Virtual Railroading

*A paradigm shift in operating a railroad both safely and efficiently by **eliminating** conventional infrastructure*

Virtual Railroading

What

Why

How

Where

When

the other V word ***VITALITY***, *being VITAL*

The process, hardware, or individual that *CREATES a* movement authority

- ✓ Book of Rules
- ✓ Time table
- ✓ Train sheet
- ✓ Computerized conflict checker
- ✓ Track circuit /Control point
- ✓ Dispatcher – upon exception
- ✓ EIC
- ✓ Back office software
- ✓ Token Block
- ✓ Token-less Block
- ✓ Grade crossing operator
- ✓ Mechanical interlocking operator

WHAT

Virtual Railroading (VR) is the use of virtual technologies (enhanced-GPS and wireless data) **in lieu of** track circuits and wayside signals

VR starts with Traffic Control with the deployment of ***VIRTUAL CTC (VCTC),*** including enforcement (think *PTC*), and can then address proactive traffic management (think pragmatic *scheduled operations*), asset management, and train integrity.

WHY

- Soooooooooo many railroads across the globe don't need the throughput of CTC.
- ***But,*** suppliers push CTC, and even more advanced systems (e.g., ETCS 2) because they don't have (or don't want to offer) simple solutions based on virtual positioning – substantial reduction in their revenue
- Dark territory is relatively unknown outside of NA, but while it provides for safe operations, it also has throughput constraints for some railroads.
- **What soooooooooo many railroads need is a low capital cost / low maintenance solution that provides substantial throughput and enforcement (PTC)**

WHY

My Challenge: Design PTC for ENR

ENR's Traffic Control

CTC

TOKEN

1

Generate
Authority

Each TOKEN is unique to an individual block

Token

2

Transmit Authority

3 / 4

Receive / Release Authority

OOPs: Design PTC for ENR ?

OOPs: Design PTC for ENR ?

Mechanical Linkage

Mechanical Signals

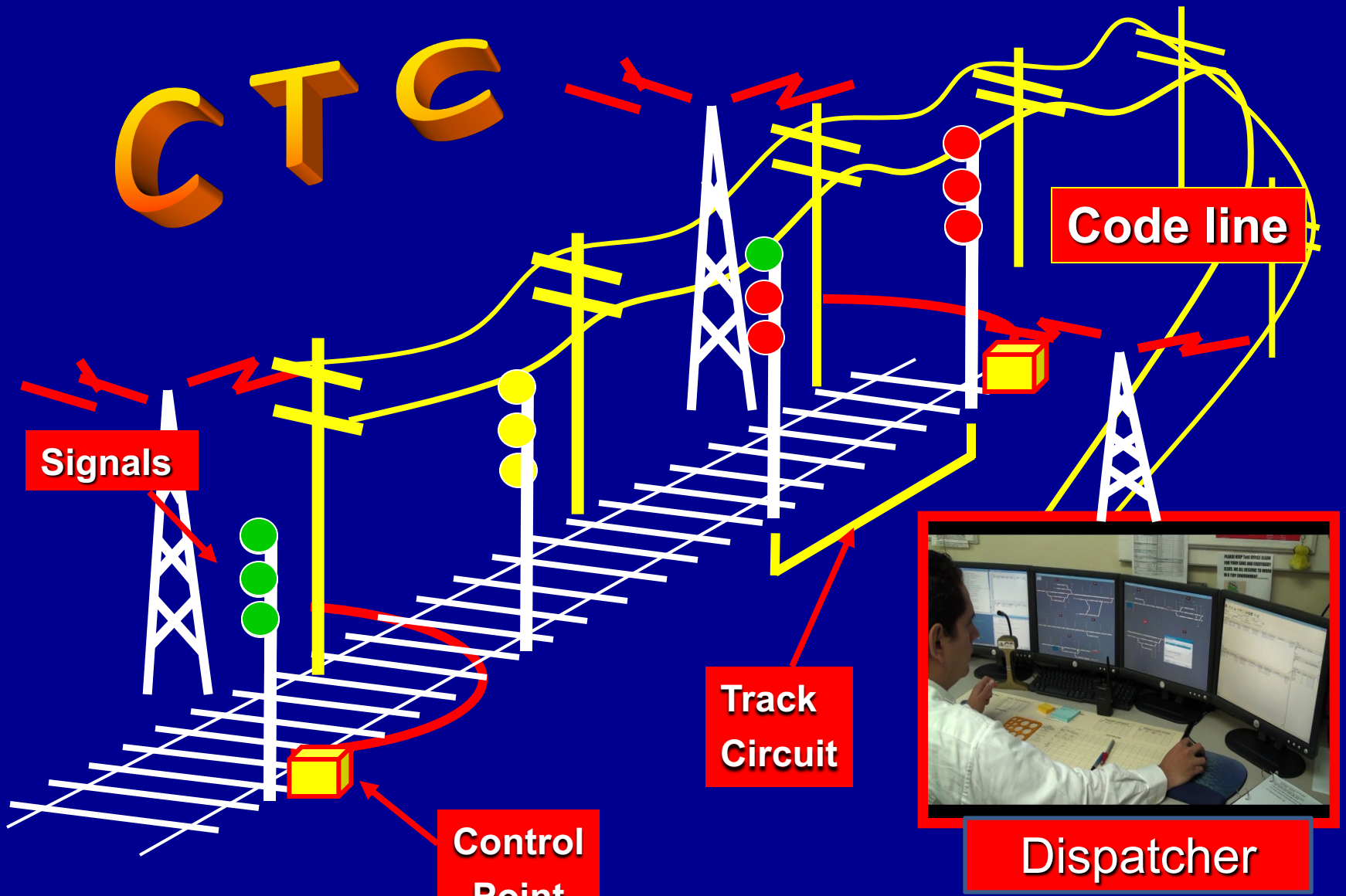
OOPs: Design PTC for ENR ?

