Employing RFID Technologies in Rail Applications

A Modern Solution for Asset Management, Accurate On-Track Location Referencing, Maintenance Record Keeping and Beyond

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Agenda

- What is RFID Technology?
- Common RFID Applications
- Rail Applications:
  - Asset Management
  - On-Track Location Referencing
    - Use in Track Testing Applications: Case Study
    - Other Location Referencing Applications
  - Maintenance Record Keeping
  - Other Applications in the Rail Industry

What is RFID Technology?

- Radio Frequency Identification
- Utilizes electromagnetic fields in radio frequency ranges to transmit data wirelessly
- Information is stored on an electronic chip on the tag
- Readers (interrogators) send an encoded radio signal to the tag
- Tag responds with its encoded information

Types of RFID Technology

- **Passive Reader/Active Tag (PRAT)**
  - **Active Tags contain a local power source (battery)**
  - **Passive Readers are activated, or awakened, by energy from an active tag**
  - **High read range; used for security-related applications**
- **Active Reader/Passive Tag (ARPT)**
  - **Passive Tags contain no power source**
  - **Tags are only “active” when excited by the energy from an active (powered) reader**
  - **Low read range; used for asset management and location**

Types of RFID Technology

- **Battery-Assisted Passive Tag or Active Tag/Active Reader**
  - **Tag contains a power source that boosts signal transmission**
  - **Tag is engaged, or activated, by an active tag**
  - **Highest read range; used for high security purposes, information fidelity**

RFID Advantages

- No line of sight necessary
- Multiple tags can be scanned or read at a time
- Low costs– most inexpensive tags are less than $0.10
- High read ranges possible
- Information security/advanced coding

Common RFID Applications

- Interstate automated toll payments
- Access control (ID badges, etc.)
- Commodity tracking, inventory and management
- Aircraft, vehicle construction and maintenance
- Animal tracking (pet ID's, wildlife research)
- Motes ("smartdust")– distributed sensor networks

Railroad Asset Management

- **RFID Tagging on Rail Cars**
  - **Allows railroads to manage the location, movement and utilization of their vehicle assets**
  - **Is used by wayside inspection equipment to accurately classify vehicle type**
- **RFID Tagging of Track Assets**
  - **RFID tags are being embedded into concrete ties for inventory management, installation and manufacturing management**
  - **Tags are assigned to special track work, track and rail components (turnouts, welds, etc.) for installation and maintenance management**

On-Track Location Referencing

- By tagging known locations or assets, RFID tags can replace manual forward observation for inserting track events into data
- Benefits:
  - Accurate location referencing for inspection follow-up activities and maintenance
  - Automated data synchronization between multiple systems, sources and platforms

On-Track Location Referencing: Case Study

- **Background:**
  - **Chicago Transit Authority does not have GPS available to identify exceptions from geometry tests**
  - **Exceptions are located with MP/Foot and distance from last known track event (FO), which could be thousands of feet to reference**
  - **Inconsistent chain marking makes on-board data collection and on-track follow up difficult**
  - **Inexperienced maintainers have trouble locating exceptions from geometry tests**

On-Track Location Referencing: Case Study

- **Tag Implementation:**
  - **Using the CTA's Track Charts, Holland devised a "map" for placing RFID tags**
  - **ID Locations (line color, branch, track number, chain marker) were uploaded into a database and referenced to a bar code**
  - **The bar codes were printed into a reference booklet/legend**
  - **Tags were placed every 500 ft, at the base of the rail, affixed using an industrial grade silicone adhesive**

