



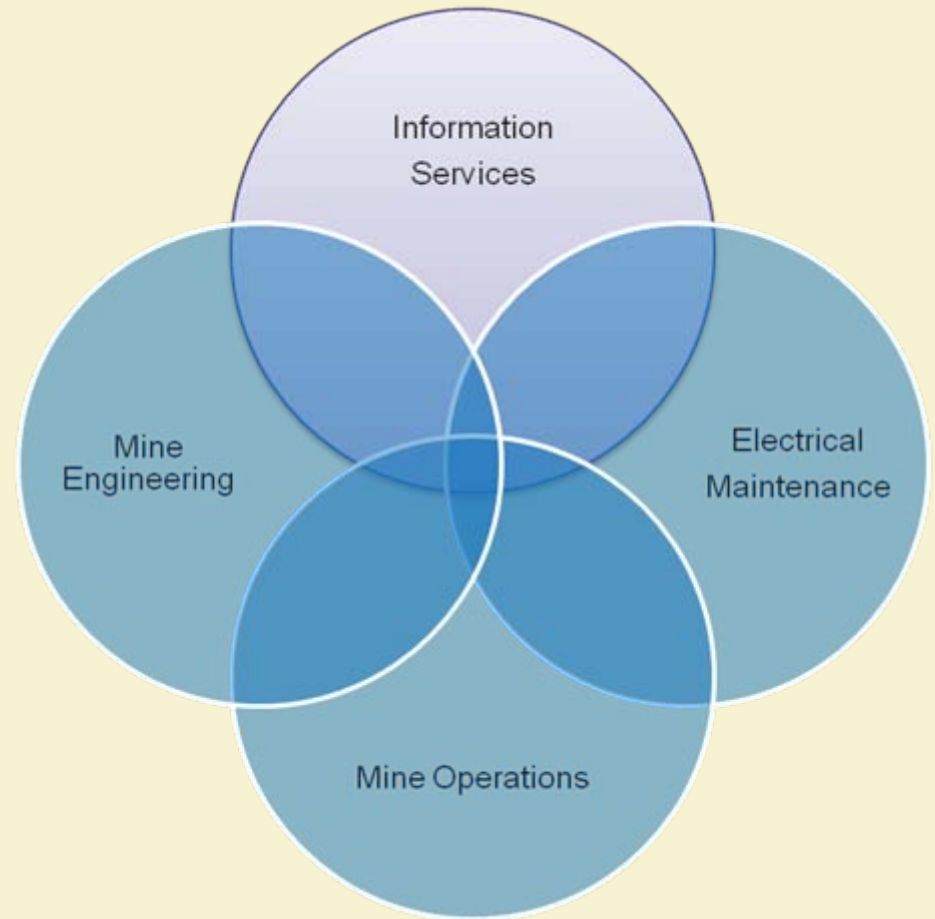
Open Standards in Mobile Computing

Peter Cunningham, P.Eng
Administrator, Engineering Systems
Teck Coal Limited

Real-time Systems Philosophy / Scope



- Close to the problem
 - Requirements by observing problems first-hand
 - Seasoned practitioners, mentoring, training
- Systems thinking
 - Integration, open systems, standards, reuse, integrity
 - New products measured against supportability
- Earned trust
 - Availability & robustness
 - Extremely risk averse
 - No remote management
 - Never a change on Friday
 - 24x7 support



