

PART 1: Boundaries in Next Generation 9-1-1

There are several types of boundaries that are used in current operations or Next Generation 9-1-1 systems, or influence call routing, dispatch, and response operations. This chart summarizes the different types of boundaries, the role they play in 9-1-1 environments, and how they are created or maintained.

Type of Boundary	Use	Creation and Maintenance
Administrative Boundary	Boundaries set for legal purposes, such as boundaries between localities and states. These are often used for taxing and voting purposes, as well as law enforcement and emergency response jurisdictions.	Once set, these boundaries rarely change in the Commonwealth of Virginia. Annexations of unincorporated areas into towns are an example. Sometimes the boundaries are refined, which is a legislative process.
PSAP Boundary	Operational boundaries that determine what 9-1-1 calls are routed to a PSAP to be answered in an NG9-1-1 i3 environment. PSAP boundaries answer the question “who gets the 9-1-1 call.” Boundaries cannot have gaps or overlap, as these would result in a 9-1-1 call not being routed most efficiently.	Boundary segments are mutually agreed to by PSAPs on both sides of the segment. Initially created during NG9-1-1 GIS data preparation, they may be reviewed and modified, especially in cases of development or land use change. Segments are submitted to VGIN, who creates and makes available state polygon layers. This way, localities can use features edge-matched to their neighbors when preparing their data.
Provisioning Boundary (Sometimes called the Authoritative Boundary)	Boundaries that identify the area of responsibility for a GIS data provider for a NG9-1-1 system. NG9-1-1 needs all features in the required GIS layers submitted once and only once with no gaps, overlaps, or duplicates.	Boundary segments are created, usually from administrative boundaries, PSAP boundaries, or parcels during NG9-1-1 preparation. Segments are submitted to VGIN, who creates and makes available state polygon layers. This way, localities can use polygons edge-matched to their neighbors when uploading their data. Unlike PSAP and response boundaries, provisioning boundaries are more

		complicated to change. The goal is to change provisioning boundaries as little as possible once the data starts populating the production NG9-1-1 system. If PSAP boundaries are not identical to provisioning boundaries, you will have to work with your neighbors to ensure that all of the data that both of you need for NG9-1-1 is sent to the ESInet.
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Type of Boundary	Use	Creation and Maintenance
Emergency Service Number (ESN) Boundary and Emergency Service Zone (ESZ)	In current 9-1-1 systems, ESNs are alphanumeric text that represent a unique ESZ. ESZs model the combination of responding agencies dispatched by a PSAP. ESZs may be very general or very granular. Information from ESZs will be used during the transition to NG9-1-1, but the zone layer is not supplied to a Next Generation Core Services (NGCS).	ESZs are created within PSAPs to facilitate response and may change as law, fire, or emergency medical service (EMS) agencies change their areas of response. ESZs are usually a combined form of dispatch areas and run boxes that lie within PSAP boundaries.
Emergency Service Boundaries (ESB) for Law, Fire, and EMS	NG9-1-1 requires separate ESB layers to show the agency with the primary responsibility for each type of emergency response, but can be more detailed. In NG9-1-1, the information is used beyond a PSAP for call transfers and documentation.	ESBs are created for each type during NG9-1-1 preparation. They may be more generalized than ESZs or may be as specific as your ESNs. They may change as responders change their areas of response. ESBs generally snap to ESN boundaries. The "Display Name" will appear in an i3 PSAP's call handling equipment (CHE) screens.

1.1 NG9-1-1 PSAP and Provisioning Boundary Agreement

PSAP and provisioning boundaries must be agreed to with the adjoining neighbor. Documentation of agreement and confirmation of the geometry of the line must be sent to

NG911GIS@vdem.virginia.gov. This is important as the ESInet is a shared system and the geometries of the provisioning boundary you upload must match what your neighbor uploads.

Most localities find it easiest to use the same geometry for the provisioning boundary and the PSAP boundary.

