

Nova Scotia



Service Nova Scotia and  
Municipal Relations



# Investigation of Routing Options for the Nova Scotia Road Network (NSRN)

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# Presentation Outline

- Background
- Routing Concepts
- Proposed NSRN Routing Data Model
- NSRN Routing Pilot Project
- Provincial Implementation Options
- Recommendations and Conclusions



# Background

- Core Nova Scotia Road Network (NSRN) database in place by Service Nova Scotia and Municipal Relations (SNS&MR)
  - One set of road geometry and several attribute classes, including civic addressing
  - Being updated on a continual basis
  - Web application in place to support civic address update
- Stakeholder interest in extension of the NSRN to support vehicle routing applications
- SNS&MR have sponsored two projects to investigate NSRN routing :
  - Development of routing options and data model
  - NSRN routing pilot project



# Network Routing Concepts

- Routing software products are being widely used today to support numerous business applications using a variety of routing functions:
  - Shortest path routing (“How do I get from A to B?”)
  - Service route planning (“What is the most efficient route to service the customers I need to visit today?”)
  - Maintenance route planning (“How many kilometres of road can I plough in 8 hours with 10 snowploughs?”)
  - Service Area analysis (“Where do I need to locate my ambulances in order to achieve complete coverage of my Region within a 10 minute response time”?)
  - Transit route planning (public transit, school bus)
  - Others ...



# Network Routing Requirements

- An ***application*** that supports the type(s) of routing that you want to do
- ***Data:***
  - A spatial *road network database* that is structured for routing
  - *Routing attributes* that constrain possible network paths



# Routing Applications

- Network routing functions are available within, or as extensions to, commercial GIS software packages
- Custom network routing applications are also available from third party software vendors to support specific business requirements
  - School bus routing
  - Public transit
  - Emergency vehicle dispatch
- Network routing services are available through Internet Service Providers (ISPs)
  - Example: MapQuest
  - A network routing service is planned for the GeoNova portal
- Not all packages support all routing functions



# Road Network Routing Database Requirements

- **Coverage:** must include the entire area needed for the analysis
- **Content:** must include all road classes needed for the analysis
- **Currency:** must support the most critical requirements for updates
- **Logical consistency:** must contain 3-D network topology (no nodes at grade separated interchanges)



# Road Network Routing Attributes

- *Constraints*: **prohibit** travel along specific network segments
  - Examples: one-way streets, turn restrictions, road closures, horizontal / vertical clearance restrictions, weight restrictions
- *Impedances*: **penalize** travel along specific network segments
  - Examples: speed limits, turn penalties

