ELSIE – A New Approach to Level Crossing Protection

GNS Associates Pty Ltd

ELSIE - Overview

- Introduction
- Monitoring and control
- Visible & audible signals, power supplies and control box

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“Choo-choo” Loco

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Level Crossings

Australia:

- 8000 – 10,000 total
- Majority are “passive” crossings
- Fatal accidents ~1% of national road toll

USA:

- >200,000 total
- Collision every 100 minutes

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“Crash” Clippings

Three die in steam train wreck on wedding trip

Girl, 14, killed by train

Men hit by train did not try to race it, coroner finds

Train kills boy just weeks before crossing upgrade

Train kills man at Glen Iris crossing

A man died yesterday when he was hit by a train while crossing a suburban railway line, the third death of its kind in five weeks.

Police said the 71-year-old was hit by a city-bound train while crossing the railway line with his bicycle in High Street, Glen Iris, about 6.20pm.

Glen Waverley rai… 8.30pm, a Connex s…

A 10-year-old girl… train near the Hamp… man in his 50s was… caught on the train … in Nunawading on …

The Connex spok… level crossings we… yesterday's acciden… receiving counsellin…

The name of the c… available.

4 News Age 11/9/02.

PETITION

Residents fight to take traffic over rail crossing

…rarat residents and the Ararat Rural City Council want an …verpass built to take road traffic over the Melbourne-…delaide rail line where it crosses the Western Highway at …he town. Mayor Gwen Allgood, left, resident Robin Powell, …entre, and council chief executive Bill Braithwaite have a …etition with 2400 signatures from the town of 7500. It will be presented to local federal Liberal MP David Hawker today. A state coroner recently recommended the crossing be removed in a report into a fatal car and train collision in January. The crossing will be fitted with boom gates next year, but the residents do not see it as the solution. Picture: Tony Feder

for the district.

FATAL LEVEL CROSSING ACCIDENT ON THE DARWIN RAILWAY

On Sun.20.10, the first fatal level crossing occurred on the Alice Springs - Darwin railway that is currently under construction.

A 40 year old pastoralist was killed when he drove an empty cattle truck into the path of a ballast train on a level crossing on his property near Tennant Creek.

Apparently the locomotive was extensively damaged by the accident

News

Crossing death man ‘warned of danger’

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Crash

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Strategic Options

- Close crossing
- Grade separation
- Upgraded/enhanced treatments
  - Passive
  - Road/traffic engineering
  - Active warning system

Conventional

Project ELSIE

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Project Objectives

General:

- Enhance public safety
- Contribute to railway operator's business model – "the value proposition"
- Demonstrate a better solution to an old problem

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Project Objectives

Specific:

- Develop a versatile general-purpose turnkey system
- Particularly for lower traffic densities and/or more remote sites
- Installed cost much less than conventional system (25~30%)
- Highest standards of system safety & integrity

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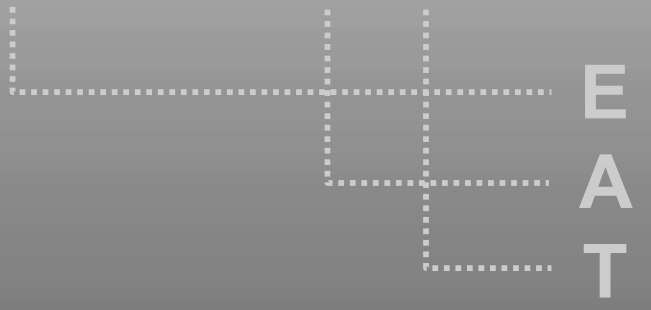
Project Drivers and Constraints

- Innovative design
- Intelligent mix of modern technology and conservative engineering
- Proven safe-working principles
- Eschew all trendiness (!)



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Project Status

- Hardware
- Software
- Testing
- “Serious demonstration” stage
- Field trials

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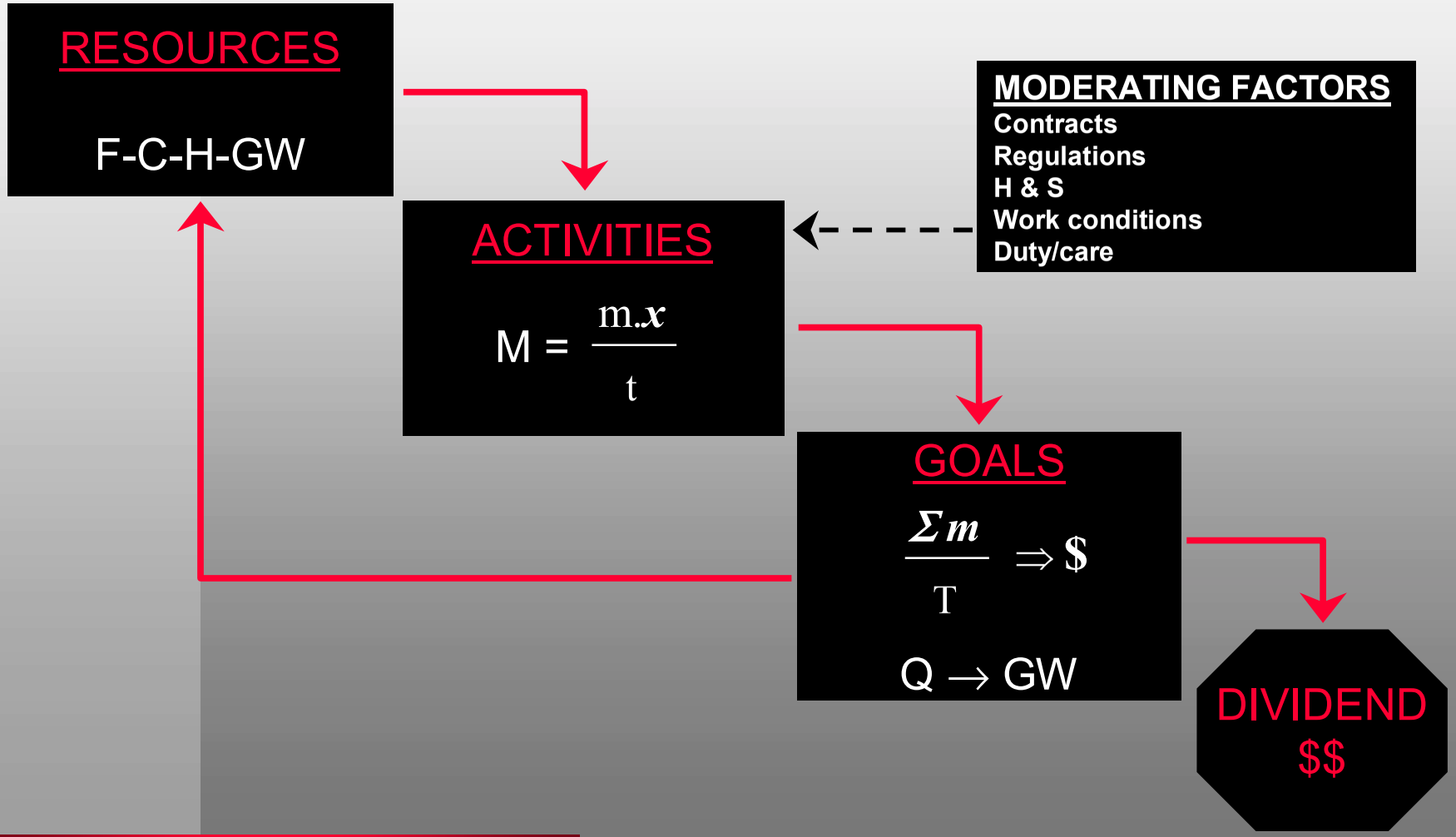
Railway Business Model