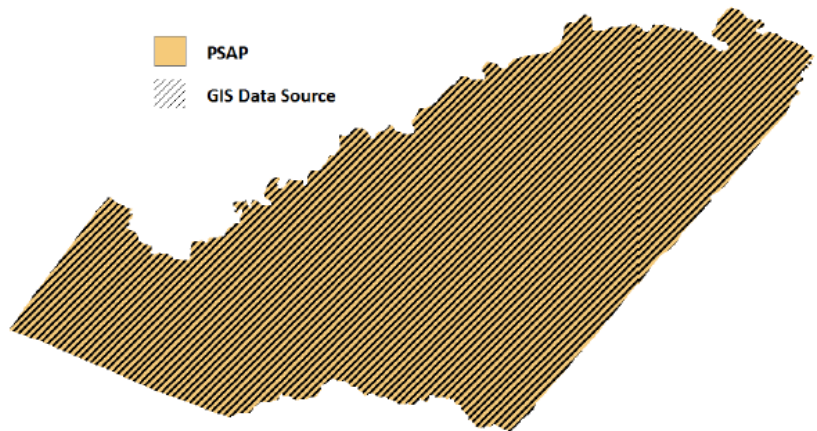
1.2 PSAP and Provisioning Boundary Combinations

The [Virginia NG9-1-1 GIS Data Provisioning and Maintenance](#)

document discusses three scenarios in how these types of boundaries relate to each other:

One PSAP to One GIS

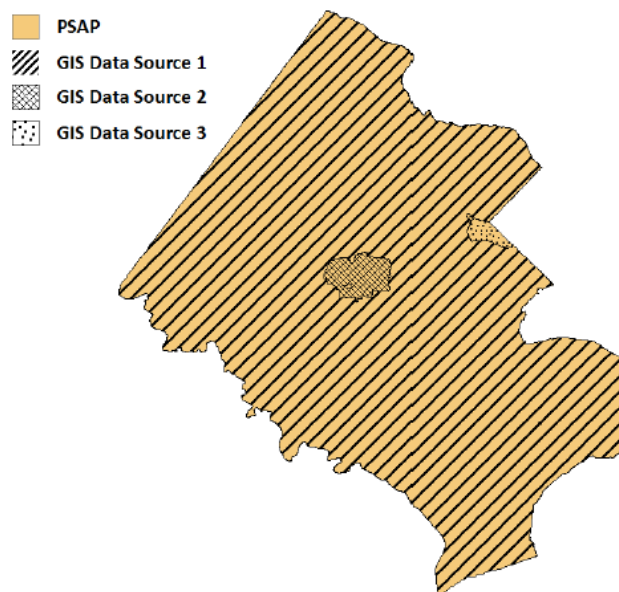
PSAP service area is equivalent to a single GIS data boundary; a single GIS data boundary is equivalent to a single PSAP service area.



One PSAP to Many GIS

PSAP service area is equivalent to multiple GIS data boundaries; a GIS data boundary is equivalent to part but not all of a PSAP service area.

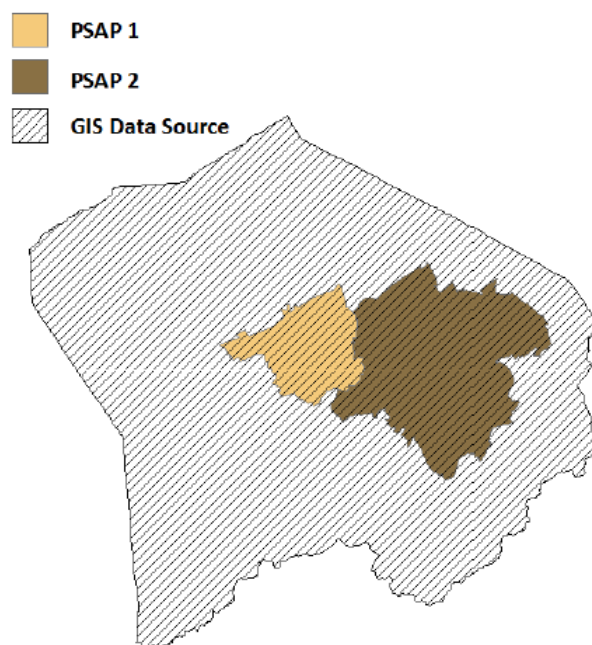
Regional ECCs and PSAPs are possible examples.



Many PSAPs to One GIS

PSAP service area is equivalent to part but not all of a GIS data boundary; a GIS data boundary is equivalent to multiple PSAP service areas.

Regional GIS projects with one GIS provider are an example.



In cases other than One PSAP to One GIS, PSAPs and GIS data providers will need to coordinate and plan data provisioning to NG9-1-1 systems to support and coincide with multiple PSAP deployments.