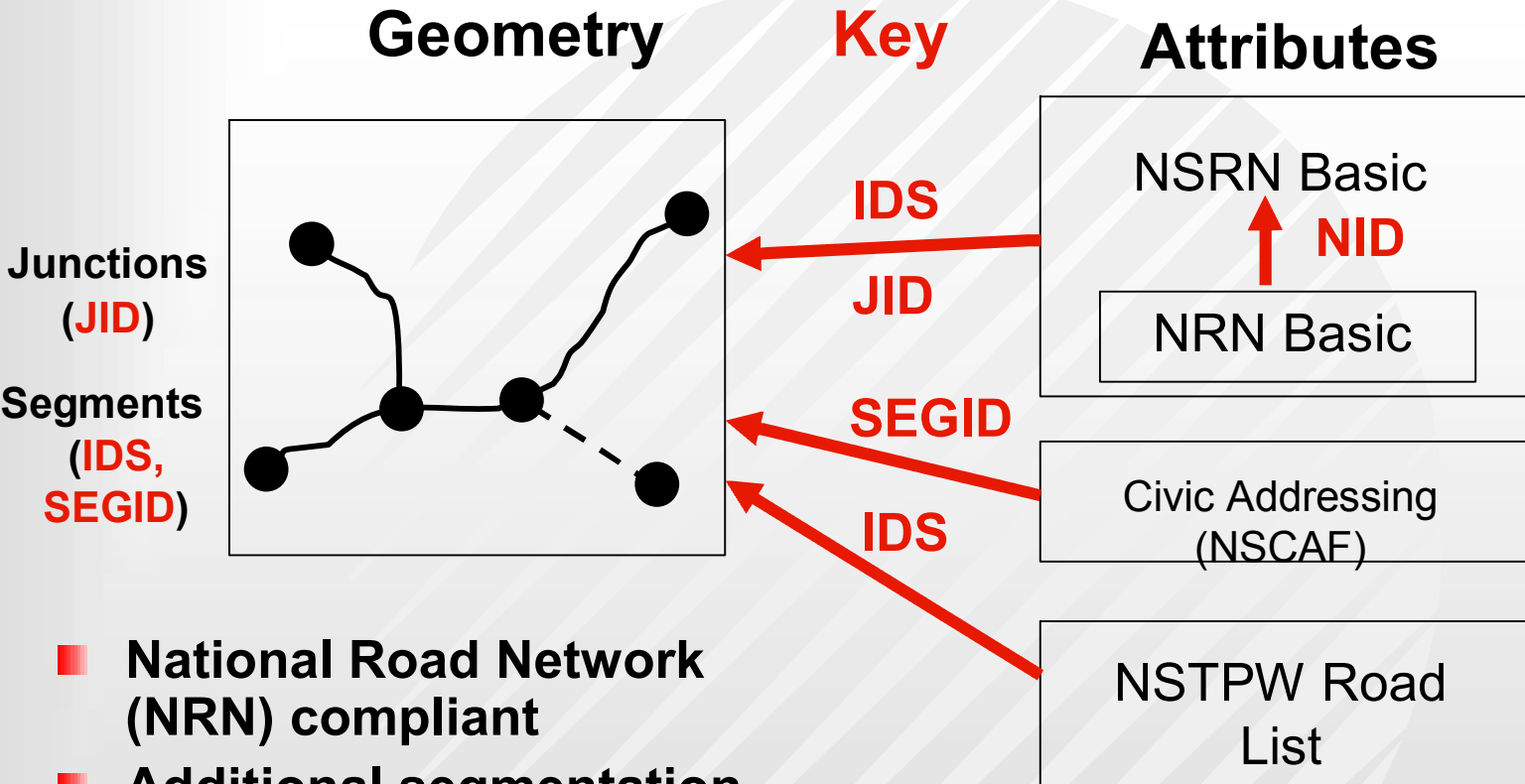




# Presentation Overview

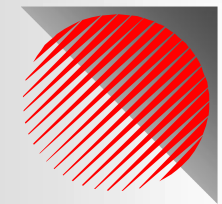
- Background
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# Current NSRN Data Content

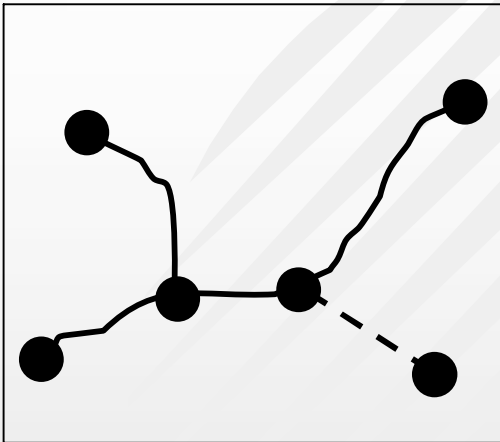


- National Road Network (NRN) compliant
- Additional segmentation and road classes
- Future: full LRS data model

# Proposed NSRN Routing Data Model



## Geometry



Junctions  
(JID)  
Segments  
(IDS,  
SEGID)

## Key

IDS

JID

SEGID

IDS

IDS

JID

## Attributes

NSRN Basic

NID

NRN Basic

NSCAF

NSTPW Road  
List

NSRN Routing

- Additional attribute tables
- Attached to the *same* network geometry – no additional segmentation
- Does not impact on NSCAF or other attributes