To implement PTC, the characteristics of the movement authority have to be captured, as well as temporary speed restrictions and the ***Nested*** authorities (as with EIC's in the U.S.) of mechanical block operators and grade crossing guards – Yuk!

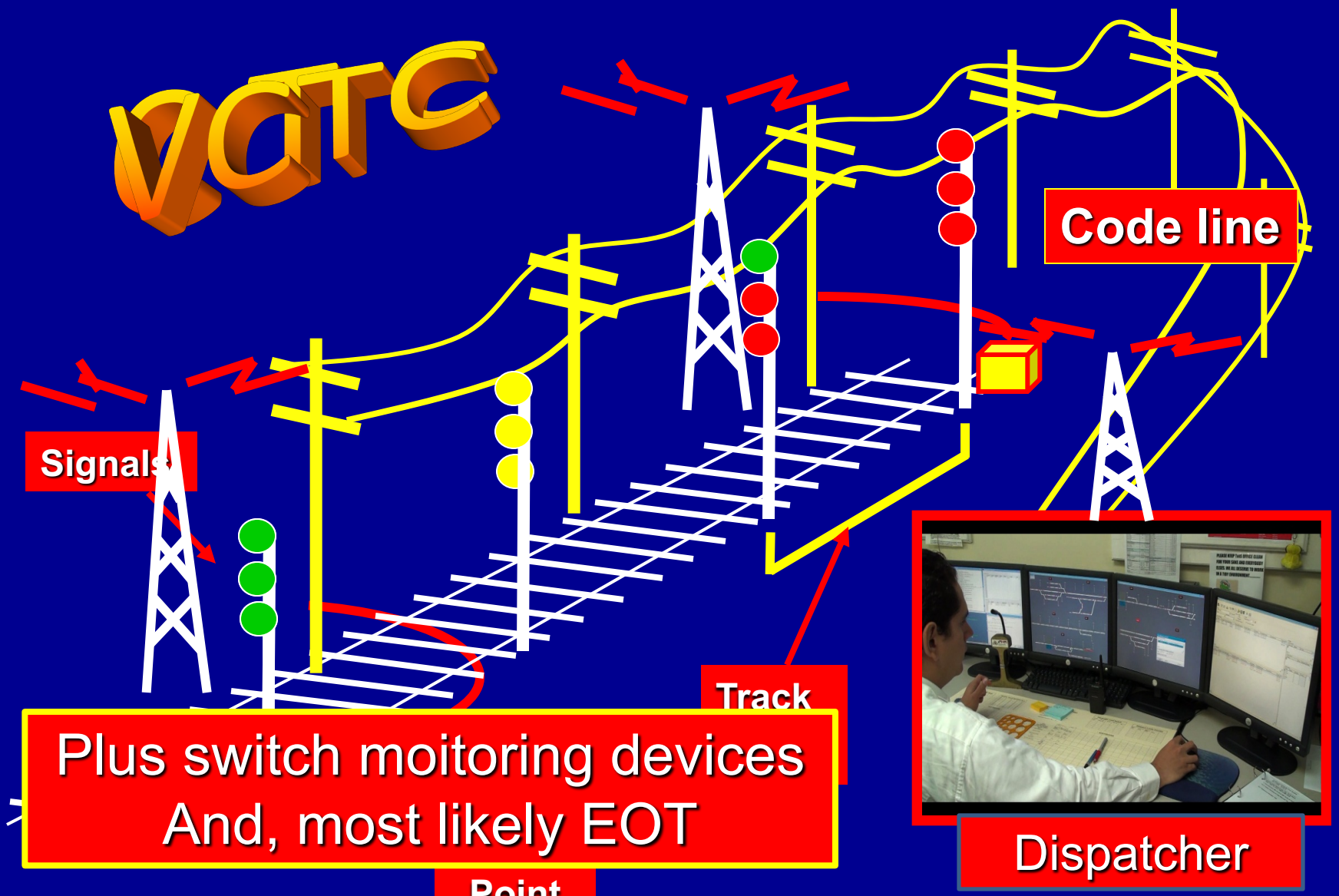
Hence, VCTC was designed to replace token and token-less, while including expanded PT functionality to protect from errors by mechanical block operators and grade crossing guards – and without replacing its mechanical interlockings.