1.3 Parks, Bases, and Other Government Facilities

Many localities across Virginia have federal or state properties such as forests, parks, or defense facilities. PSAPs usually have an understanding with these stakeholders in how their 9-1-1 calls are handled. Wireless calls in particular usually go directly to a locality PSAP. Beyond call delivery, there may be existing call handling protocols or response agreements in place.

As you consider your NG9-1-1 deployment, reach out to these stakeholders to discuss your transition and how it affects them. Some stakeholders may be planning their own NG9-1-1 deployment, but these will usually be in a much later timeline. As such, Virginia PSAPs should plan to cover them with their PSAP boundaries. Changes can be made if these stakeholders become 9-1-1 PSAPs and migrate to an ESInet at a later date.

For a PSAP boundary to be loaded to the ESInet, it must fall completely within a provisioning boundary. From the government facility perspective, this may mean that they share GIS data with their neighboring locality so it is loaded as part of a single provisioning boundary. Thus, the One

PSAP to One GIS scenario is met by exchanging data ahead of time. Fort Lee, for example, has an agreement with Prince George County relating to 9-1-1 service and exchange of GIS data.

A government facility may decide to provision its own data. In this case, they would need to go through the same Intrado onboarding process to load their address points and road centerlines. If they do not have a ready-to-go 9-1-1 PSAP, the PSAP boundary would direct to the locality that serves them. This is an example of the One PSAP to Many GIS scenario. A variant of this would be if the facility was served by multiple locality PSAPs.

Given the wide variety of stakeholders in the commonwealth and the diversity of existing arrangements, future plans, and timelines, localities should reach out to these NG9-1-1 stakeholders and agree on a course of action.

1.4 NG9-1-1 Provisioning Boundary Validation

The provisioning boundary defines the area of GIS data ownership and provisioning responsibility for a given 9-1-1 jurisdiction. This allows 9-1-1 authorities to provide GIS data and make changes to the data only within their established area of responsibility. A provisioning boundary polygon must be provided with each agency's GIS data. The provisioning boundary serves as the basis for all future spatial data validations for roads, address points, and other boundary layers. Typically, once established, this boundary should be relatively stable, in that only annexations or other jurisdictional boundary changes would impact the boundary.

In general, 9-1-1 agencies or their local government are usually responsible for maintaining all GIS layers (responder boundaries, road centerlines and address points) within their region, but there may be some cases where multiple agencies maintain GIS layers for a given region. Those cases are treated as a special case. Staff at the 9-1-1 agency, or elsewhere in local government, or a vendor working on behalf of the agency or locality may fulfill the role of "provisioning" data within this footprint.

Generally, a single provisioning boundary should be created and maintained for every 9-1-1 GIS data maintaining authority. This polygon should represent the outermost boundary of the given agency's area for which they are responsible for the GIS data maintenance for 9-1-1 purposes. The area of the provisioning boundary must be completely covered by the features in the PSAP and law, fire, and EMS emergency service boundary layers so that there are no gaps in coverage within the provisioning boundary. Also, emergency responder/PSAP boundary polygon layers should not contain gaps or overlaps within each layer independently.

You can only upload features that fall inside your provisioning boundary. If you have a street segment or address point that falls outside your provisioning boundary, you will need to work with your neighbor whose provisioning boundary covers that area to make sure that data is sent to the ESInet.