# Recommended NSRN Routing Attributes

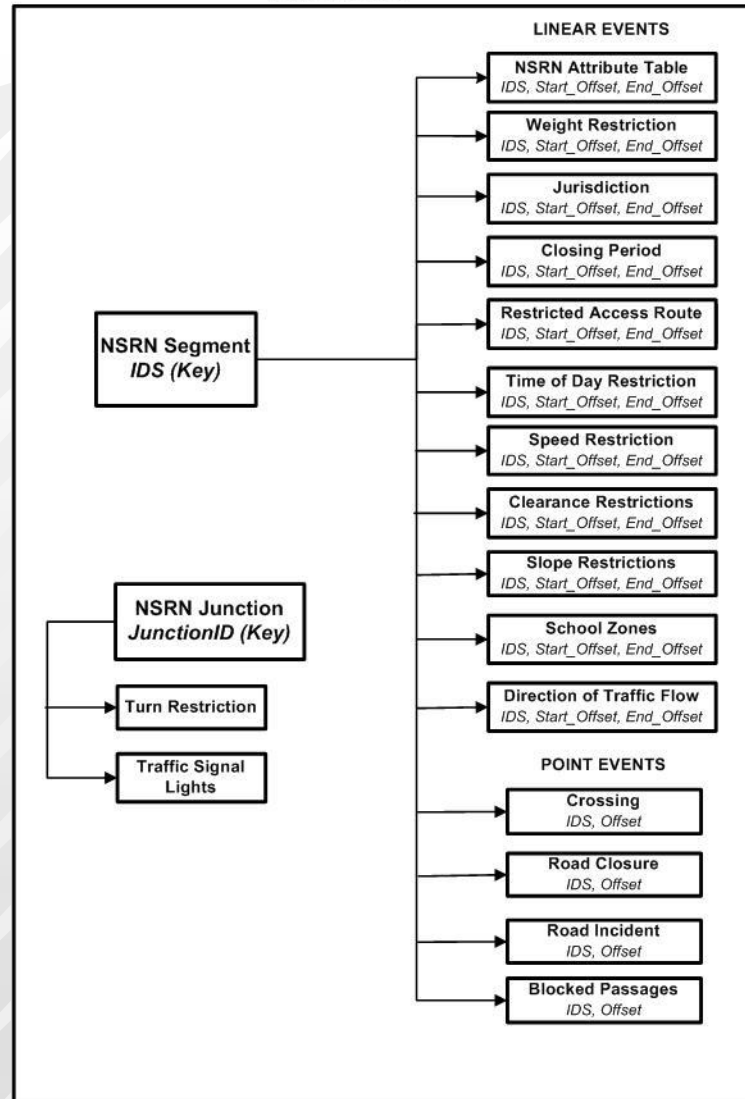
Priority	Attribute	Use by Software	
		Impedance	Penalty
Mandatory	Direction of Traffic Flow	X	
	Turn Restriction	X	
Other Routing	Speed Restriction		X
	Crossing		X
	<b>Closing Period*</b>	X	
	Restricted Access Route	X	
	Weight restrictions	X	
	Clearance Restriction	X	
	School zones		X
	<b>Time of Day Restriction*</b>	X	
	<b>Slope Restriction*</b>	X	

**\* Not collected during pilot project**

# NSRN Routing Data Model

- Contains 3-D network topology
- Additional attribute tables for linear and point events attached to NSRN network Segments
- Also contains turn restrictions and traffic signal locations attached to network Junctions
- Used to create *vendor specific* routing networks for application usage

## LRS MODEL





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# Pilot Project Objectives

- Develop field data collection / data integration procedures and collect data for a pilot project area
- Verify the proposed NSRN Routing Data Model and data collection specifications
- Reassess data collection / maintenance strategies, procedures and costs
- Develop provincial implementation options



# Pilot Project Activities

- Project Initiation / Confirmation of Data Collection Scope
- Develop Data Collection Approach
- Develop Pilot Database Environment (GeoDatabase)
- Conduct Initial Data Collection
- Assess Data Collection Results
- Field Data Verification / Revision
- Data Integration / QA
- Reassess Data Maintenance Strategy
- Stakeholder Agency Routing Application Tests
- Draft Final Report
- Stakeholder Workshop
- Final Report





# Data Collection Approach

- Field data collected as GPS point features through a Sign Inventory
- Different procedures for urban and rural collection:
  - Rural – vehicle mounted GPS, range finder and compass
  - Urban – on foot with GPS mounted on a backpack
- NSRN Road Classification and Number of Lanes were field verified and errors documented
  - These are NRN mandatory attributes



# Data Collection Observations

- Sign collection was a small component of the overall field data collection activity
  - Most time spent in network travel and segment attribute verification
  - Signs collected for routing represented approximately 25% of total sign population
- Data Collection Costs:
  - Urban: **\$112.33/km**
  - Rural: **\$23.48/km**
  - Could be reduced by approx. 10% through more streamlined field collection procedures
- Data Integration Costs: **\$8.29/km**
  - Does not include custom tool development costs



# Data Specification Revisions

## ■ Field Collection Specifications:

- The addition of sign flags in the data dictionary
- The addition of new sign type codes
- Modification of metadata assignment rules
- Addition of verification flag to confirm roads traveled by data collection contractor

## ■ NSRN Routing Data Model:

- A new NSTPW Weight Restriction Event
- The addition of new sign type codes



# Stakeholder Feedback

- **Routing attributes verification:**
  - Limited stakeholder resources to undertake this task
  - Most stakeholder agencies stretched to maintain NSCAF data
- **Routing applications:**
  - School bus route planning, driver instructions / maps
  - Snow plow and salting route planning
  - Solid waste pickup route planning
  - Emergency management planning
  - Emergency response (EHS, RCMP)
  - Agencies involved in the delivery of goods and services
- **Observation (Opus):** most benefits from routing applications appear to be in agencies other than municipalities