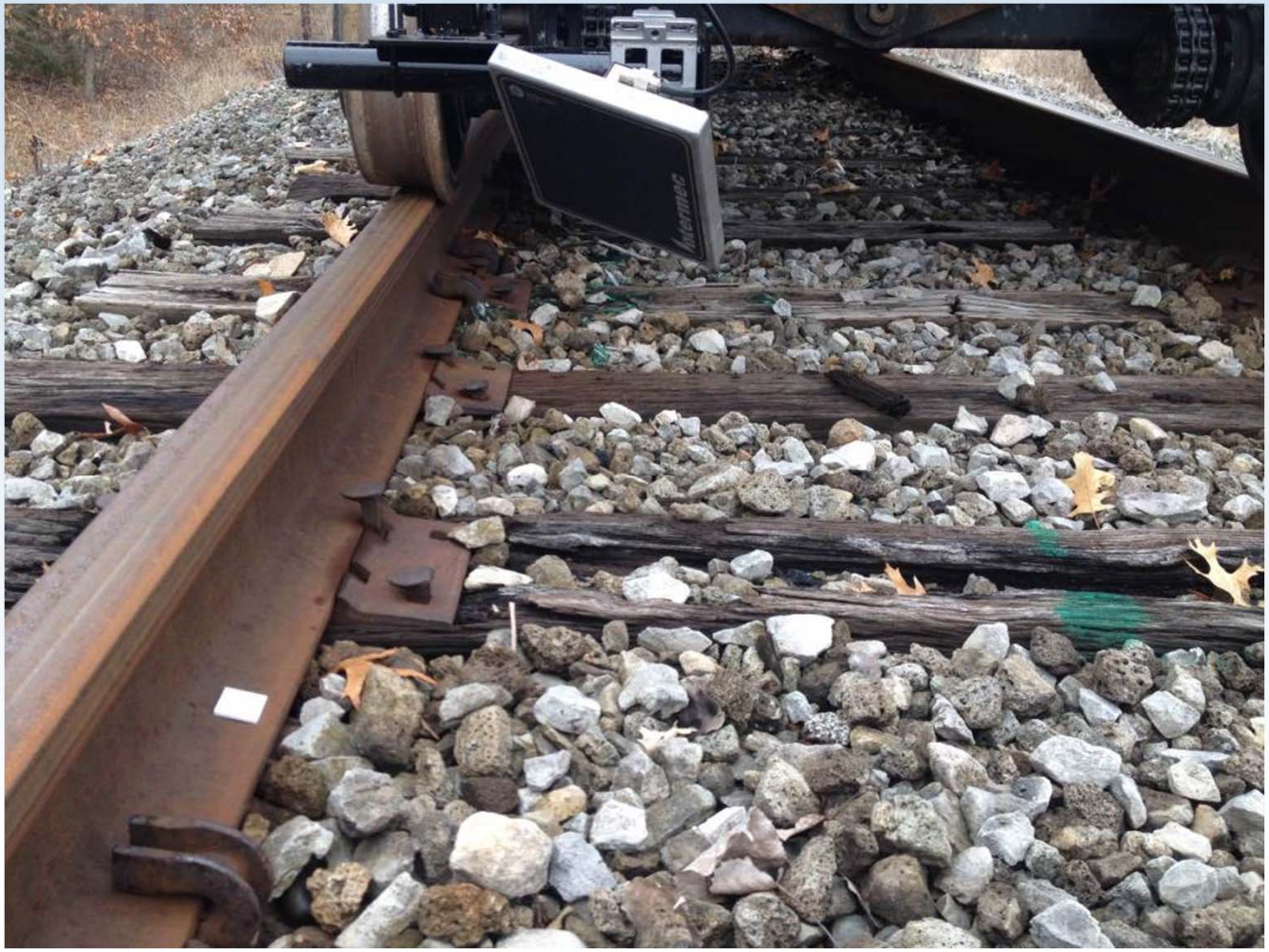
On-Track Location Referencing: Case Study

- **Tag Implementation:**
  - **The tag was scanned using a handheld device, and then the bar code was scanned to "link" the geophysical location to the RFID tag**
  - **"Preprogramming" the bar codes eliminated the need to input location information in the field (time consuming, subject to error)**
  - **Upon installation completion, a single database was generated with all geophysical locations of RFID tags**

On-Track Location Referencing: Case Study

- **On-Board Equipment and Software:**
  - **Holland's Transit Testing Vehicle (TTV) was equipped with antenna, a reader, and periphery equipment to read the tags**
  - **Antenna and reader were optimized for maximum accuracy and repeatability**
  - **TrackSTAR® operating software was modified to utilize tag reads as events (treated similar to MP)**
  - **Tag events are inserted into the geometry record**
  - **Software relies on database to filter out unexpected tags**