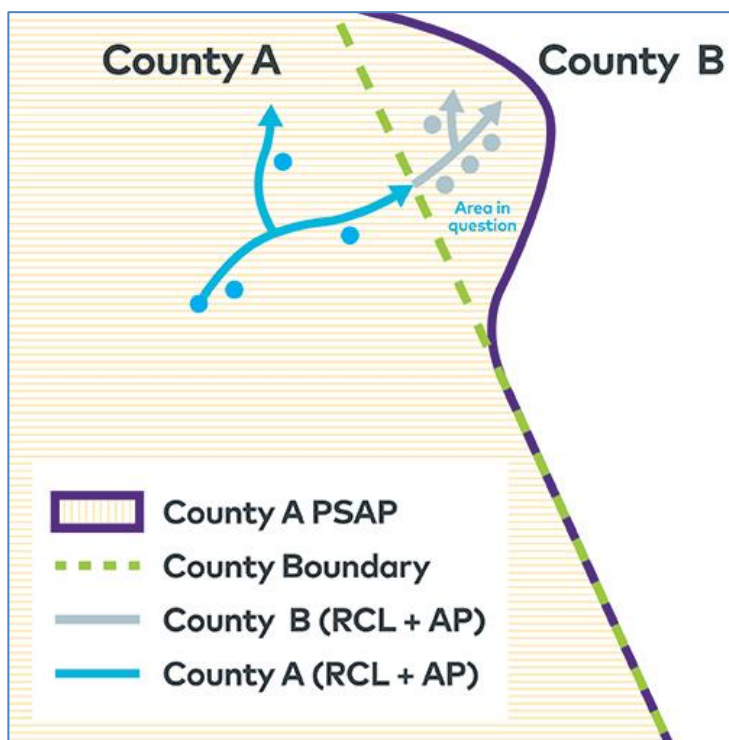
If the provisioning boundary matches the PSAP boundary, we would expect that there would be one polygon in each, and all of the primary response agencies would be located within the locality. If the provisioning boundary is different from the PSAP boundary, we would expect that there would be PSAP and emergency service boundary features from your neighbors.

Provisioning boundaries must also be seamless (contains no gaps or overlaps) when uploaded into the system and validated against neighboring agencies. The validation system has a first in-first-served concept, in that any existing, validated production data will be considered accurate until a discrepancy has been found, at which time the agencies in question must work together to determine the resolution for the discrepancy. Therefore, NGS and Intrado highly recommended to work with neighbor agencies **prior** to submitting data to the system, so that provisioning boundaries pass the initial validation checks and data that moves to production stays in production. See 2.3 Loading Data into NG9-1-1 for more information.

1.5 Considerations when the PSAP Boundary and 9-1-1 Addressing Responsibility Coverage Area Differs

There are some cases where localities may decide to have provisioning and PSAP boundaries that are not coincident. In these cases, localities will be dependent on each other to upload data (e.g., PSAP boundary, address points, road centerlines) that others require. Once the data is in the ESInet, anyone on the ESInet benefits from it. Timing is a consideration in these situations. Because a locality may load their data into the Spatial Interface, ensure it is error free, and have it populated into the Emergency Call Routing Function (ECRF) *without* their own PSAP going live, a neighboring PSAP going live would be able to use the first locality's data.

For this example, two neighboring counties, County A and County B, are both converting to geospatial routing on the ESInet. County A is cutting over to the ESInet ahead of County B. For this particular area of interest, County B is responsible for the 9-1-1 addressing (roads and address points) but calls route to and are dispatched by County A due to access considerations.



Below are the recommended options.

Scenario 1: If GIS data is error free, complete, and ready for geospatial call routing and Intrado's production emergency call routing function (ECRF) for both counties:

Option 1) County B submits the roads, address points and responder boundaries within their provisioning boundary which matches the county boundary, and includes a portion of County A's PSAP/responder layers.

Option 2) County B sends GIS data (roads and address points) to County A for provisioning. County A adjusts their Provisioning boundary to extend into County B, and submits all data to ESInet. County B adjusts the provisioning boundary to match County A's. Any future changes to County B's roads and address points within the area in question would need to be sent to County A for provisioning to ESInet.

Scenario 2: If GIS data is NOT ready for provisioning to the ECRF for County B:

As a temporary but mandatory solution, County A must include the area in question (the area within County B that is covered by County A's PSAP boundary), and must include all layers.

When County B's data is complete and is ready to provision to the ECRF, and assuming that County B wants to retain control of GIS data provisioning (resulting in Option 1 above) then County A and County B would coordinate an adjustment to the provisioning boundaries such that County A would no longer submit the region within County B, and the data would be submitted as described in Option 1 above moving forward.

Such coordination involves multiple stakeholders.

If County B does not wish to maintain control of GIS data provisioning in this area (resulting in Option 2 above) then there would be no change to County A's provisioning boundary and County B would match the provisioning boundary. Any future changes to roads and address points in this area would need to be sent to County A for provisioning to ESInet.

1.6 Call Routing Scenarios Based on GIS and PSAP Readiness

For PSAPs on the AT&T ESInet solution, there are three phases possible for landline call routing depending on the operational readiness of the GIS data and the PSAP:

Phase 1 - Pre-GIS readiness: occurs when the GIS data is not yet finalized and loaded into the system. During this phase, calls will ESN route based off the incoming ANI of the call.