Subsequently, I did the same for Kazakhstan's railroad to consider replacing its ancient Soviet Union's **CTC** infrastructure

What We Did


CTC
Code line
Signals
Track Circuit
Control Point
Dispatcher

What We Did


VATC
Code line
Signals
Track
Point
Plus switch moitoring devices
And, most likely EOT
Dispatcher

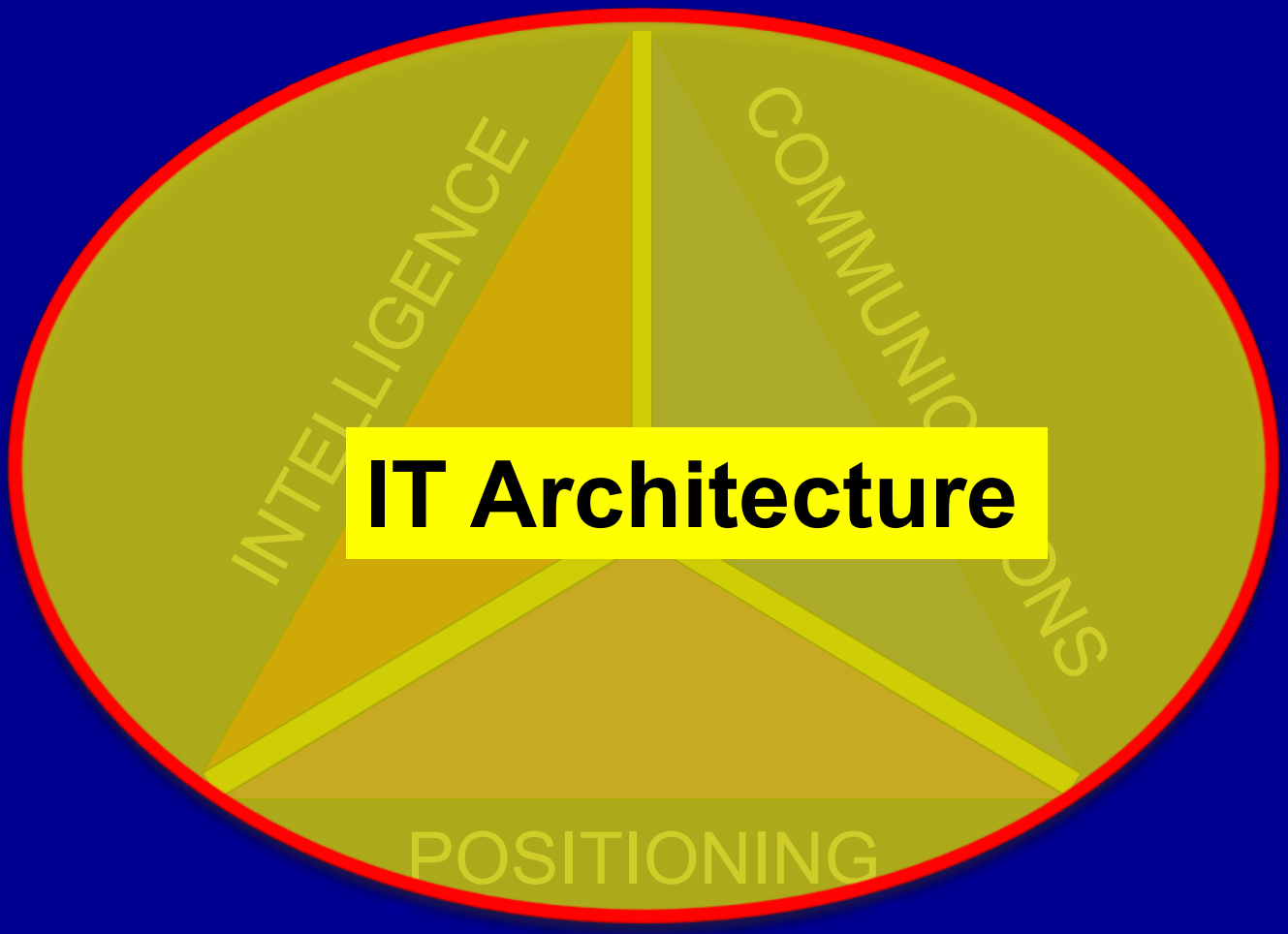
Virtual CTC (VCTC)