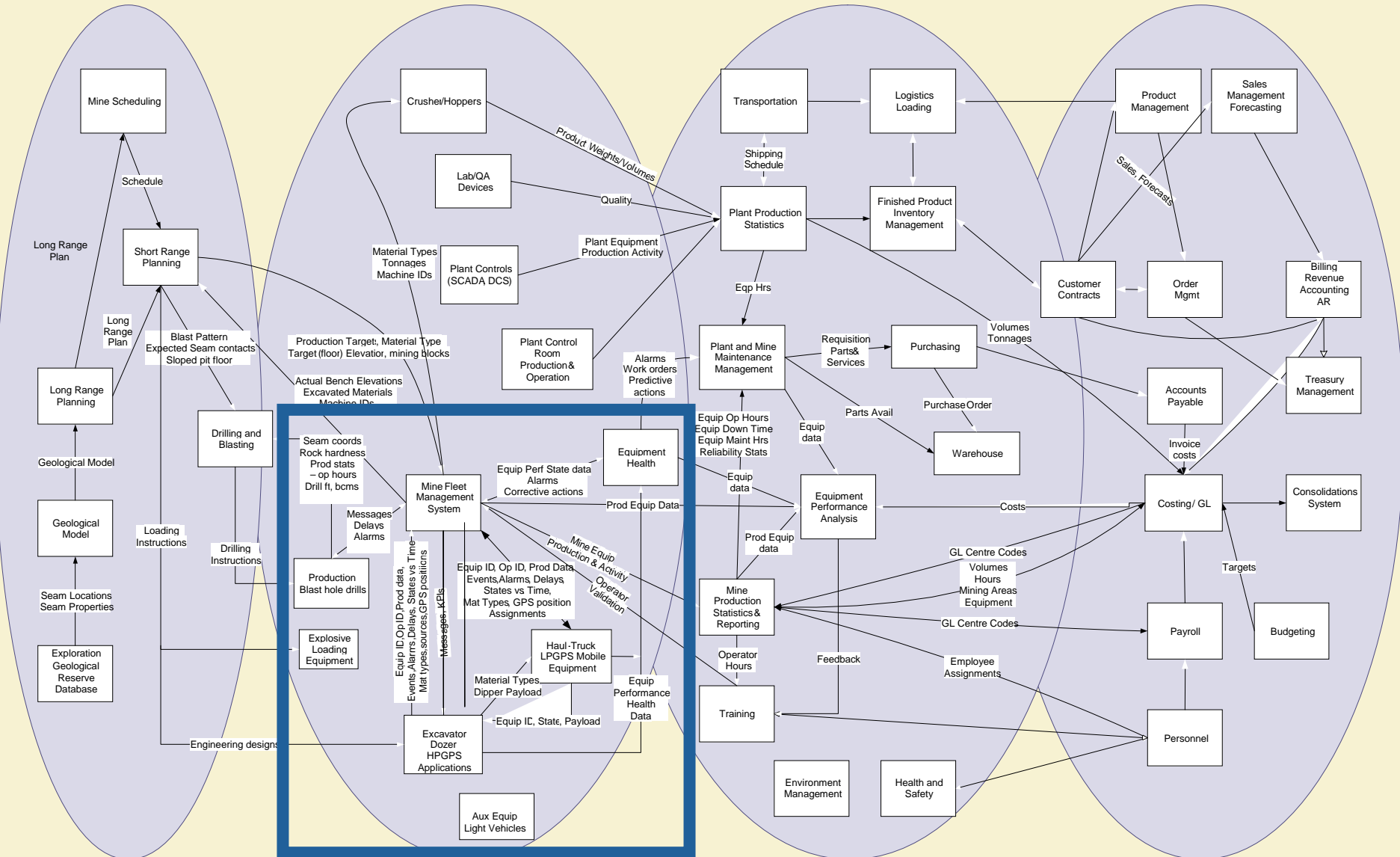
Teck Coal - 6 Mines

460 Mobile Computers



Machines	Haul Trucks	Shovels	Loaders	Pickups	Drills	Dozers	Aux	Totals
FRO	60	7	4	12	4	24	15 - 20	131
EVO	50	9	6	12	4	16	15 - 20	117
GHO	40	3	2	16	2	8	8 - 10	81
LCO	20	3	3	8	3	8	6 - 8	53
CRO	20	3	0	10	2	8	6 - 8	51
CMO	8	2	2	4	1	4	4	25