Phase 2 – Post GIS readiness/Pre Migration: occurs once GIS data is ready and provisioned to the ECRF, geocoding has occurred and therefore the X,Y will be found in the system, but the designated PSAP has not been cutover and fully configured as live for geospatial routing. In this phase, the call will use the fallback to ESN route based off the incoming ANI of the call.

Phase 3 – GIS Ready/PSAP Deployed: occurs once the PSAP is fully migrated to the ESInet and geospatial routing is enabled. In this phase, the X,Y will plot within a PSAP boundary for a specific PSAP, and that PSAP will have been configured as a live PSAP, so the call will route to that Primary i3 PSAP identified by the GIS.

1.7 Call Routing Scenarios Based on Different PSAP and Provisioning Boundaries and PSAP Deployment

There will be situations where County A and County B decide to provision data as discussed in Scenario 1 Option 1 in 1.5 on page 7. This arrangement works well as long as the GIS data for County A and County B is ready by the time the first neighbor needs it. Situations may arise where County A or County B is ready to go live, but the GIS data for the other county is not quite ready yet, or the other PSAP is not ready to go live with i3 NG9-1-1. While these situations may happen, everyone benefits if the time spent in these situations is kept to a minimum. Calls will still be routed correctly in these situations. Given that County B submits the roads, address points and responder boundaries within their provisioning boundary which matches the county boundary, and includes a portion of County A's PSAP/responder layers.

Scenario 1: County B has its GIS data ready and will deploy. County A is not ready to deploy. Wireline calls associated with the gray addresses will be geospatially identified as needing to go to the County A PSAP. The NG9-1-1 system cannot deliver these calls as i3 calls to the County A PSAP

because it is not live yet, so it will deliver the calls to the County A PSAP using another method. Not all of the i3 information may pass with the call.

Scenario 2: County A has its GIS data ready and will deploy. County B does not have its GIS data ready. If the gray addresses are in County B's MSAG and ALI, wireline calls will be sent to County B. If the gray addresses are in County A's MSAG and ALI, they will be sent to County A based on ESN routing.

In both examples, wireless calls will continue to route based on "cell sector/tower routing" until the wireless carrier starts sending i3 and location information with the call as it is placed.

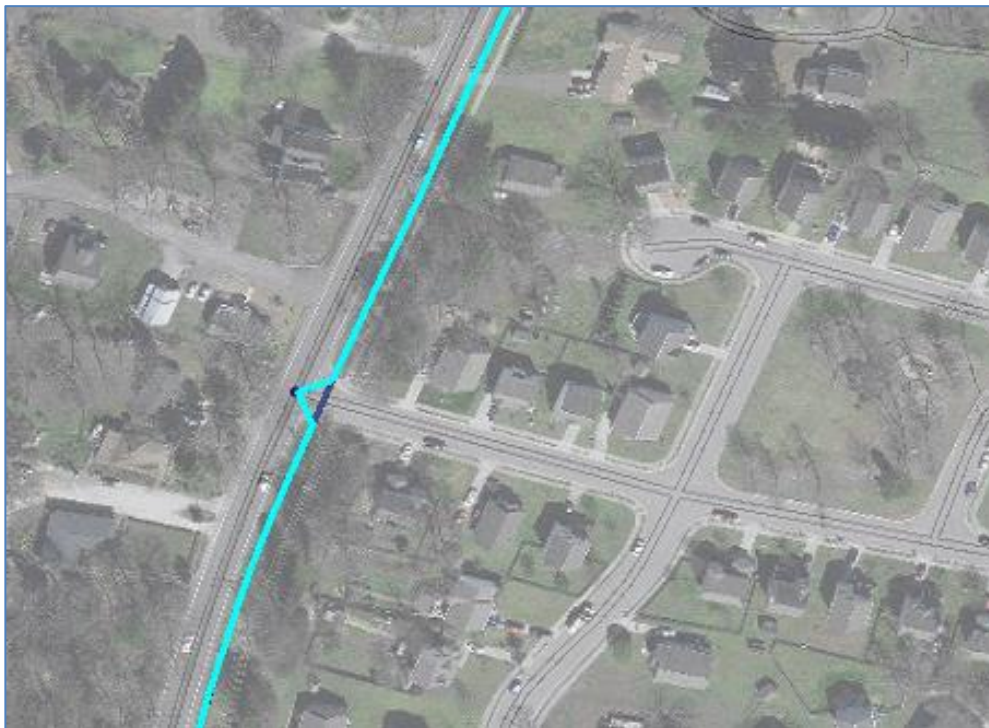
1.8 Address Point Maintenance along Provisioning Boundaries

It is strongly recommended to maintain accurate and complete address points along borders as address points are generally more accurate than relying on road centerlines for location validation and call routing purposes. Road centerlines along provisioning boundaries create additional maintenance challenges compared to address points.