- The Traffic Control functionality of CTC, but without much of the extensive wayside infrastructure. ***Hence***, minimal capital investment and on-going expenses
- Both Fixed and Virtual (flexible) Block capability
- Train integrity is provided
- Expanded PTC functionality can be incorporated, e.g., mechanical interlockings, crossings, etc.
- No inherent broken rail protection

About that Broken Rail

- ✓ 1/2 of U.S. freight rail trackage is Dark
- ✓ 1/3 of that is ABS
- ✓ Hence, 1/3 of the trackage has **NO** track circuits
- ✓ Many European RRs have **NO** track circuits
- ✓ Other technologies for broken rail are available: downgraded circuits and optic sensing technologies (e.g., all of the Deutsche Bahn)
- ✓ When does the rail actually break?

How … the core technologies



HOW

There have been paradigm shifts in all 4 technologies in last 2 decades

- Positioning — Track circuit ***to*** GPS
- Communications — Wireless voice / signal ***to*** wireless data
- IT Processing — Central office ***to*** on-board
- IT Architecture — Silo ***to*** EITA

How

- ***VR*** starts with Traffic Control with the deployment of ***VCTC***
- *But can go further to address traffic management & asset management*

However, to do so requires the deployment of an ***advanced IT architecture . . .*** *an* ***enterprise perspective***