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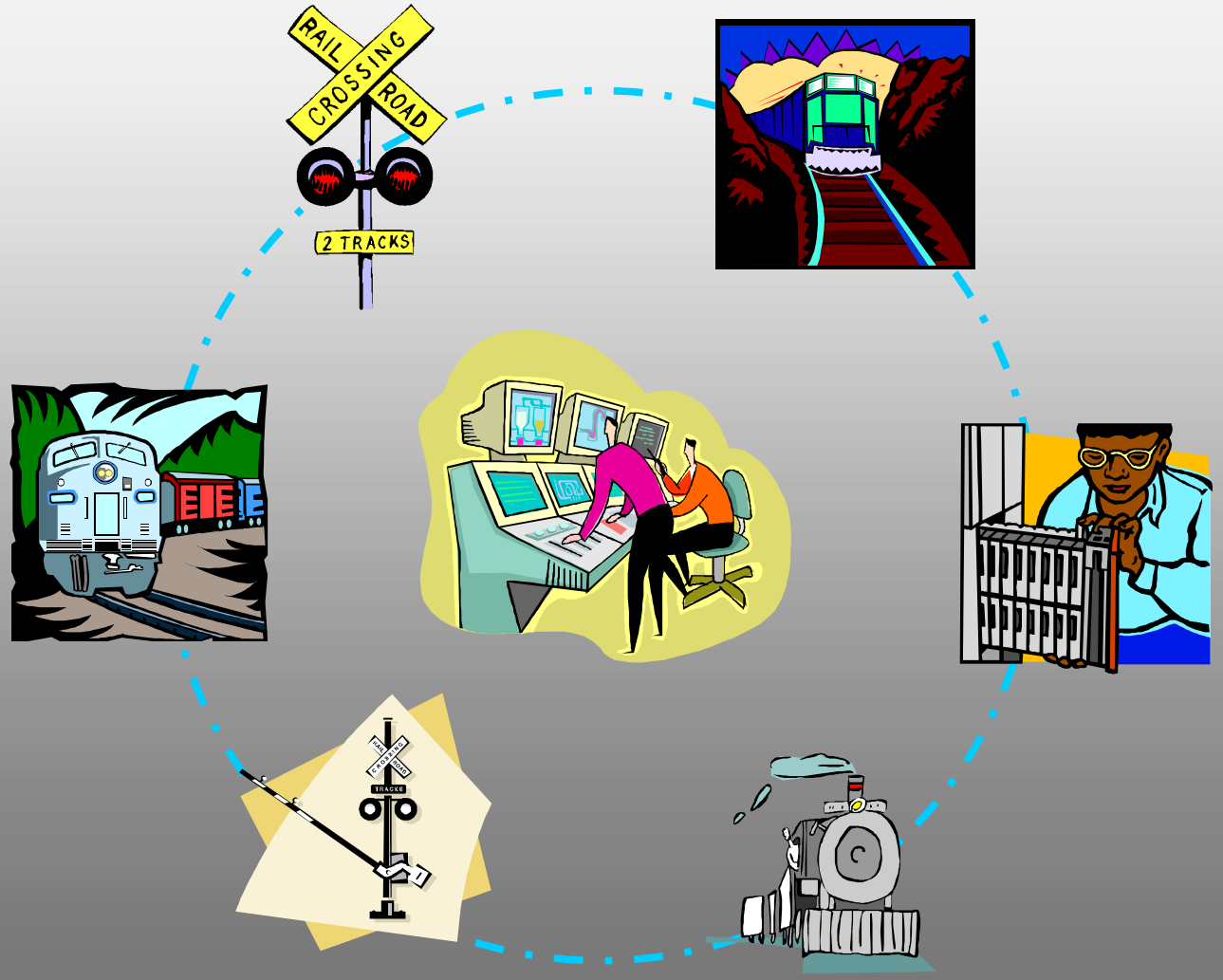
Control and Monitoring



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Control and Monitoring

- General operating logic
- Train detection techniques
- Monitoring & data logging
- Communications
- System security & functional testing
- Installation

