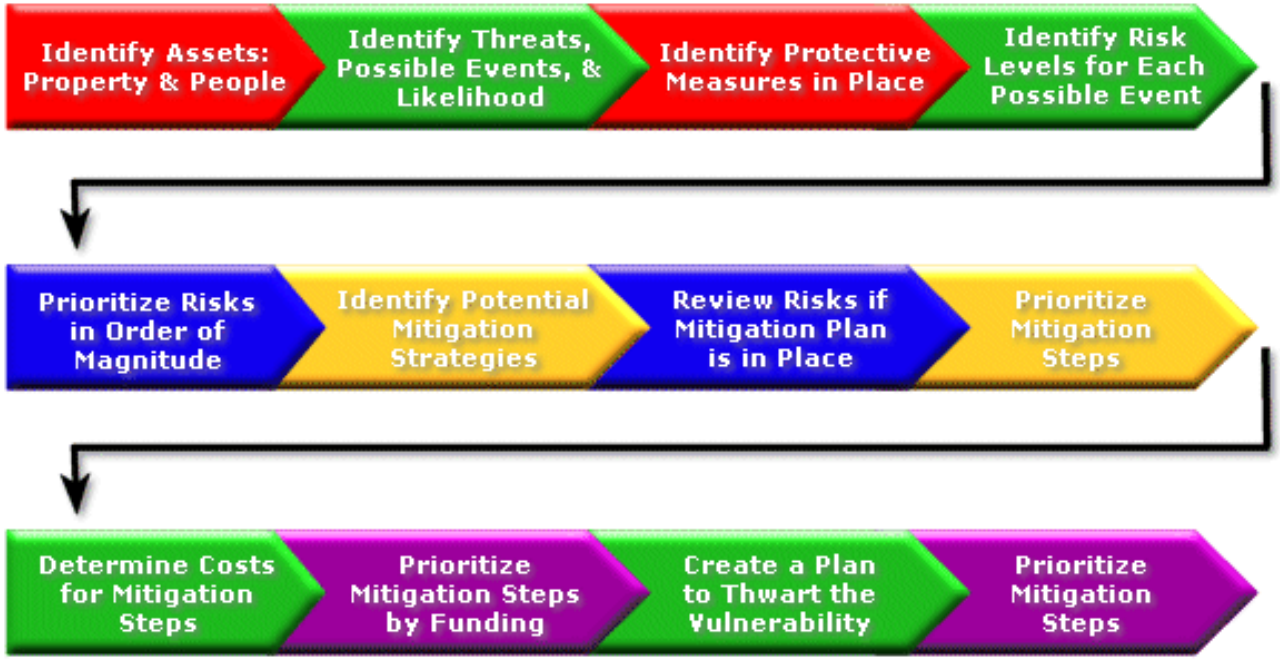
Foundation of Vulnerability Analysis



- What can go wrong?
- What are the consequences?
- How likely is it to happen?
- How is a normal state restored?