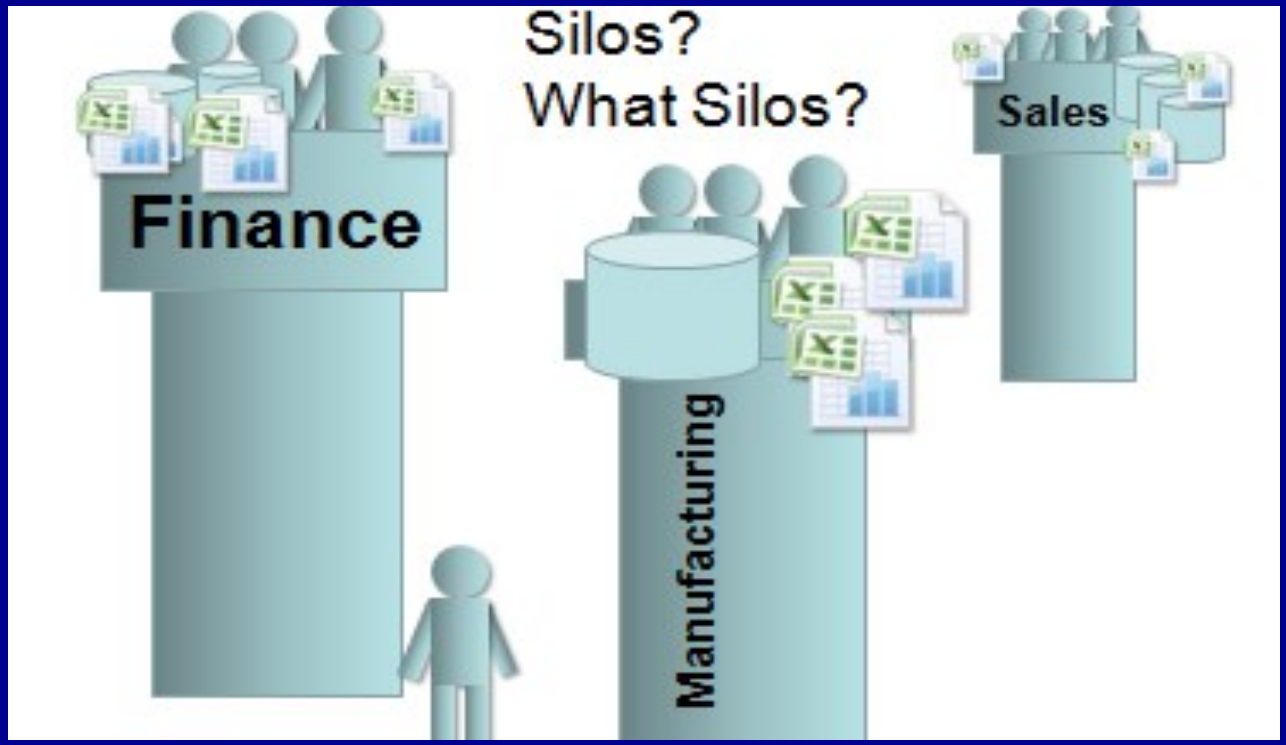
HOW

- Railroads across the globe have a conventional IT architecture: ***Silo-based***

- As major passenger airlines have done to run truly scheduled operations, they have transitioned to an Enterprise IT Architecture (EITA) for both efficiency and safety reasons.

Currently

Silo-based IT Architecture (SITA)



Each department developed what it desired.

So! What's the Problem?

