RAILWAY SIGNALING AND TELECOM INFORMATION SYSTEM (RASTIS)
A network management application for addressing the challenges of Railways’
Signal and Telecom (S&T) division

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Abstract:

Signaling system plays an integral part in any transportation network where means of instant
communication is required when the reach is beyond the range of sound. The nature of
appearance of a signal conveys the driver and instructs him to stop, move or be cautious. The
basic use has not changed over the years but the priority has shifted heavily towards safety
rather than only distinguish between stop and go. This safety is of more importance in India,
which has one of the largest rail network and second largest population. A small human or
technical mistake can bring about a catastrophic result, causing large scale damage to human
life and properties.

Indian Railways division maintains information about signals and cables, which are
subsequently used by field crews for maintenance operations like identification of faulty
cables, signals and other assets. To do these maintenance works, the crews need to go
through and look into various hard copy diagram (Cable plans, Cable Route plans, Signaling
Plans, Rule diagrams etc.). This method can sometimes become tedious and less productive.
They need to have a spatial asset management system to convert paper drawings to
intelligent digital drawings, which would improve safety, profitability by reducing and
containing expenses and costs while increasing revenue through improved services.

To address the challenges of handling the Indian Railway assets available in various
heterogeneous formats, WTI has designed and developed an intelligent tool “RastIS” (Railway
Signaling and Telecom Information System) to satisfy the requirements of Indian Railways/
cable management department.
**Introduction:**

Railway system is made up of multiple components, in which signaling is one of the most important. Movement of train, its safety, control and management depends on the signaling system. In the earlier days Railways did not have fixed signaling – there was no system for informing the driver of the state of the line ahead. Trains were driven "on sight". Drivers had to keep their eyes open for any sign of a train in front so they could stop before hitting it. From the time of “no signals” to the present day of sophisticated signaling, Railways have seen different transitions. The different signaling that came after witnessing several unpleasant accidents due to unavailability of proper signaling are – time interval, line capacity, fixed signaling, distant signals, interlocking etc. in the present days.

The working condition of the signaling system depends on various railway assets such as cables, track circuit, location box, battery box, etc. Hence the requirement to maintain and manage assets in a systematic manner using state-of-art technology systems becomes very much inevitable. In this regard, WTI has developed a Geo-spatial asset management system for railway assets, which will help the railway officers for informed decision making.

**Need for RastIS:**

Currently, in S&T division of Railways, the following records are being maintained as paper records,

- Cable plans
- Cable Route plans
- Signaling Plans (Rule diagrams)
- Location Diagrams
- Power Supply diagrams
- SWR (Station Working Rule) document
- Track Bonding Plan
- Failure particulars from data logger

system. Hence the above data needs to be converted / integrated into an intelligent database with relevant spatial context, for which a customized spatial information system is very much necessary. A system that can generate, store, update the drawings, documents etc. available in a digital format would assist in knowledge management across the organization and can address the deficiencies. Such an Information system would also assist in the provision of an asset management system for use by internal and external stakeholders. Keeping the above requirement in mind, WTI has come out with a geospatial system “RastIS” (Railway Signaling and Telecom Information System).
**RastIS development objective:**
To address the needs of Indian Railways in handling and management of asset data available in various heterogeneous formats and to aid in informed decision making, WTI has designed and developed an intelligent tool “RastIS”.

RastIS application is developed using ESRI Map Objects, VB.Net, and MS-Access on three tier architecture. The application addresses day-to-day needs like maintaining information about railway signaling cables, which are subsequently used by field crews for maintenance operations and identification of faulty cables and other assets. With this intelligent tool and availability of integrated source records, identification of location box where the fault has occurred is very easy and less time consuming; this also reduces risks and makes an easy way to change cables immediately. RastIS was developed keeping in mind, the limitations of the out-of-box solutions / software available in the market, considering the following criteria,

- Tailor-made functionalities to meet specific utility requirements
- Cost- effectiveness
- In terms of software licenses and maintenance charges (AMC)
- Ease to use (User – friendliness)
- Open development platform and database

RastIS has been developed to address the challenges and specific requirements of the Railways.

