Major and Minor classification of Intersection Legs + Intersection Attributes

Some required fields in the Node feature class are dependent on how the intersection's Major and Minor routes are defined, or more specifically, on the Major/Minor classification of NodeLegs. These Node fields are:

MajorRoute
MinorRoute
MajorRoadName
MinorRoadName
Major_MM
Minor_MM
Major_AADT
Minor_AADT
Major_AADT_Year
Minor_AADT_Year
MajorRouteType
MinorRouteType
IntersectionSkewAngle

The above Major and Minor related fields from the Node dataset have values that depend on how one defines Major and Minor routes at intersections. More specifically, the values reflect how one associates an intersection's approaches (or a Node's NodeLegs) with appropriate conceptualizations of Major and Minor routes. Because VTrans will be using the intersection data to conduct safety analyses, we currently need to designate an intersection's Major and Minor routes in a manner consistent with assumptions built into ASHTO's Safety Analyst software.

Although the Major route (a thru-route by definition) always has two approaches (as does a Minor thru-route), the Safety Analyst software also assumes that thru-routes are best characterized by their more-traveled approach whenever the characteristics happen to change across the intersection. Therefore, if chosen carefully, a single NodeLeg is sufficient to characterize a Major or Minor thru-route. If there is no difference between the two approaches of a Major or Minor thru-route, then the approach with increasing route mileage (ApproachDirectionMeasures = increasing) is chosen for consistency.

Each NodeLeg is Major or Minor depending on whether it corresponds to the Major route or a Minor route as conceptualized at that Node/intersection, but only one Major NodeLeg will be used to populate an intersection's Major route attributes. Similarly, only one Minor NodeLeg will be used to characterize an intersection's Minor route. These two "representative" NodeLegs are identified in the Node's **Major_LegID** and **Minor_LegID** fields. A Node's Major and Minor route attributes can be therefore be verified against (or updated from) the NodeLegs indicated by those ID fields. Likewise, any NodeLeg attributes extracted from the road centerline data can be updated whenever the road centerline attributes are changed, and those changes can then be pushed to the Node's Major and Minor route attributes if (and only if) the Major_LegID and Minor_LegID fields are populated correctly.

Intersection safety analysis is gradually becoming more leg-oriented, so we are also keeping track of the IDs of the other Major and Minor NodeLegs, if they exist (i.e. **Major_LegID_2**, **Minor_LegID_2**, and **Minor_LegID_3**).

Determining Major and Minor routes in Simple vs Complex Intersections

Determining which NodeLegs are Major and which are Minor is a multi-step, partially automated process that is slightly different depending on whether the intersection is represented by a single node (a simple intersection) or by multiple nodes (a complex intersection). This procedural difference is entirely due the project requirement of representing every intersection (simple or complex) as a single point with an appropriate number of NodeLegs representing approaches in a manner consistent with field inventory data collection.

Simple intersections and each of their approaches are identified by the unique identifiers NodeID and NodeLegID, respectively. Each NodeLeg feature also carries the NodeID of its associated intersecting Node. The NodeID and NodeLegIDs in simple intersections therefore also serve as unique IntersectionID and IntersectionLegID identifiers.

Complex intersections have multiple nodes and a full set of NodeLegs associated with each constituent Node. One of the intersection's Nodes is therefore designated as the Principal Node, and it's NodeID is the IntersectionID that is then associated with all of the intersection's Nodes and NodeLegs. A subset of the NodeLegs are designated as the Principal NodeLegs that each represent an approach, and their NodeLegIDs are therefore equivalent to IntersectionLegIDs. The choice of which Node is the Principal Node and which NodeLegs are designated as Principal NodeLegs is made manually, with priority given to those affiliated with inventory direction, main-line routes.

Once the Principal Node and Principal NodeLegs have been identified in a complex intersection, they are functionally (computationally) equivalent to a simple intersection's Node and NodeLegs.

Some Workflow details:

For the purposes of facilitating a quasi-automated, categorize-and-review process of identifying the NodeLegs representing the Major and Minor routes, I used the Major_Leg, Minor_Leg, Major_Leg_2, Minor_Leg_2, and Minor_Leg_3 fields as an intermediate step for rearranging (or not) the order of NodeLegs after they had been sorted in order of decreasing AADT, as recorded in fields NodeLegID_1 – 6 indicating that order. The following steps outline the process in much greater detail:

1. Populate NodeLegID_1, NodeLegID_2, NodeLegID_3, etc… fields in the Nodes feature class using a method most likely to result in an appropriate hierarchical rank of the Node's intersecting NodeLegs in order of decreasing "Major-ness". At this time the sorting is based (sequentially) on AADT (decreasing), then Functional Class (decreasing), then TWN_LR code (increasing), and last by whether the LRS measures are "increasing" or "decreasing" as one approaches the intersection along the leg. Including the last two fields in the sort conditions has only minor or rare importance
    a. The method to populate the NodeLegID_n fields for multi-node intersections is slightly different, and depends on manually populating the relevant NodeLeg fields with

appropriate IntersectionID and IntersectionLegID values, and flagging those NodeLeg records as Complex = 1, and IsPrincipal = 1. The method of isolating and sorting these records to populate NodeLegID_1, NodeLegID_2, etc. is simple, but has not yet been coded.

2. Isolate scenarios where each of the 1st, 2nd, 3rd etc. legs are reliably predicted to be Major or Minor.
    a. Generally the 1st leg is always major because of the highest AADT, but one exception is a T intersection where the base of the T legitimately has the highest AADT, in which case the leg along the top of the T with the 2nd highest AADT is designated Major (for the purposes of Safety Analyst).
    b. If there is ~90 deg angle between the two legs with the highest AADT, those two legs are designated Major and Minor
    c. If there is ~180 deg angle between the two legs with the highest AADT, the first leg is designated Major and the second one is assumed to be a continuation of the Major route (regardless of route name, route code, or stop control). The Minor leg is the 3rd leg (last remaining leg of a three-leg intersection or the 3rd highest AADT of a four-leg intersection).