Mining Application Architecture

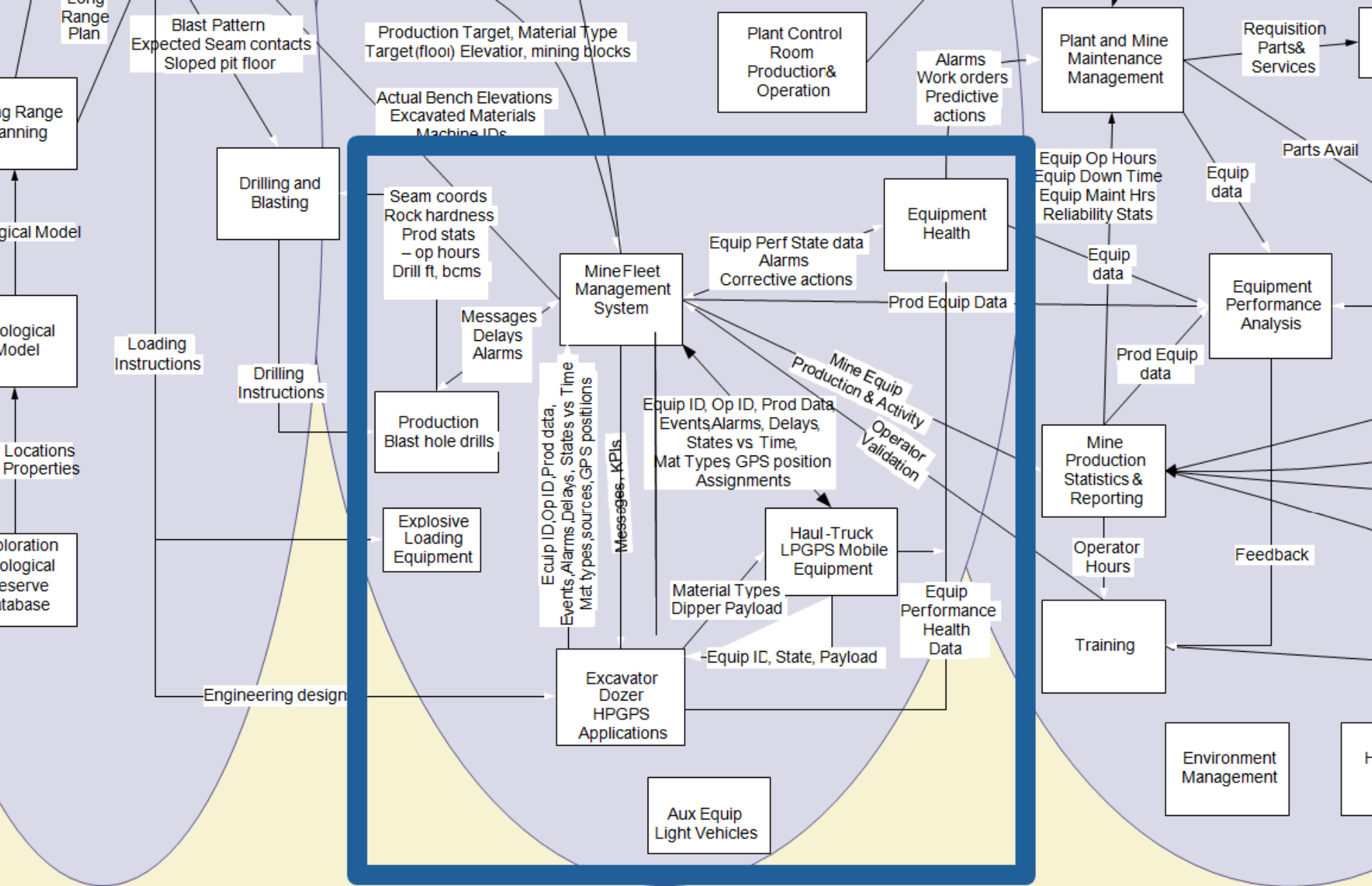


**Geology
Mine Engineering**

**Real Time Data
Acquisition and Control**

**Production and
Operations**