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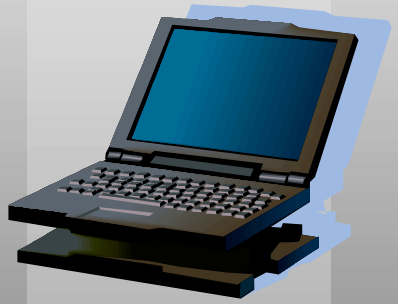
General Operating Logic

Central Monitoring



Cont

Wirel

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Controls

1) Master controller
   - Control, supervisory & monitoring
   - Communications subsystem
   - Dual micro-controller – a variant of diverse redundancy pattern (DRP) for safe-working assurance
   - Non-volatile RAM (with RTC) for data storing

Fail-safe

2) Alarms controller
   - Controls the audio and visual alarms
   - Monitored by master controller

Safe-working

3) Detectors interfacing controller
   - Interfaces with various detection methods
   - Monitored by master controller

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Fail-safe

- To eliminate the hazardous effects of a failure of a component or system
- Exposure level, human perceptions, evaluation & reactions
- "*Towards a new paradigm of systems safety with special reference to advanced electrotechnologies*"

How Safe Is Safe ENOUGH

?????

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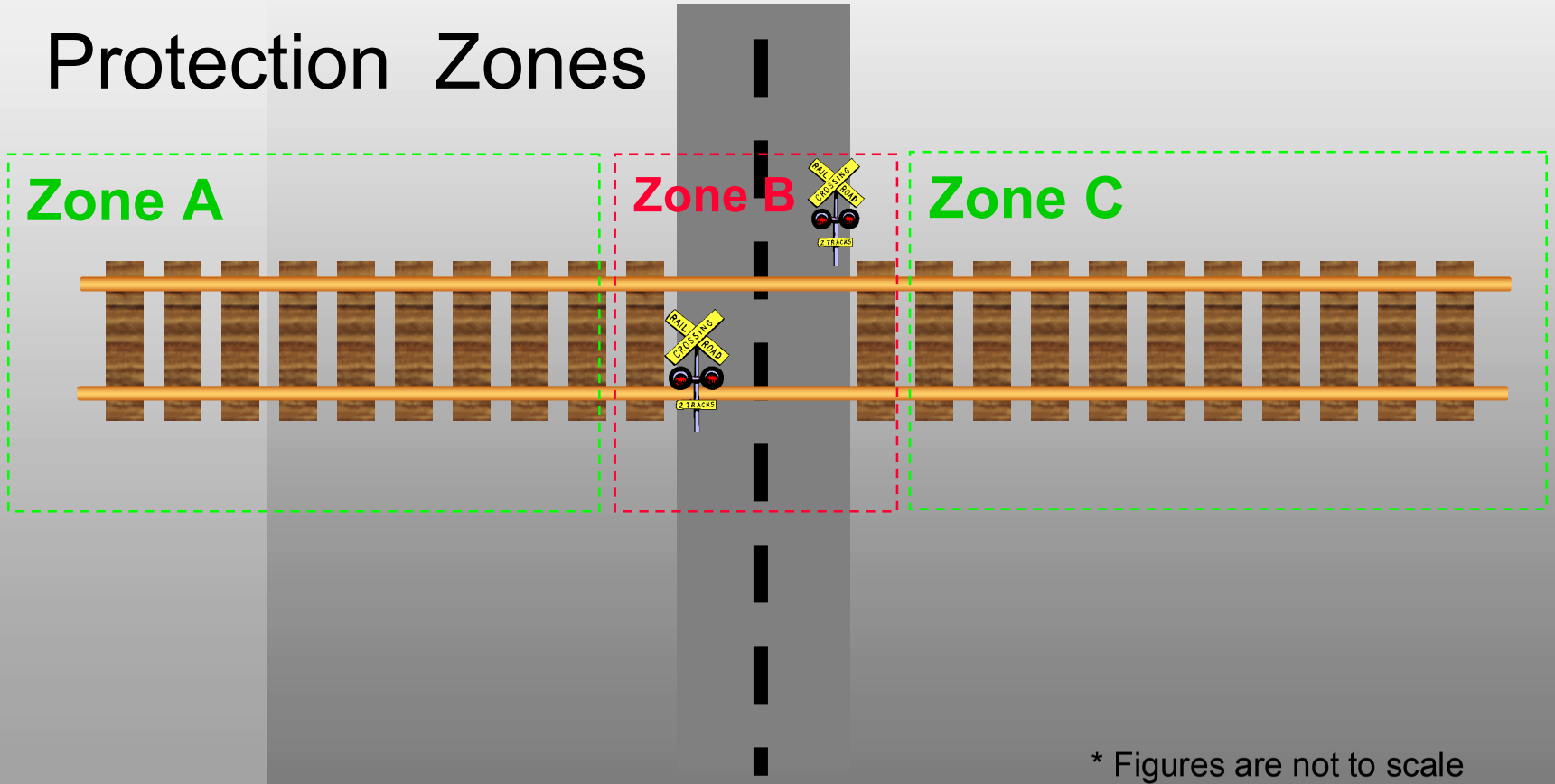
Level Crossing Protection