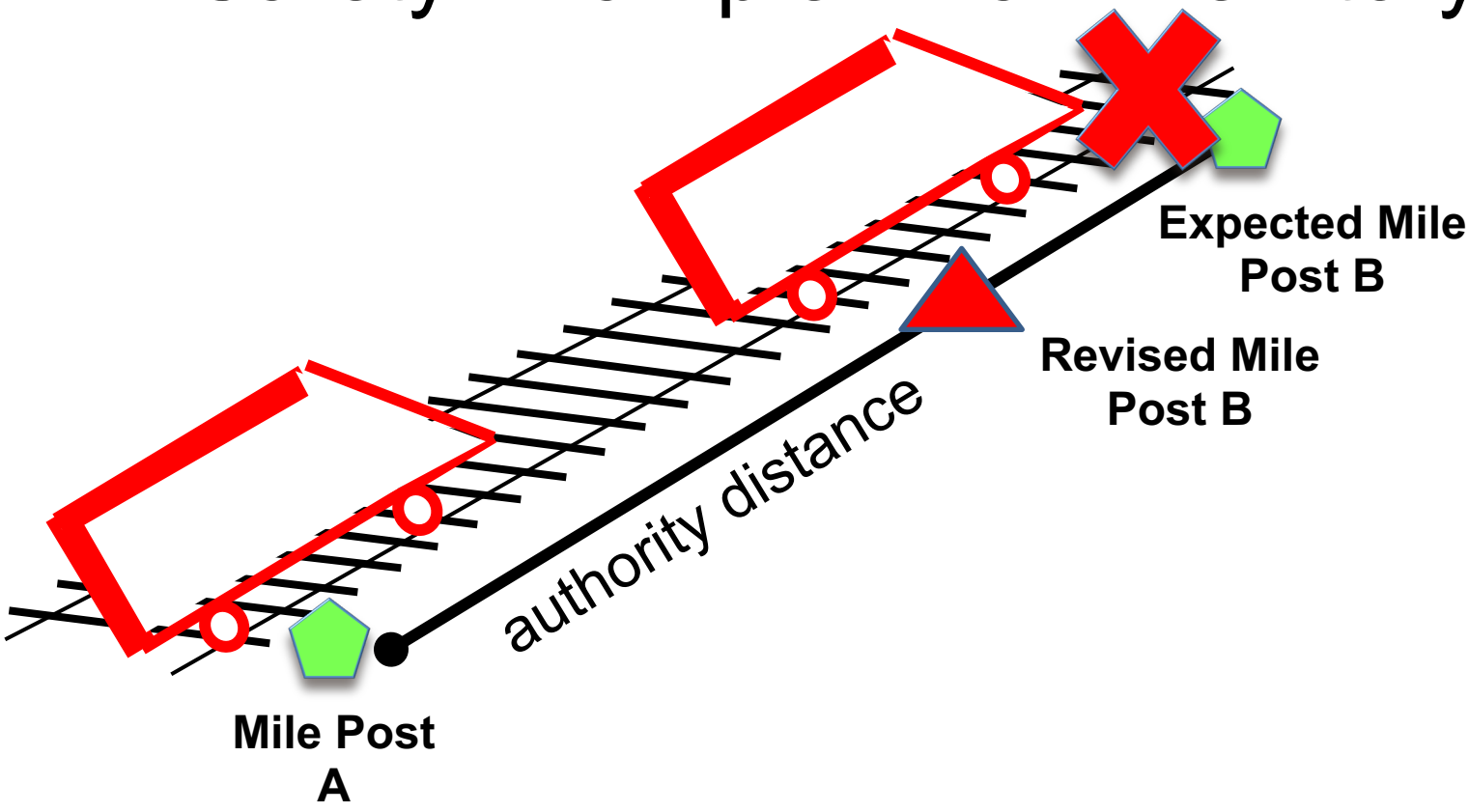
SITA's Issues

- Duplication of the generation, storage, processing, and distribution of primary data.
- The use of the *"Same"*, but actually conflicting, data given different sources.
- No "true" ownership (accountability) for the generation of some key operations data.

SITA's Issues

- **IT** determines development instead of operations management
- Lack of corporate perspective of business operations priorities
- Dilution of business benefits across departments thereby restricting productive use of capital investment.

SITA Safety Example: Dark Territory



Hence, the train was stopped at the designated Mile Post, thereby violating the revised authority distance.

Simply stated …

A safe and efficient railroad requires an IT Architecture that structures the information flow between systems to avoid duplication in the generation, storage, processing, and sharing of data.

But, designing that architecture first requires having a threshold understanding of current operations.

EITA Steps

- ✓ Rethinking business processes based upon timely / accurate train position / speed data
- ✓ Rethinking business processes based upon the availability of locomotive IT platform and wireless data connectivity
- ✓ Identifying new or modified business systems that can address the new business processes.
- ✓ Rethinking the flow of critical data between the primary business systems and operation.

Business System Planning (BSP)

BSP is a well structured, highly proven process from the 1970's for developing IT architectures based upon identifying primary business processes and systems of an organization (both current and new) and the primary data flows between those processes and systems

Encourages "re-engineering" business processes to take advantage of new technologies

WHERE …

Those railroads that are

- replacing CTC infrastructure, e.g., microprocessor control points;
- looking for less capital expenditure and substantially reduced on-going maintenance costs and don't require the the maximum throughput of CTC … or ETCS-2 / 3
- out of capacity with Dark Territory;
- desiring PTC functionality included.

WHEN

NOW: Known revenue service in Australia, Mozambique, and Kenya (soon)

BUT, when in U.S.?

- Unions will fight it,
- Conventional suppliers won't offer because it is ***too cheap*** as to capital and wayside maintenance
- Requires "***Technologists"*** that can make the business case
- Requires Executive Management involvement in technology strategy.

The Teddy Bears

Things that make us feel comfortable,
BUT are ***NOT*** REAL / TRUE

- ✓ ~~PTC is vital.~~
- ✓ ~~PTC provides business benefits, e.g., increased traffic.~~
- ✓ ~~PTC needs to enforce Interim signals (ISs).~~
- ✓ ~~Signals are installed for safety.~~
- ✓ ~~There is no vitality in Dark Territory since there is no wayside equipment.~~
- ✓ (until recently) … ~~CSX's Precision Scheduled Railroading (PSR) doesn't make sense – upsets the shippers.~~
- ✓ ~~220 MHz spectrum was required to implement PTC.~~

Thank You for your attention !

For further insight into VR

- **I have a suite of courses on VR, PTC, EITA, Wireless Data, and basic/advanced railroad operations based upon advancing technologies for:**
  - Executive Management
  - Middle Management
  - Technicians and **TECHNOLOGISTS**
- **Professional Course, University of Delaware, April 26 / 27**
- **My Blog: www.strategicrailroading.com**
- **Railway Age, September, 2018 article, *Going Virtual***

I sell ***NO*** products and am independent of suppliers

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