**Business Support
Systems**

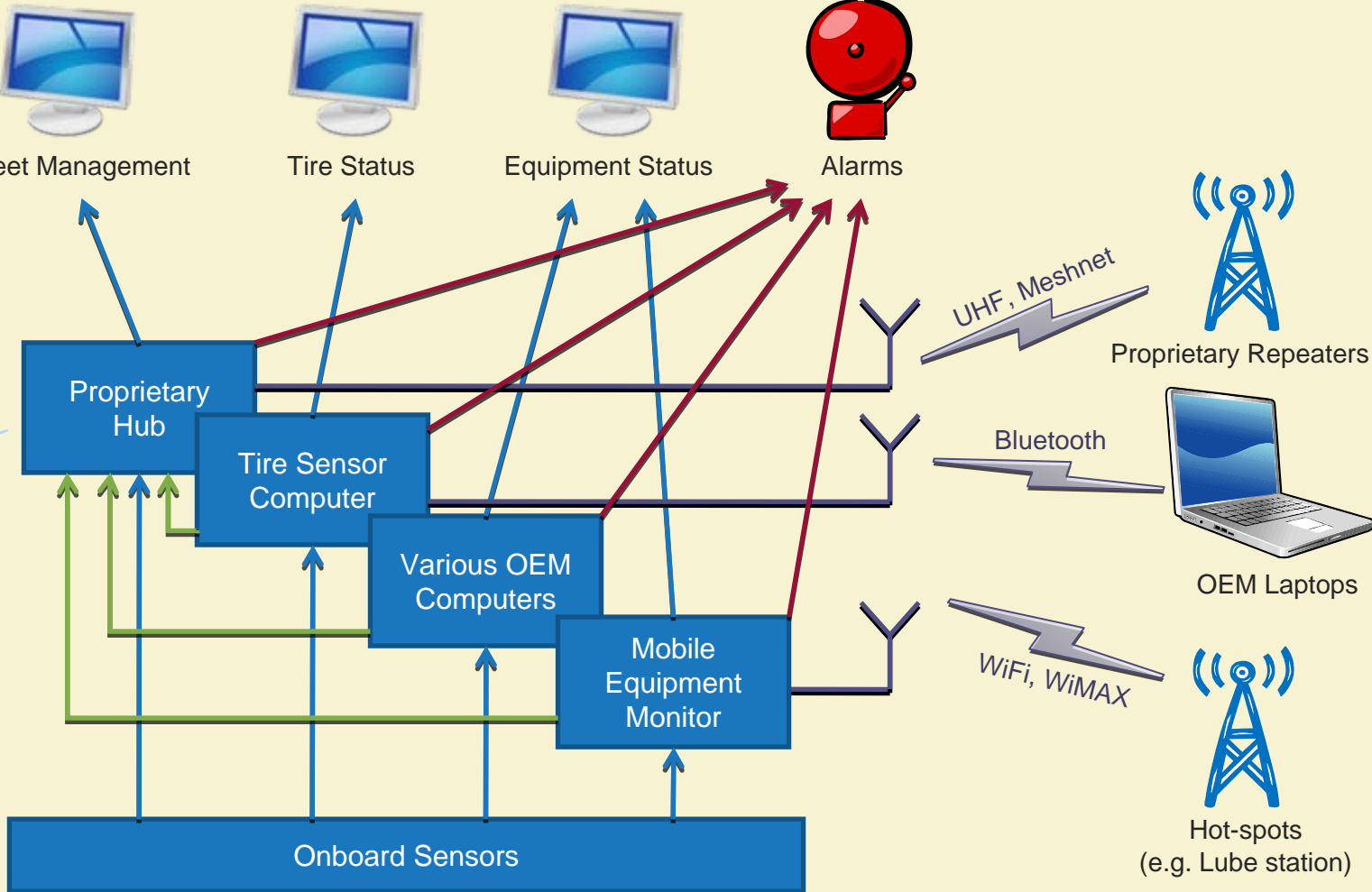
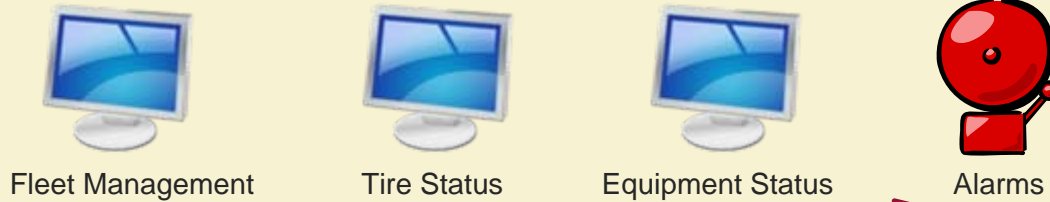
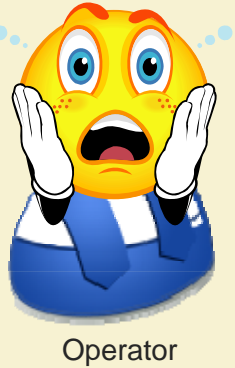