Protection Zones



* Figures are not to scale

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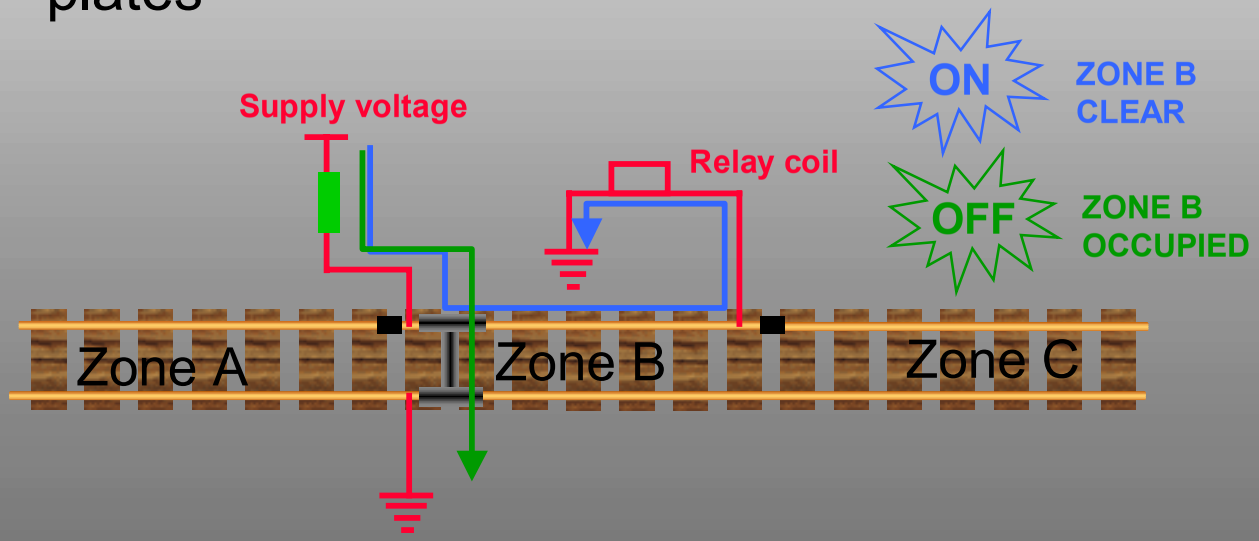
Track Circuits

- By Dr. William Robinson in 1872
- Applying a voltage across – powers the relay
- Two rails connected by the wheels and axles – turn off relay
- Wooden sleepers, zone separation by insulated fish-plates



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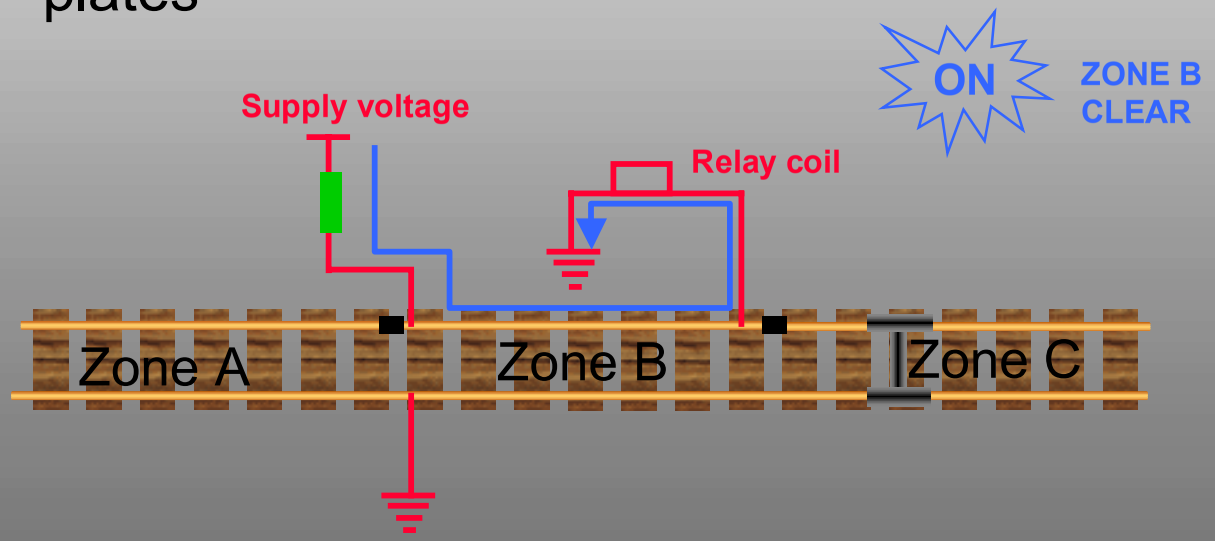

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Track Circuits

- Advantages:
  - Simple circuit
  - Is virtually fail-safe
  - Reliable ??
- Disadvantages:
  - High cost
  - Large current supplies
  - Rust & contamination

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D-tact 100

- Independent of existing signalling and control circuits
- Speed sensing features
  - Effective control of warning time
- Wired & wireless versions
- Compatible with alternative detecting techniques

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Control and Monitoring

- ✓ General operating logic
- ✓ Detection techniques
- Monitoring & data logging
- Communications
- System security & functional testing
- Installation