RFID Tag and Antenna



On-Track Location Referencing: Case Study

- **Reports:**
  - **Strip Charts show each tag event**
  - **Exceptions Reports locate exceptions using feet past closest tag or other closest event (frog, platform, etc.)**
  - **Missing Tag Report generated; used for follow-up maintenance of tags**
- **Handheld Unit:**
  - **Exception Report is uploaded into handheld unit**
  - **Unit is used to confirm specific RFID tag in-track**
  - **Exception is located by measuring distance from tag**

Exception Report

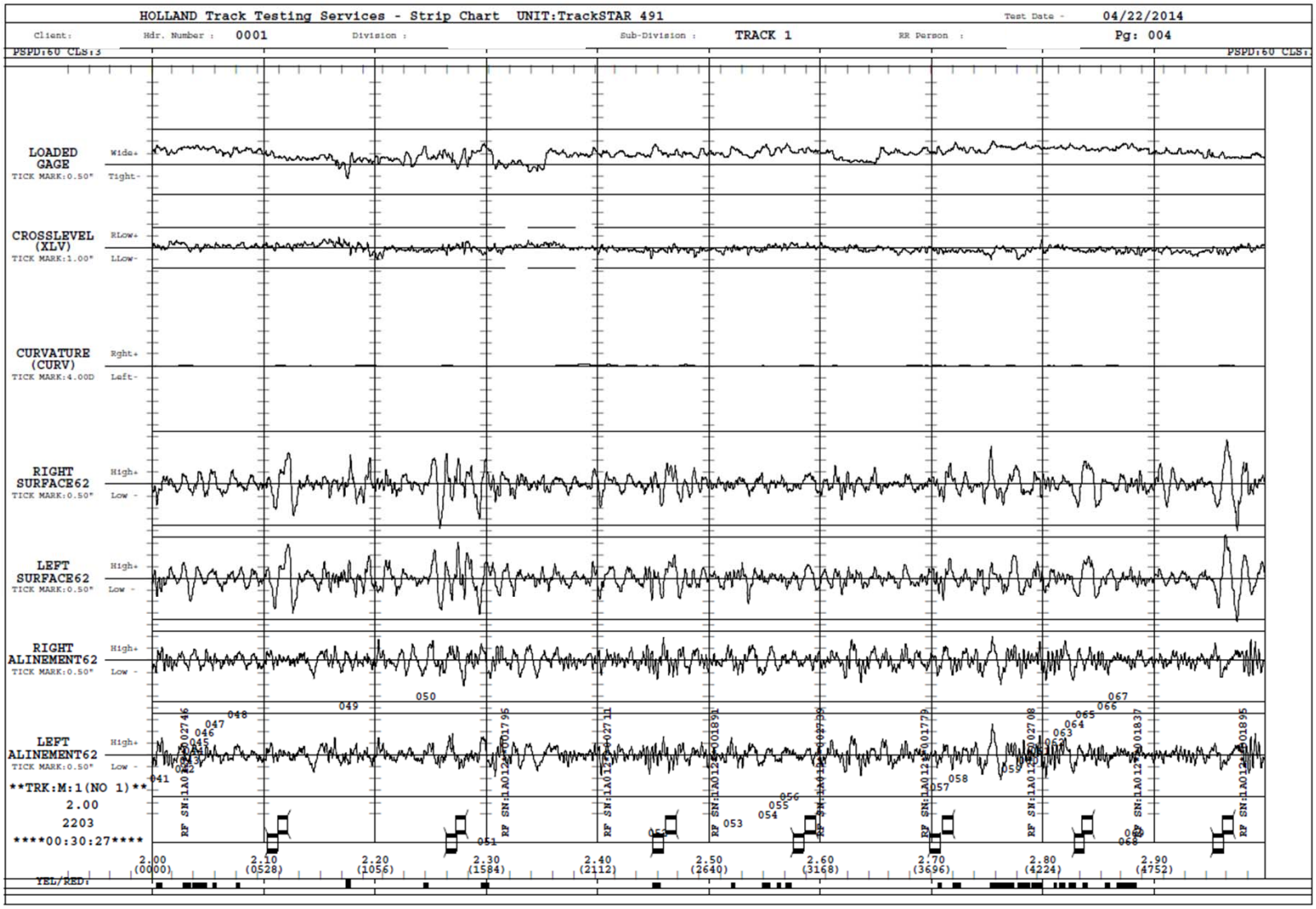
HOLLAND TRACK TESTING SERVICES - RED DEFECTS REPORT

Vehicle: TrackSTAR 491 Direction:S Units: MILES 04/22/2014 00:54am Page 5

Client: H#: 0001 Div: Sub: TRACK 1 RR Person: J Trk

Def #	Worst Loc.(MP)	TRACK INFO	R/Y Defect	Max(in)	Len(ft)	Cls	Safe(MPH)	LM+PT	Gage	Latitude	Longitude	Crv
0105	4.226(1193)	M:1	(NO 1) R WARP62:54	2.38	0005	3	030/025	RF + 13		041.96158	087.65707	S
POST:0004	OFFSET:01329	Frog								041.96120	087.65706	
POST:0004	OFFSET:01379	Switch								041.96106	087.65705	
POST:0004	OFFSET:01684	RFID Tag	SN: 1A0120000000000000001444							041.96020	087.65703	
0108	4.386(2038)	M:1	(NO 1) R R SURF62	-2.82	0016	3	015/010	RF + 359		041.95927	087.65701	T
POST:0004	OFFSET:02187	RFID Tag	SN: 1A0120000000000000002104							041.95886	087.65699	
0110	4.432(2278)	M:1	(NO 1) R LGAGE WIDE	1.40	0021	3	-E--	RF + 100		041.95858	087.65699	T
POST:0004	OFFSET:03189	RFID Tag	SN: 1A0120000000000000002081							041.95604	087.65691	
0111	4.688(3633)	M:1	(NO 1) R WARP62:62	3.29	0085	3	-E--	RF + 492		041.95480	087.65688	T
POST:0004	OFFSET:03697	RFID Tag	SN: 1A0120000000000000001452							041.95462	087.65686	
POST:0004	OFFSET:04114	Station								041.95383	087.65603	
0114	4.781(4125)	M:1	(NO 1) R WARP62:62	-2.73	0022	3	030/025	ST + 21		041.95382	087.65599	S
0115	4.789(4165)	M:1	(NO 1) R WARP62:62	-3.03	0036	3	015/010	ST + 75		041.95381	087.65584	S
POST:0004	OFFSET:04215	SHERIDAN								041.95382	087.65565	
POST:0004	OFFSET:04224	RFID Tag	SN: 1A0120000000000000001412							041.95382	087.65561	
POST:0004	OFFSET:04522	Station								041.95383	087.65448	