**Geology
Engineering**

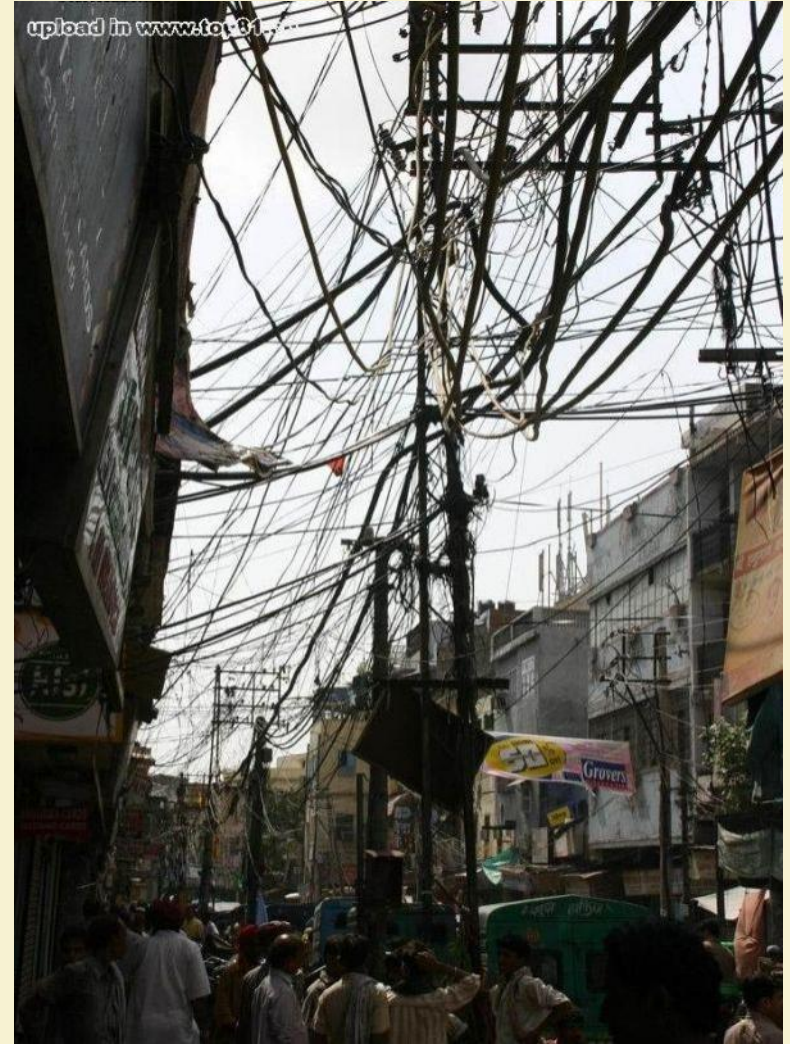
**Real Time Data
Acquisition and Control**

**Production and
Operation**

“Turn-key” Systems



He who fails to plan, plans to fail



Open Systems Architecture



Operator



Single Screen



WiFi, WiMax
802.11, 802.16e, 802.20



Hot-spots
(e.g. Lube station)



GPS

Serial

CAN bus

Ethernet



Open Systems Philosophy



- Industry standard operating system & applications
- Connectivity between field equipment and office via customer-supplied network (TCP/IP)
- Off the shelf computing equipment and software



Open Systems Computing Platform



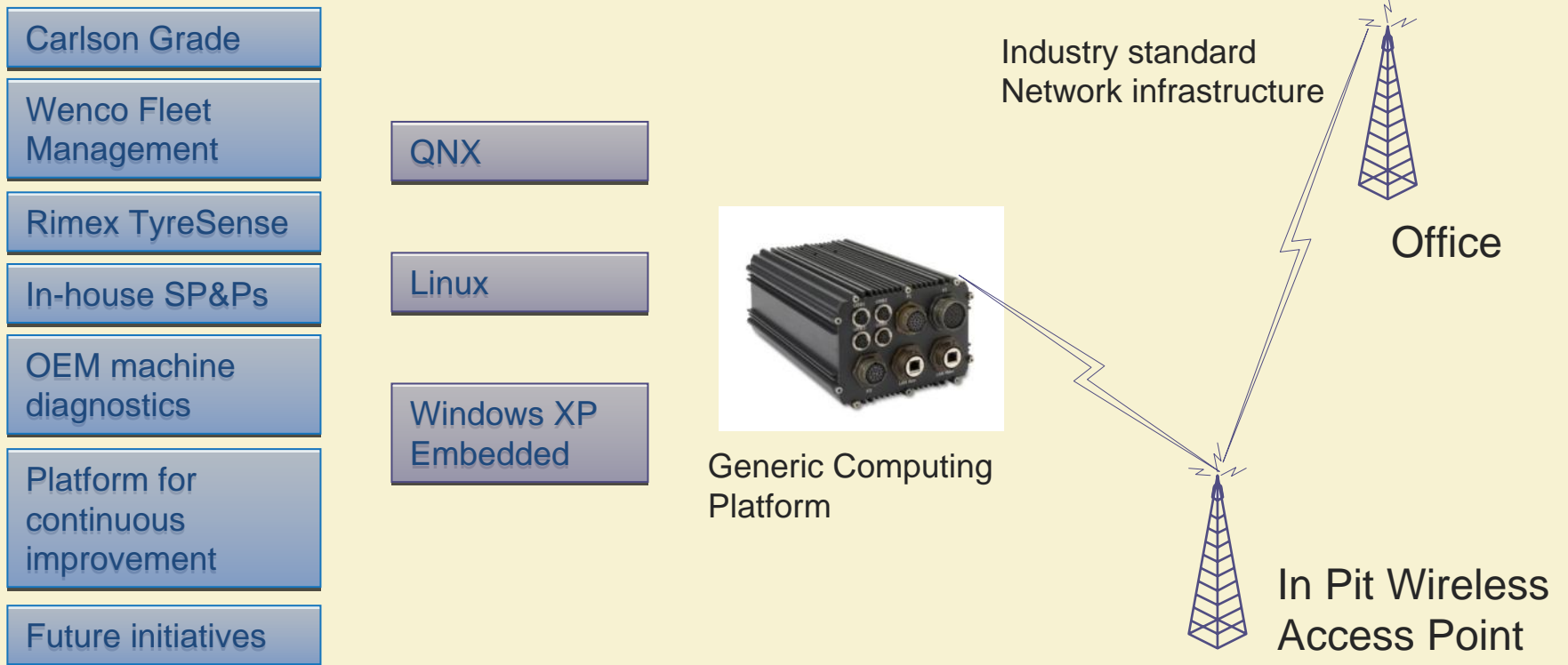
- One Computer, All Applications
 - I/O capability and processing power
 - Multiple network interfaces
 - Industrial temperature and vibration
 - Goal – an openly available, off the shelf computer available 5+ years from now... the same or interoperable box used by other mines, etc.
- Daylight Readable Touch Display
 - Waterproof, aluminum housing
 - Available in sizes from 8" to 21"
 - Ruggedized
- GPS
 - NMEA standard
 - Low precision, 3 - 5m accuracy
 - High precision, cm accuracy