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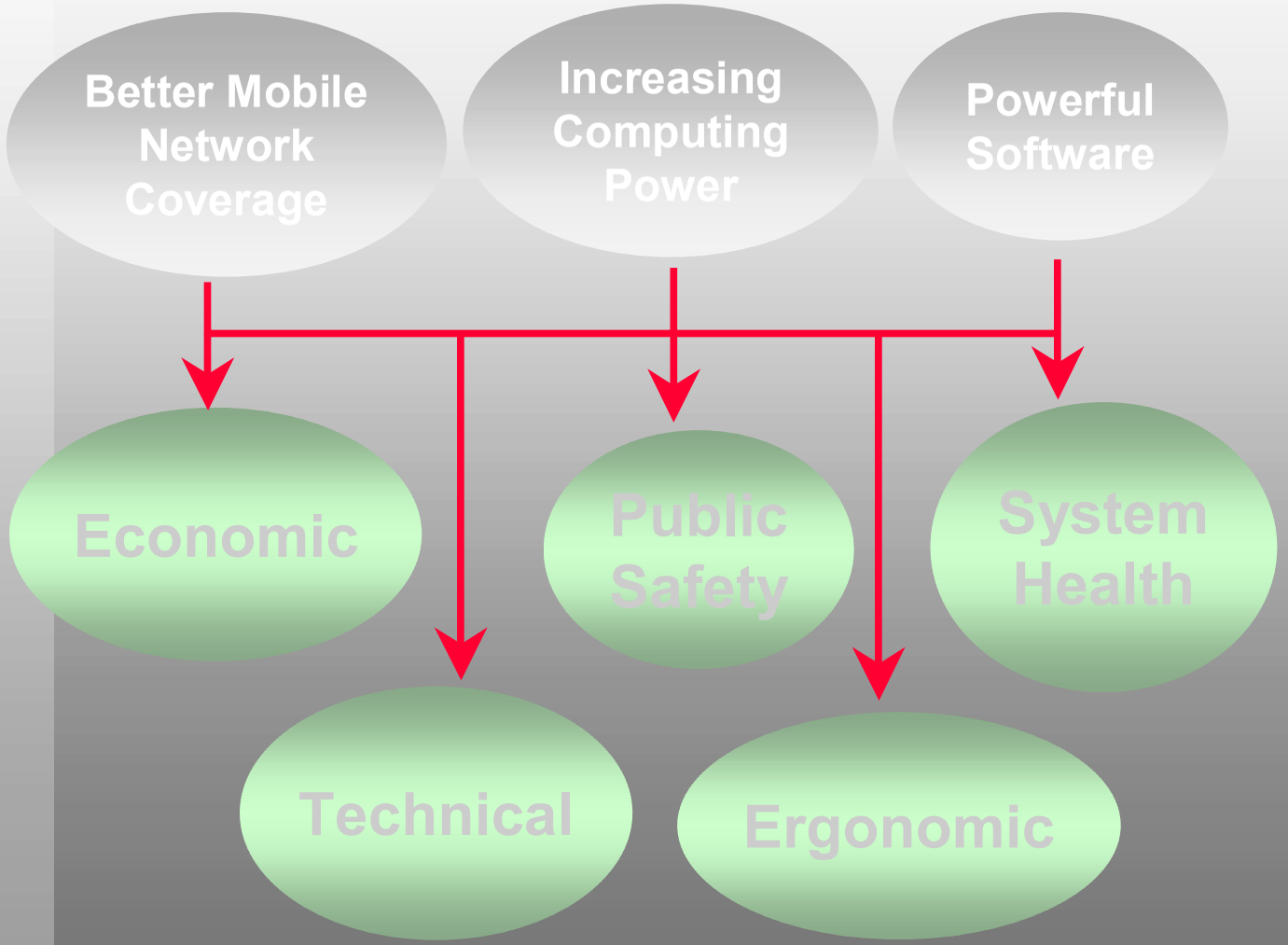
Technology Push



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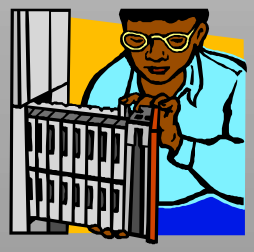
System Health Diagnostics

1. Remote diagnosis
   - Activities & irregularities recorded with date/time
   - Sent via modem to central control

2. Fatal faults reporting
   - SMS messages sent to maintenance staff
   - Urgent messages sent to central control



3. On-site diagnosis
   - General faults - displayed with LEDs
   - Allow for fast on-site correction

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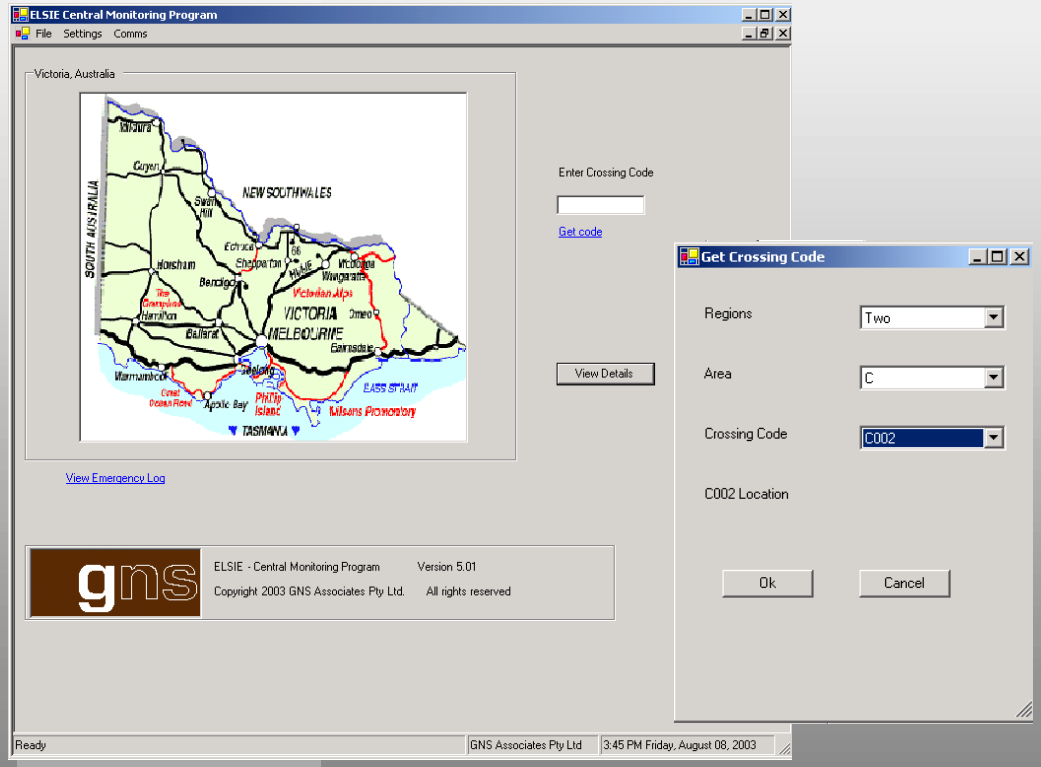
Central Monitoring Program