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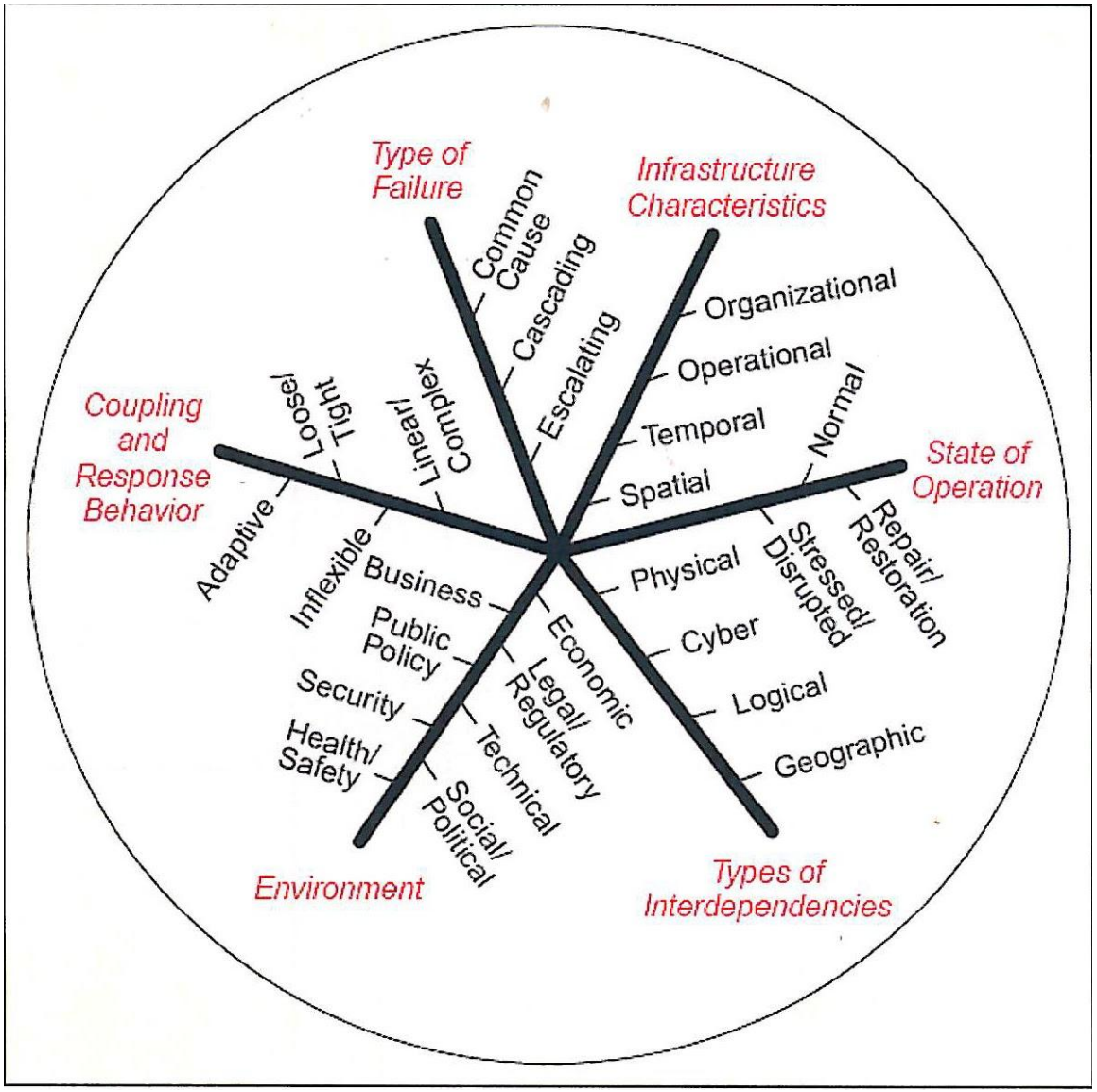
Complexity of systems that can affect the public



Developing a Network Management Strategy

- **Network management means deploying and coordinating resources to plan, operate administer, analyze, evaluate, design and expand networks to meet service-level objectives at all times at a reasonable cost with reasonable capacity.**
- **Network benchmarking can be used for three purposes**
  - Highlight gaps in network management processes
  - Offer comparisons with industry averages or best practices
  - Prepare for decisions related to sourcing

Proactive vs. Reactive Network Management Services

- **Reactive**
  - Incident by incident
  - Lack of a plan
  - Limited communication of a network architecture
  - Little or no stakeholder support
- **Proactive**
  - Anticipating problems and issues
  - Trending
  - Long term analysis
  - Formulated network architectural plan
  - Strong stakeholder support

Benchmarking Processes

- **Data Collection**
- **Data Consolidation**
- **Gap Analysis**
- **Recommendations**
- **Presentation to stakeholders**
- **Driven by**
  - Service
  - Reliability
  - Reduced vulnerabilities
  - Cost savings to operators and societal benefits
- **Develop next steps for a Network Management Process**

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Examples of Potential Failures of A Positive Train Control System

- **Communications office systems**
- **Wayside Systems**
  - Communications at the wayside (a non-vital system)
  - Wayside vital systems connectivity through communications systems
- **Server Systems**
- **Applications Failures**
- **Carrier Services**
- **Mobile systems**
  - Radio
  - Power
  - Cabling
- **Other human factors and failure**
- **Inadequate network management capabilities**

Are we at the fork in the road for network management of some of our technical systems?

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Recommendations to the Network Facility Operator

- **Plan ahead for network management services**
- **Invest in the technologies to support robust network management systems**
- **Develop in your stakeholders the support of the strategic value of network management services**
- **Benchmark your network management capabilities**
- **Perform gap analysis**
- **Bring in competent and experienced network management service providers with a strong core competency in both transportation systems and network management**
- **Train your personnel**
- **Document your systems**
- **Proactively search for the best of class net management systems**

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Strong Warning on Positive Train Control Systems and Other Advanced Wireless Systems Implementations

- **Consider network management a critical success factor**
- **Test at the specifications and integration stages as well as at the implementation and develop trouble shooting strategies**
- **Develop a well established risk mitigation plan**
- **Expect heavy network management integration work**
- **Expect the most out of your vendor but adopt network management capabilities as YOUR core competency**
- **Explore the use of new advanced technologies for network managed services**
- **Build your network management strategy as part of your critical safety services plan whether it is required or not by the FRA**
- **Learn from your industry peers**