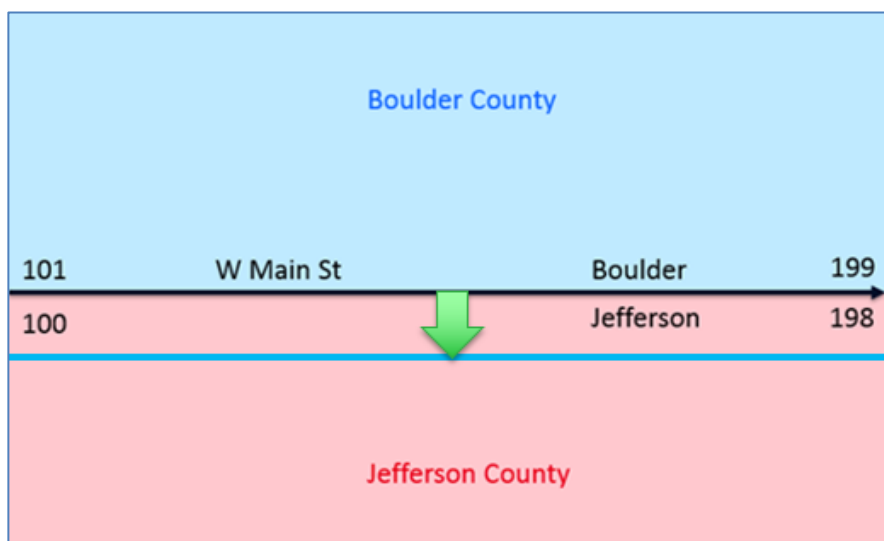
1.9 Road Centerline Maintenance along Provisioning Boundaries

All road centerline segments must fall completely within their respective provisioning boundary polygon, or they will be considered errors. As you work on your provisioning boundaries, most localities follow these recommendations.

- Use road centerline snap points based on X, Y values snapped to the provisioning boundary to manage road segments that extend into another provisioning polygon. Snap points are point features on provisioning boundaries that localities use to determine where responsibility transitions from one to the other and ensure that the road segments connect when uploaded from different sources.
- Have provisioning boundaries cross roads through intersections using existing road centerline nodes. This avoids creating new small road segments for the purpose of provisioning data.

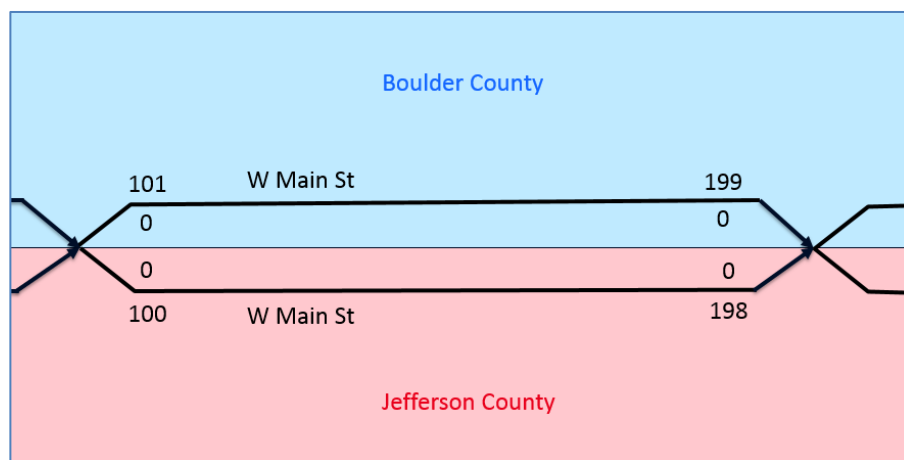


For road centerlines that run along or are coincident to administrative boundaries, agree with your neighbor to offset the provisioning boundary to one side of the pavement edge or ditch or the other. The locality that will provision GIS data to the ESInet first based on the overall NG9-1-1 deployment schedule should usually send the road.