ELSIEMON v1.0

- *ELSIEMON v1.0* central monitoring program
- Stand-alone package
- Global monitoring system
- Integrates up to 120 level crossings
- Duplex communications
- Maps of crossing sites, in the state or region of interest

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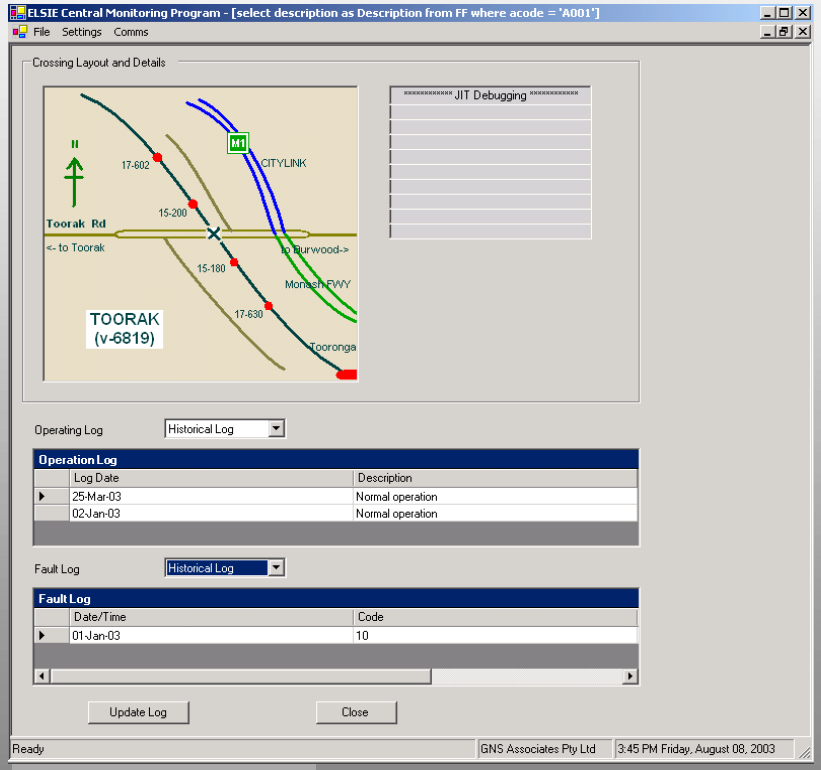
Central Monitoring Program



ELSIEMON v1.0

- Site information, e.g. rail track, crossing installations etc as required
- Log of :
  - All rail movements
  - All faults detected
  - All emergency anomalies detected
- SMS messages

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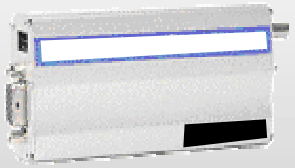
Communications

- Wireless –mobile network
  - GSM/GPRS
  - CDMA



- Alternative communications for regional areas outside of mobile coverage:
  - UHF point-to-point
  - Satellite data/telephony
  - Public switched telephone network

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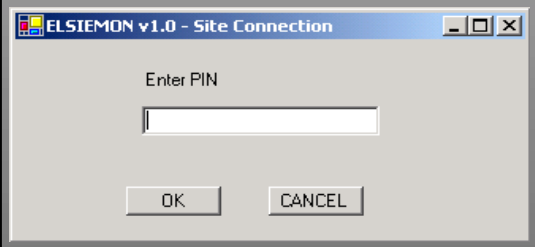
System Security

Anti-tampering

	• Intruder Alarms • Emergency message dispatched • Recorded voice message
	• Separate enable-key • Code-hopping system • Tamper-proof screws & casing
	• Identification PIN • Prevent unauthorised access

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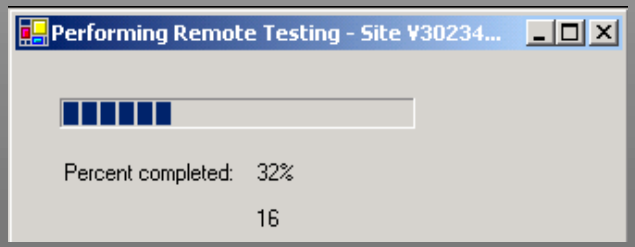
Functional Testing

- TEST and TEST-MUTE modes:
  1. Hand-held remote
     - Secure system
     - Operates up to 30 metres
     - Separate enable-key
  2. Pushbuttons
  3. Key-operated switch

- Provision for remote testing



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Installation

Basic site preparation

Control box, battery box, lantern-heads pre-wired

Train-detector assemblies

Solar panels for wireless detectors

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Visible and Audible Signals, Power Supplies and Control Box

Safety

Cost

Convenience

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Visible and Audible Signals, Power Supplies and Control Box

System Hardware consists of:

1. Visual Signal Modules
2. Audible Signal Module
3. Power Supply Module
4. Control Box

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1.Visual Signal modules

Visual signals include:

a) Warning Modules
b) Healthy-State (HS) Indicator Module

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1.Visual Signal Modules

a) Alternative Versions for Warning Module

I- Model 6007.01

II- Model 6007.02

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1.Visual Signal Modules

I. ***Model 6007.01*** Amber/Give Way

Suitable for “uncomplicated” crossings

>>driver onus<<

II. ***Model 6007.02*** Red/Stop

Suitable for crossings with higher traffic volumes and/or sub-optimal approaches

>>mandatory<<

PENDULANT ®

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1.Visual Signal Modules

Why two different models?