POST:0004	OFFSET:04711	RFID Tag	SN: 1A0120000000000000001484							041.95363	087.65387	
0141	4.979(5169)	M:1	(NO 1) R WARP62:62	2.67	0018	3	030/025	CR + 100		041.95237	087.65375	T
POST:0004	OFFSET:05204	RFID Tag	SN: 1A0120000000000000001482							041.95228	087.65376	
POST:0005	OFFSET:00428	RFID Tag	SN: 1A0120000000000000001465							041.95086	087.65372	
0142	5.084(0445)	M:1	(NO 1) R WARP62:52	2.36	0010	3	030/025	RF + 21		041.95081	087.65372	S
POST:0005	OFFSET:00649	Signal								041.95024	087.65368	
POST:0005	OFFSET:00671	Switch								041.95023	087.65368	
POST:0005	OFFSET:00744	Frog								041.95003	087.65375	
POST:0005	OFFSET:00878	Signal								041.94966	087.65373	
POST:0005	OFFSET:00934	RFID Tag	SN: 1A0120000000000000001490							041.94950	087.65373	
POST:0005	OFFSET:01434	RFID Tag	SN: 1A0120000000000000001424							041.94810	087.65373	
POST:0005	OFFSET:01940	RFID Tag	SN: 1A0120000000000000001474							041.94668	087.65363	
0144	5.395(2085)	M:1	(NO 1) R LGAGE WIDE	1.32	0027	3	-E--	CR + 24		041.94625	087.65364	C
0145	5.400(2113)	M:1	(NO 1) R LGAGE WIDE	1.06	0011	3	-E--	CR + 16		041.94617	087.65364	S
0147	5.407(2150)	M:1	(NO 1) R LGAGE WIDE	1.02	0009	3	-E--	CR + 54		041.94606	087.65364	S
0150	5.423(2235)	M:1	(NO 1) R LGAGE WIDE	1.01	0014	3	-E--	CR + 138		041.94583	087.65363	S
POST:0005	OFFSET:02441	RFID Tag	SN: 1A0120000000000000001493							041.94526	087.65362	
POST:0005	OFFSET:02942	RFID Tag	SN: 1A0120000000000000001438							041.94396	087.65350	
POST:0005	OFFSET:03167	Signal								041.94333	087.65347	
POST:0005	OFFSET:03386	Frog								041.94272	087.65350	
POST:0005	OFFSET:03404	Frog								041.94266	087.65350	
POST:0005	OFFSET:03413	Frog								041.94264	087.65350	
POST:0005	OFFSET:03423	Frog								041.94261	087.65350	
POST:0005	OFFSET:03452	RFID Tag	SN: 1A0120000000000000001496							041.94253	087.65350	
POST:0005	OFFSET:03475	Frog								041.94247	087.65350	
POST:0005	OFFSET:03548	Switch								041.94226	087.65350	
POST:0005	OFFSET:03559	Signal								041.94223	087.65350	
POST:0005	OFFSET:03578	Switch								041.94218	087.65350	
POST:0005	OFFSET:03631	Frog								041.94203	087.65349	
POST:0005	OFFSET:03658	Frog								041.94196	087.65349	