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# CSFs for Provincial Implementation

- Stakeholder commitment to maintain the routing data for the roads under their jurisdiction is essential
  - If the data is not maintained, there is no business case for initial collection
- Resources within NSGC must be available to manage and maintain the NSRN routing data on an ongoing basis
- Funding must be available
  - Partnerships are needed



# Data Migration Recommendations

1. Data should be obtained closest to the source wherever possible.
2. Consideration should be given to contracting out the initial lift.
3. Explore the possibility of using commercial vendor data to support the initial lift.
4. Optional attributes should be populated only if funding and staff resources are made available explicitly to cover the additional data collection *and maintenance* effort required.
5. Data should be continually verified by stakeholder staff (municipal, TPW, RCMP, EHS, DOE, etc.) wherever practical to do so.



# Provincial Data Migration Options

Description	Approach	Attributes	Cost
1: Minimum	No field collection	One-way streets Turn restrictions	Low
2: Intermediate	Field verification, no GPS sign collection	Option 1 + road class, derived speed limits	Med.
3: Full	Field verification and GPS sign collection	All pilot project routing attributes	High

## Notes:

1. 3-D Topology required for all options.



# Proposed Data Migration Strategy

Class	Attribute	Option 1	Option 2	Option 3
Mandatory	One-way streets	Stakeholder verify	Field collection	Field collection
	Turn restrictions	Stakeholder verify	Field collection	Field collection
	Barriers / gates	Stakeholder verify	Field collection	Field collection
Optional	Speed restrictions	Not Collected	Rule based population	Field collection
	Functional Classification	Not Collected	Field collection	Field collection
	Number of Lanes	Not Collected	Not Collected	Field collection
	Jurisdiction	Not Collected	Not Collected	Field collection and NSTPW
	Crossings	Not Collected	Not Collected	Field collection
	Restricted access routes	Not Collected	Not Collected	Field collection
	Weight restrictions	Not Collected	Not Collected	Field collection and NSTPW
	Clearance restrictions	Not Collected	Not Collected	Field collection
	School zones	Not Collected	Not Collected	Field collection
	Other signage	Not Collected	Not Collected	Field collection
	Traffic Signal Lights	Not Collected	Not Collected	Field collection
	Slope restrictions	Not Collected	Not Collected	DEM processing
	Closing Period	Not Collected	Not Collected	Not Collected
	Road Closure	Not Collected	Not Collected	Not Collected
	Road Incident	Not Collected	Not Collected	Not Collected
Time of day restrictions	Not Collected	Not Collected	Not Collected	





# Data Maintenance Strategy

## ■ General principles:

- Stakeholder agency change detection – consider multiple sources including the RCMP and ambulance service provider (EHS)
- Closest to source data collection where possible and practical
- Source data providers are responsible for initial quality control (Q/C) prior to data submission to SNS&MR
- Submission of changes through a web application for most agencies, and via electronic file transfer if currency is an issue
- SNS&MR will be the data custodian with a Q/A role with respect to standards enforcement
- Distribution of updates according to overall plans for the NSRN

## ■ Other considerations:

- Discussions with potential commercial data partners



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# Provincial Implementation Recommendations

- If a provincial implementation is to be undertaken:
  - 3-D topology must be included within the NSRN
  - Minimum attribute requirements: one way streets and turn restrictions
  - Prior to field data collection, a review of the routing data available in regional municipalities should be conducted
  - A more robust application should be developed for data integration and the construction of the route network
  - If field collection is to be done, include all relevant signs as part of this program (small % of total cost)



# Alternate Approach Recommendations

- If province wide implementation is not feasible, consider:
  - Adding functionality to NSCAF web-based maintenance application to enable stakeholders to identify one-way streets and turn restrictions
  - Approaching ambulance service provider (EHS) and / or the RCMP to determine their ability to collect this information
  - Approaching data vendors to determine whether a cost shared approach is viable
  - Assist interested individual stakeholders to develop a routing network consistent with the NSRN Routing Network database design



# Conclusions

- Not a sufficient business case to proceed with province wide routing database at this time
  - Confirmed through additional stakeholder consultations
  - No “killer application”
- Benefits of routing applications acknowledged, but stakeholders have higher priorities for funding at present



# For more information ...

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