Open Systems Rewards



- Future upgradeability
 - Hardware / network independence from vendor software
 - No proprietary vendor hardware hostage situations
 - Platform for future strategic initiatives




Wireless Challenges

400 km² of mountainous mine



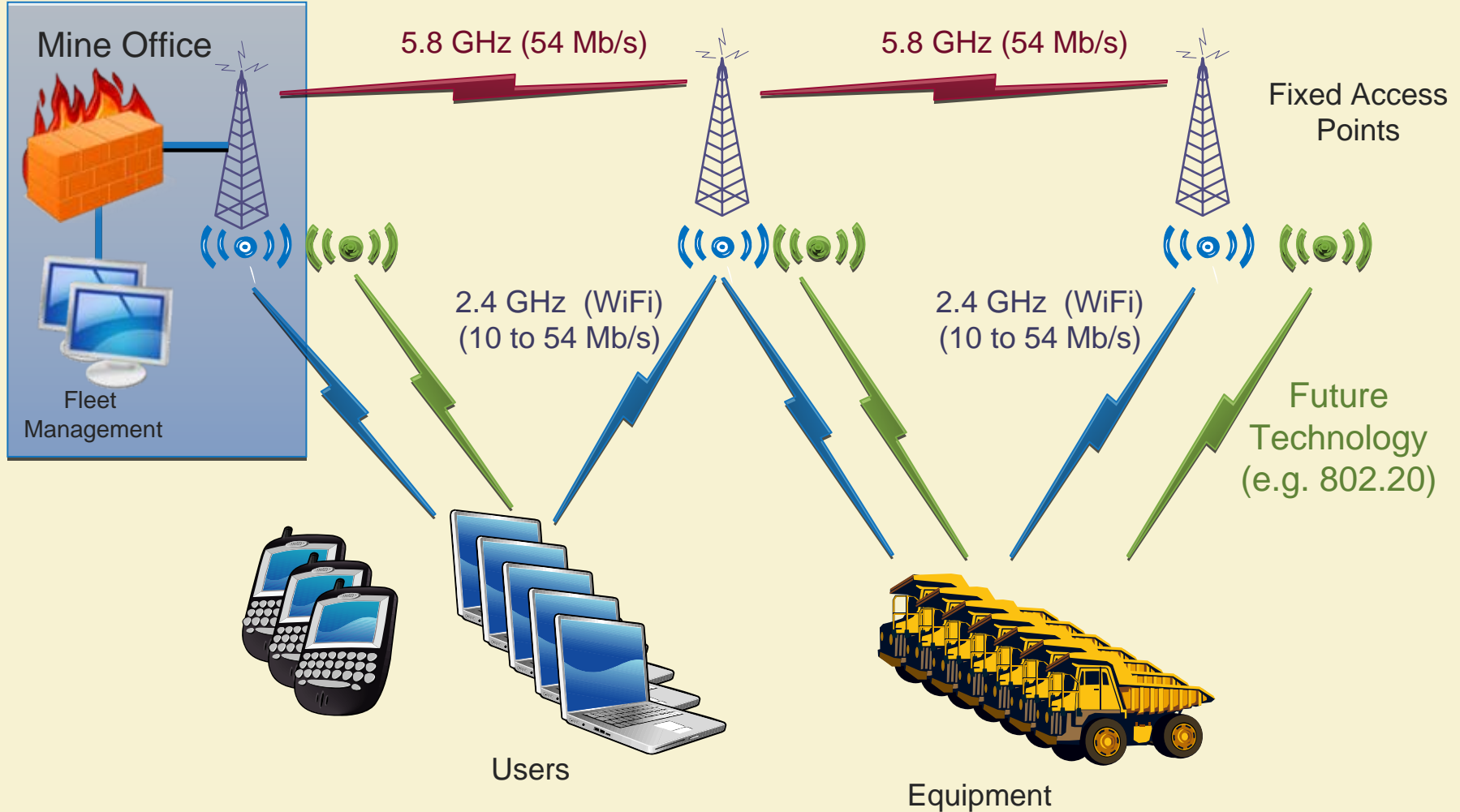
Cardinal River Zroback Ridge



Fording River Lookout 

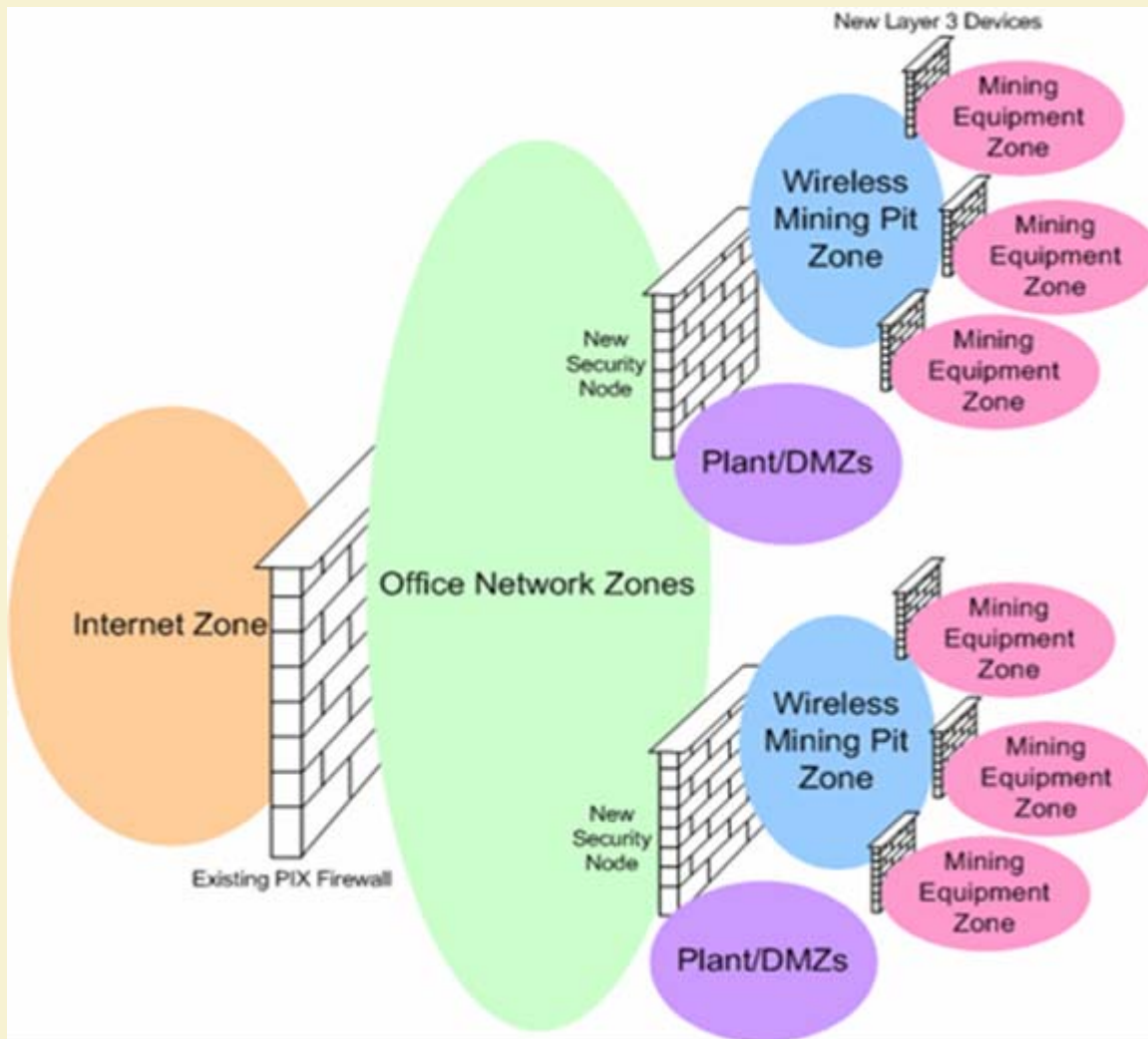


Open Wireless Design (future-proof)



Network Security

Wireless and Plant