Based on published research (e.g. *P.Hughes (1999)*) , we designed our system to cater for various risk aspects :

- Existing controls at the level crossing
- The road geometry
- The road traffic controls
- Volume of road traffic
- Volume of rail traffic
- Geometry of level crossing
- Approach visibility

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1.Visual Signal Modules

b) Healthy-State and Fault Indicators:

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1.Visual Signal Modules

- Advantages of ultra-bright LEDs:

- Long Life
- Low Power Consumption
- Rapid Response
- Using Water-Clear Lenses
- Reliable
- Easy Installation and Maintenance
- Cost-Effective

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Visible and Audible Signals, Power Supplies and Control Box

System Hardware consists of:

- ✓ Visual Signal Modules
2. Audible Signals Module
3. Power Supply Modules
4. Control Box

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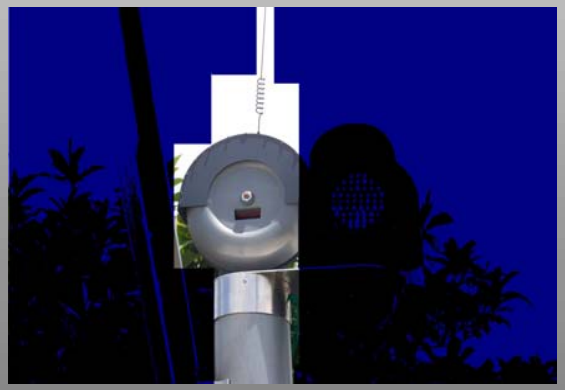
2. Audible Signal Module

Various alternative is available for audible alarm:

- Electro-mechanical Bells
- Electro-pneumatic Horns
- ✓ Electronic Horns and Bells (e.g. ***galah-01***)



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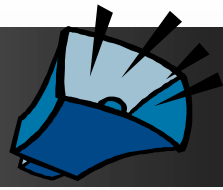
2. Audible Signal Module



Features of our Audible Signal(***galah-01***):

- Programmable
- No moving parts
- Suitable for any ambient temperature
- Suitable for polluted and salt-laden atmospheres
- Maximum warning effect with minimum subjective annoyance

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3. Power Supply Modules
4. Control Box

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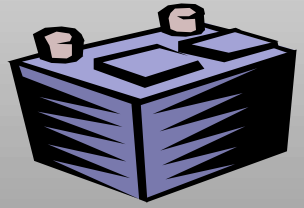
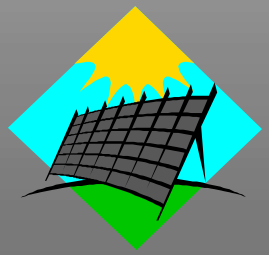
3. Power Supply

Power Supply module consists of :

- Batteries to supply:
  - Visual/Audible signals
  - Control circuitry



- Battery Chargers



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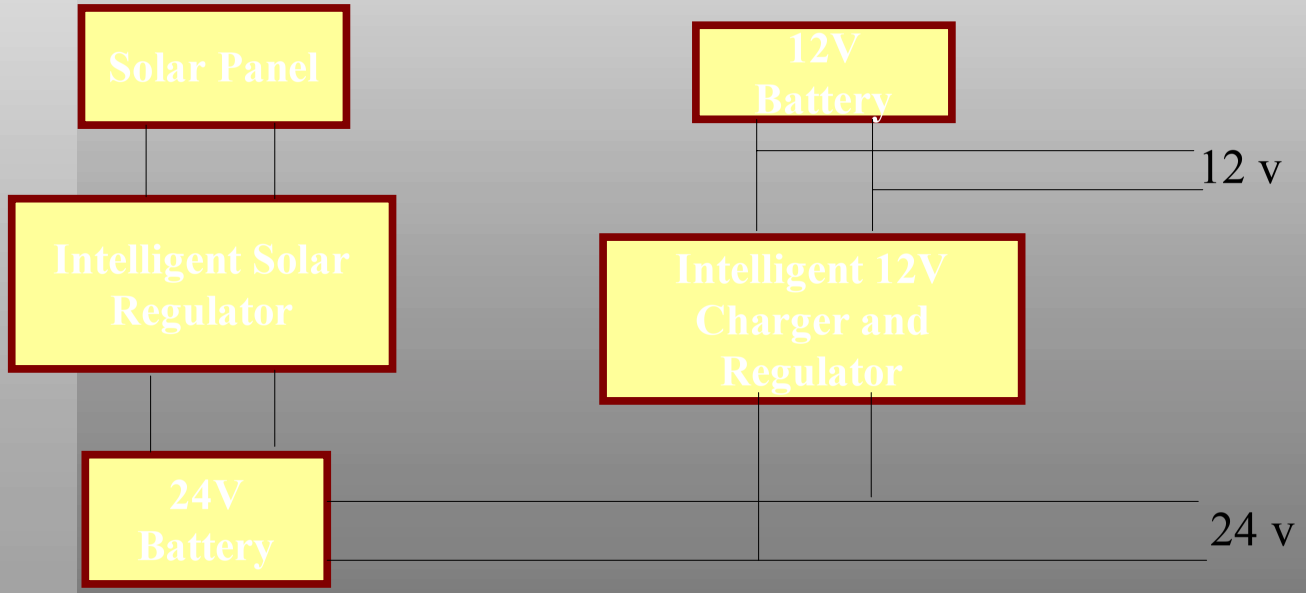
3. Power Supply

Diagram below shows the principle of the power supply module:



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3. Power Supply

Features:

- Monitored batteries current
- Adequate battery capacity to survive safely
- Emergency and visual signals to show fault
- Photovoltaic array for automatic battery charging
- Monitored solar arrays current
- 60 min stand-by battery for control system