**RastIS Application Features:**
This application carries the following features as listed below

![Figure 1 Showing the Home page of the RastIS Application](image)
• User Login: Secured and easy access to application based on privileges like Administrator, Editor and viewer.
• Station Selection: Station selection by means of Station key map or Route Table
• User Interface: An easy-to-use interface based on windows standards which comprise of:
  • Dual Window – Two separate map windows - Track window and Cable window. One can play around both the windows separately or by using “Smart Navigation” both the windows can be brought into a synchronous view.
  • Tools Panel – Tools on right side panel for navigation, Queries - Spatial and Aspatial, Locate – cables and signals, network analysis, etc.
  • Menu Bar – Drop down menu containing a list of functionalities.
  • Birds View – An over view of the map area with additional facility for navigation.
  • Legend Panel – To add or remove and switch on/off layers.
  • Navigation – This smart navigation will bring both the windows (Track & Cable) to sync, so that when one moves/pan in track window, the features in the cable window are automatically moved and vice versa.
  • Attributes – Display of attributes for any yard object when clicked
  • Aspects: Aspect is shown both as symbol and as well as with the colour of Colour light used.
  • Tool Tip – Display of the attributes as we move the mouse. It contains two options
    • Simple - Display of any particular attribute like cable core.
    • Customised – Set of attributes can be chosen for display – e.g.: signal pair details

**Architecture of RastIS**

The RastIS is built on 3-tier architecture and is highly scalable that provides an end-to-end model of all network elements.

The architecture of RastIS is layered architecture, it contains the following layers:

- Database layer
- Business logic layer
- Presentation layer

![Figure 2 Showing the Architecture of RastIS](image-url)
**Database Layer:**
This layer is designed in such a way that it handles the data related functionality independent of the type of database. It can be easily plugged into any type of RDBMS based on the utility requirements.

**Business Logic:**
Layer coordinates the application, processes commands, makes logical decisions and performs calculations. It also processes data between the two surrounding layers.

**Presentation layer:**
This is the top most layer of the application, designed in a most user friendly/effective manner.

**Functionalities of RastIS:**
RastIS has been incorporated with the following functionalities:
- User authentication
- Network Analysis
- Spatial Analysis
- Non-spatial Queries
- Locating Network Features
- Reports generation

**Network Analysis:**
Cable length required for laying cables between two location boxes, this would be further useful for BOM generation
Querying cables based on track circuit and tracing the cable feeding the track segment from relay room
Tracking the signal feeding cable and finding the connectivity of cables between relay room and the location box

**Spatial Query:**
Select and analyze the objects within the specified buffer distance / view extents/rectangle at any point on the map.

![Figure 3 Showing the Spatial Query Results](image)
**Aspatial Query:**
Querying based on attributes for e.g.: based on no. of cores, either using query builder or query expression. Saved query expression and results can be reloaded for repeated use.

**Locating Network Details:**
- Functional details-Each cable is modeled based on the function it serves like signal, tele, track, slot, point, etc.
- Pair level details-Pair details for selected cable is displayed with cable specifications like number of pairs, spares, etc.
- Spare Pairs- Identify spare pairs between two location boxes and allocate spares to replace defective pairs.
- Tail Cable-Tail cables are small cables that are used for connecting location boxes and the yard objects such as signals, siding points, etc. Connectivity details are modelled and displayed during analysis.
- Location box- Connectivity details of all cables between two locations boxes.

**Reports Generation**
- Any Query / Analysis result can be generated as reports. Other reports include
  - Statistics – Count of all the Indian Railways Assets
  - Length of cable – customized report of cable length required between two location boxes

**Results & Discussion**
The following are the benefits which we are derived out of using RastIS:
- Maintaining and managing assets
- Network inventory management
- Better visualization of assets as an integrated dataset
- Helps field crew for locating faulty cables
- Get information on associated objects like location boxes
- Detailed/section drawing of Cable plans, Cable Route plans, Signaling Plans, Rule diagrams etc as attachments

**Future Scope of RastIS**
The RastIS architecture will support seamless integration of Enterprise systems/ third party systems such as:
- SAP (ERP)
- Signaling systems
- SCADA
Conclusion

The benefits of a true enterprise Geographic Information System lies in the fact that it can map and manage facilities and implement cross-cutting applications for streamlining operations, driving down costs, and improving service. Indian Railway Industry is one of the first in implementing Information Technology across the country. Adoption of GIS is vital in Railways, as quick response and recovery is very critical in case of any malfunction, so that valuable time and effort are utilized properly thus saving both money and life. Hence Indian Railway Industry can make best use of RastIS for best management of their assets in an efficient manner which in turn will improve their overall performance.

Reference:

- (http://www.indianrailways.gov.in/)