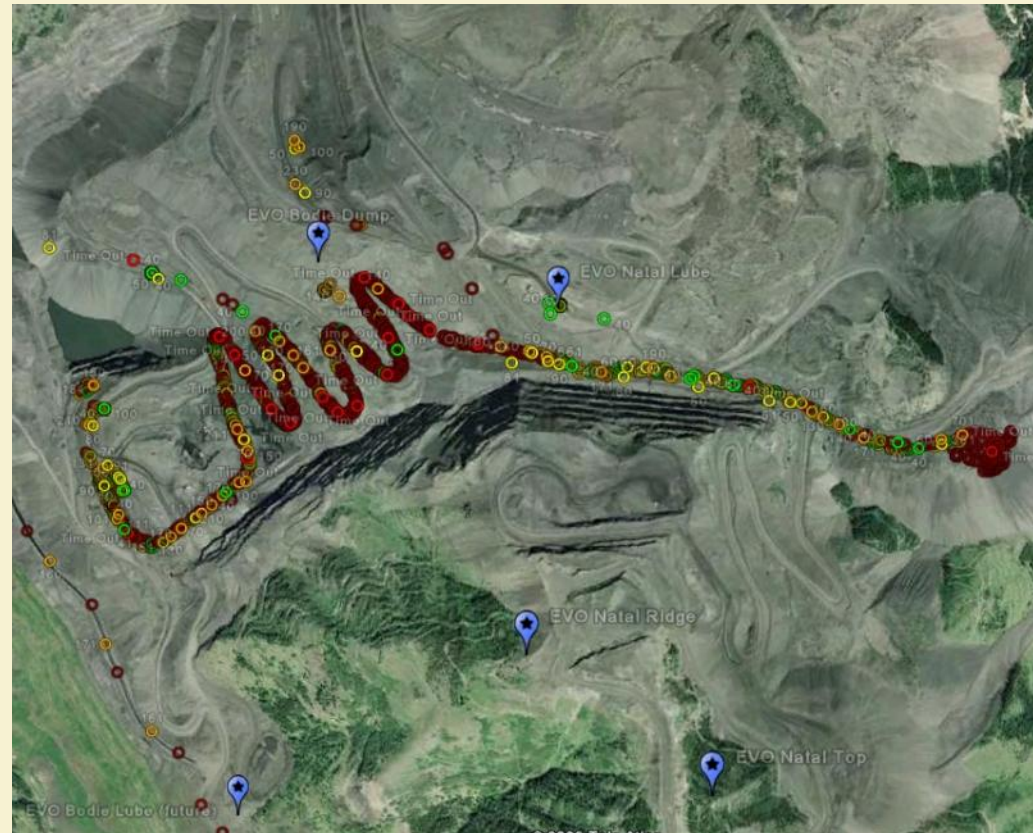


- All wireless networks have vulnerabilities
- Divide the wireless and plant networks into zones
- Isolate high-risk control networks with access control lists
- Defined quality-of-service (VoIP)
- Vendors operate wirelessly with limited privileges at low encryption
- Vendors self-manage their servers in an isolated demilitarized zone (DMZ)

Lessons-learned



- 90% coverage is easy in most of the mine
- 80% of the effort is expended in certain areas
 - Switchbacks
 - High benches
 - Slots
- Availability in-motion depends on more than signal strength
- Dual-antenna outperforms single 20% in some areas
- High encryption affects hand-off
- Rain is worse than snow
- Lightning protection



Field Technology Opportunities



- Realtime tire monitoring
- Remote diagnostics
- GPS Slope monitoring
- In-field computer based training
- Keyscan access to equipment
- Condition based monitoring
- Autonomous equipment
- Product quality optimization



Questions?



Teck