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4. Control Box

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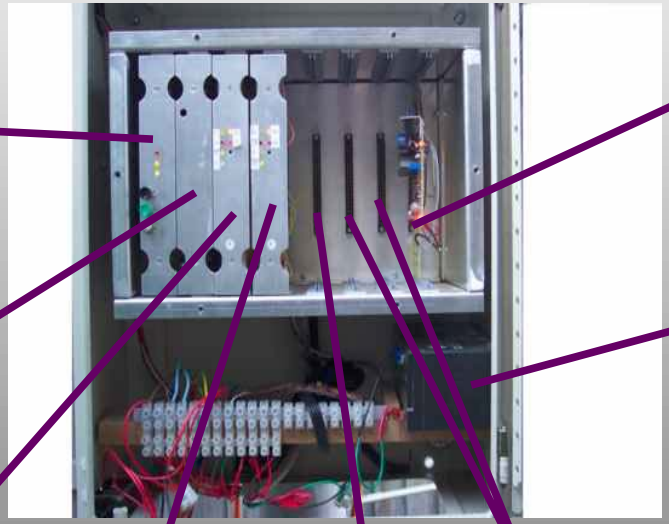
4- Control Box Layout

The plug in electronic modules inside the control box include:



Master Controller

communications

Alarm A

Alarm B

Detector inputs

Spare slots

Stand-by battery

Power supply

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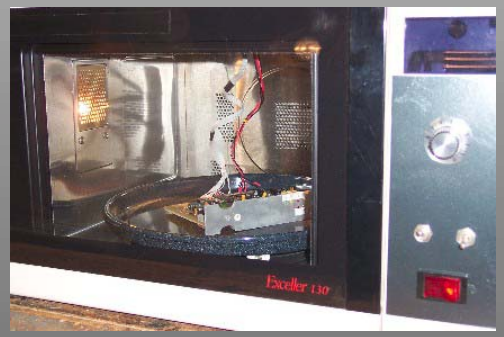
4- Control Box

Environmental features:

- Water resistance
  (driving rain test)
- Heat resistance (dry heat test)
- Humidity resistance (damp heat test)
- Corrosion resistance
  (salt-spray test)
- Sand and dust protected
  (dust test)



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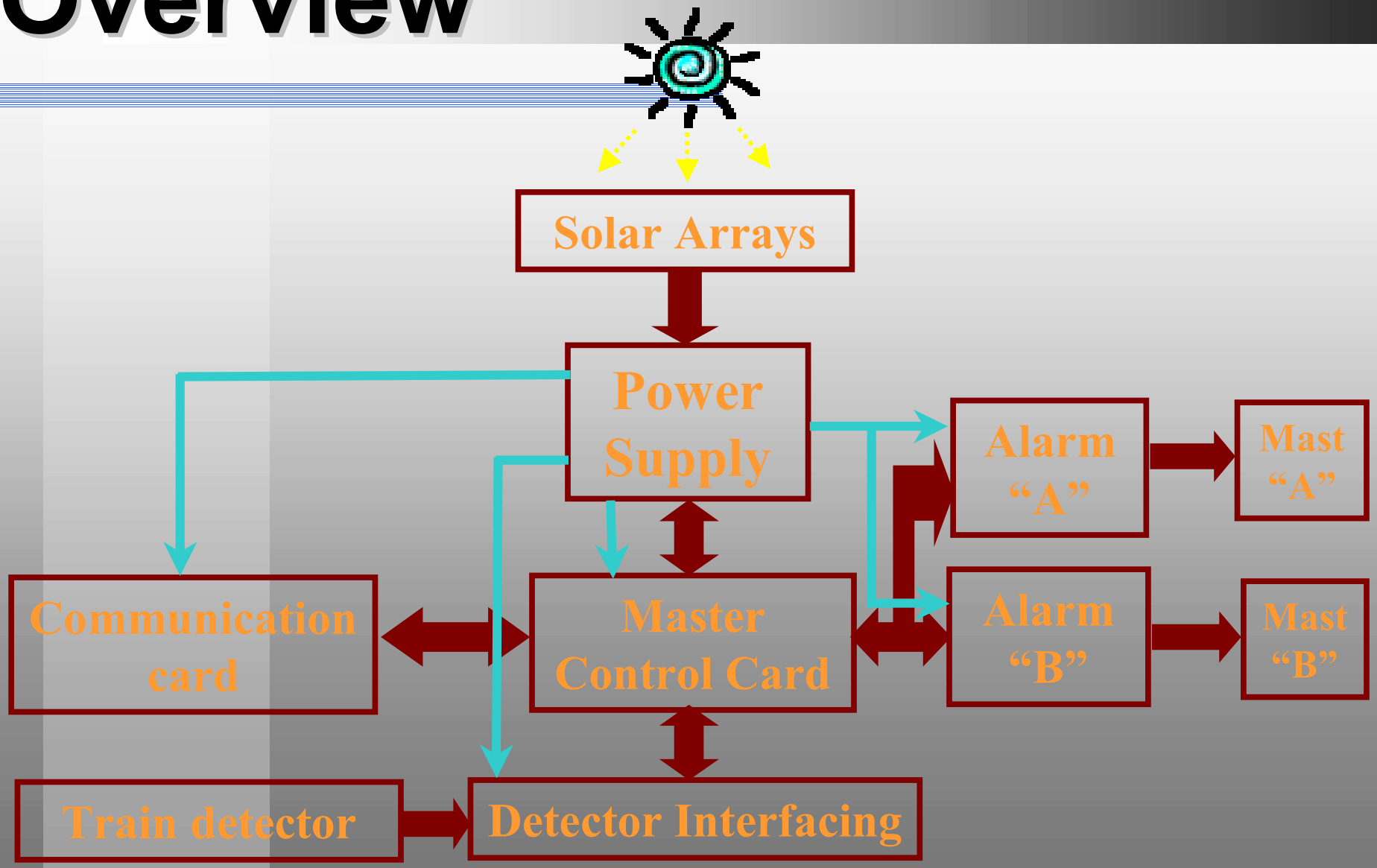
Overview



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Overview

- ***Versatile*** train detection system
- ***Effective*** system health monitoring
- ***Optimum*** and ***flexible*** warning signals
- ***Intelligent*** power management
- ***Simple*** installation
- ***Easy*** maintenance
- ***Cost***-effective

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