Strip Chart


HOLLAND Track Testing Services - Strip Chart UNIT:TrackSTAR 491
Test Date - 04/22/2014
Client:
Hdr. Number : 0001
Division :
Sub-Division : TRACK 1
RR Person :
Pg: 004
PSPD:60 CLS:3
LOADED GAGE
TICK MARK:0.50"
Wide+
Tight-
CROSSLEVEL (XLV)
TICK MARK:1.00"
RLow+
LLow-
CURVATURE (CURV)
TICK MARK:4.00D
Rght+
Left-
RIGHT SURFACE62
TICK MARK:0.50"
High+
Low -
LEFT SURFACE62
TICK MARK:0.50"
High+
Low -
RIGHT ALINEMENT62
TICK MARK:0.50"
High+
Low -
LEFT ALINEMENT62
TICK MARK:0.50"
High+
Low -
TRK:M:1(NO 1)
2.00
2203
****00:30:27****
2.00 (0000)
2.10 (0528)
2.20 (1056)
2.30 (1584)
2.40 (2112)
2.50 (2640)
2.60 (3168)
2.70 (3696)
2.80 (4224)
2.90 (4752)
YEL/RED:

Other Uses in Location Referencing

- Tags can be placed on in-track assets (turnouts components, mile posts, road crossings, bridges, etc.) to eliminate forward observation on test vehicles
- Tags can be used in addition to other advanced technologies for high precision location of track assets such as ties
- By combining in-track tagging with vehicle tagging, vehicle location and movement can be tracked and predicted

Using RFID for Maintenance Records

- **Tags are placed on track assets for manufacturing, installation and maintenance recording:**
  - **Embedded into concrete ties**
  - **Turnout components and special track work**
  - **Welds**
  - **Rail**
- **Databases are created and updated to reflect inspections, repairs, maintenance**

Other Applications in the Rail Industry

- Inventory control and management
- Build material tracking and construction/assembly validation
- Supplier auditing
- Personnel tracking
- Equipment tracking
- Enhanced safety and security practices

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