Another option for road centerlines coincident with administrative boundaries, particularly where the road names are different, is to model the road as a dual carriageway as you would a divided highway. This method allows each locality to send a road segment with the names and attributes they need with the provisioning boundary running in between. Address ranges on the provision boundary side of each line should zero out. A geocoder will work properly with this scenario in identifying the correct PSAP and emergency responder polygons. If desired, a separate data set

showing a single line segment could be maintained for PSAP map display purposes. Modeling roads in this way is recommended if the single road segment has different names on either side of the road. The example below shows the scenario where W Main St is known as Broadway in Boulder County and Main St [no directional] in Jefferson County.



If you elect the option, you may still need a single lane feature in your local data to support other needs in local government. We recommend adding a field to your data that you can attribute each road segments as:

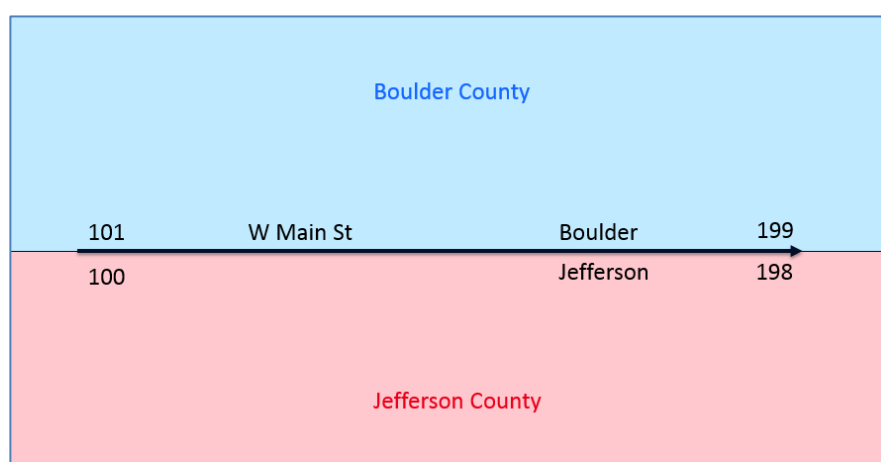
Code	Use
0	Primary Representation
1	Single Lane Representation
2	Dual Carriageway Representation

While a city street map may use a definition query of codes 0 and 1, extracting your data for NG9-1-1 where you want to use the dual carriageway representation would query codes 0 and 2.

There may be some circumstances where these recommendations cannot be followed and the provisioning boundary must be coincident to a road centerline. In such cases, the two localities should decide which will send the road. Roads should not be duplicated. For the locality that sends them, the road will initially return as an errors because they technically fall within two boundaries. If the offset or dual carriageway method discussed above is not possible, the submitting locality must

mark the segments as exceptions to pass spatial validations. In order to make these exceptions, an exception field must be in the uploaded data schema, attributed with the exception code "OAB", and field mapped to the appropriate field in loading data into Intrado's system. "OAB" stands for "Outside Authoritative Boundary." "Authoritative Boundary" is the older term for "provisioning boundary." See the EGDMS user guide for more information on exception code usage.

In the example image below a single road forms the border between the 2 counties, but this would introduce spatial validation errors because the road is not contained completely within the provisioning boundary and possibly cause segment ownership/duplication issues between the 2 agencies if each data source sent the same segment. In the below case, the road centerline segments should only be marked as exceptions after the agency has confirmed the road is not duplicated or conflicting with the neighbor agency.



Before pursuing this option, it is recommended that you discuss with your Intrado i3 GIS Coach.

1.10 Geometry Tools while Drafting NG9-1-1 Boundaries

Desktop GIS software packages have many tools to create and reshape line and polygon features. Some advanced tools create curves based on arcs or ellipses, such as Bezier curves. It is important to note that any features containing these elements will be transformed into simple line and polygon features when they are uploaded to Intrado's NG9-1-1 system. These transformations are automated, it is not always certain how they affect your data.

If you know your data includes these elements, be aware that the data validation stage of the GIS Project with Intrado may take more time. It is also recommended to not intentionally introduce these features into data used for NG9-1-1 purposes.