

Chapter 4 - Freight Network Condition and Performance

KEY POINTS

- While Missouri has improved the freight system in recent years, aging infrastructure is affecting all freight modes.
- Funding for maintenance and improvements is an on-going concern.
- The condition and performance of various components of the existing freight network provides important data to assess the current and future needs of the system and prioritize future investments.

Introduction

In recent years, Missouri has made improvements to the freight system, and these improvements have enhanced freight network condition and performance. However, aging infrastructure is affecting all of the freight modes and funding for maintenance and improvements will continue to be a concern. Accurately identifying the Missouri Freight Network's current condition and performance helps assess the need for improvements to the freight system.

Performance measures are used across the transportation industry to evaluate transportation systems and agencies. The Missouri Department of Transportation's (MoDOT's) rich history in performance measurement and management is best exemplified by Tracker, MoDOT's quarterly performance measure publication. Tracker, mode-specific measures, and national performance measures were used to help develop this Missouri State Freight Plan.

Highway

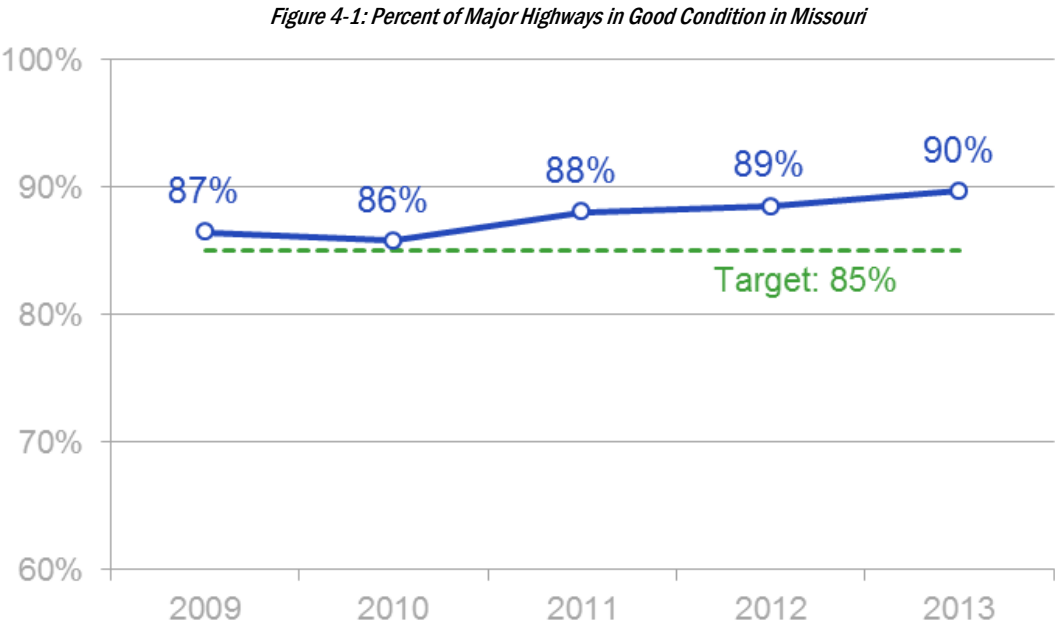
Missouri has the seventh largest state highway system in the United States. It is made up of approximately 33,700 centerline miles of roadway, 5,500 miles of which are classified as heavily traveled "major highways" and 28,200 miles of which are defined as lesser traveled "minor highways." Missouri's major highways include just 20 percent of the State highway miles, but carry 80 percent of the State

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highway traffic. The more than 10,000 bridges that cross rivers, other highways, and valleys are also important elements of the highway system.

Highway and Bridge Condition and Performance

The major highways include busy routes in urban areas, particularly where vehicles travel between business districts and residential areas. Overall, most major highways in Missouri are in good condition, as shown in **Figure 4-1**. MoDOT has established a target rate of greater than 85 percent for this measure, which has been exceeded each year for the past five years.



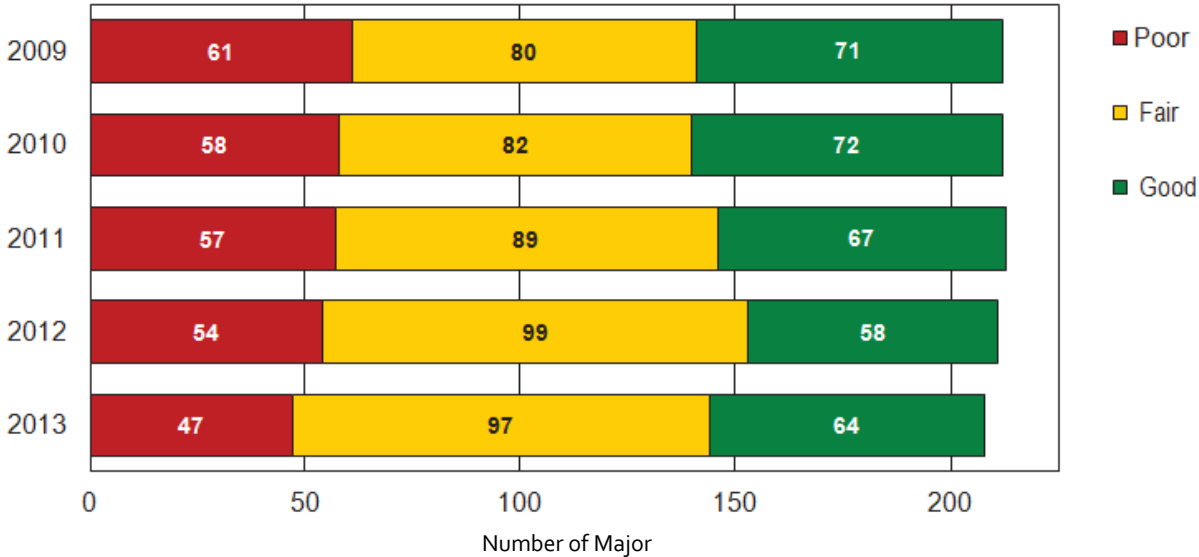
Source: MoDOT Tracker, July 2014 edition

Missouri has 208 major bridges that cross large rivers and lakes and are longer than 1,000 feet. These bridges can be classified as in good, fair, or poor condition. Significant investment in Missouri’s major bridges resulted in a decreased number of structures falling into the poor category, but the number of structures classified in the good category also decreased.

Major bridges are very expensive to rehabilitate and replace. A simple rehabilitation typically costs over \$10 million, while major bridge replacements can exceed hundreds of millions of dollars. The 2013 Missouri major bridge conditions are shown in **Figure 4-2**.

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Figure 4-2: Condition of Major Bridges in Missouri (208 Total Bridges)



Source: MoDOT Tracker, July 2014 edition

MoDOT tracks the percentage of structurally deficient deck area for bridges that are part of the National Highway System (NHS). The *Fixing America’s Surface Transportation (FAST) Act* requires that states track this measure, with a target of less than 10 percent. Missouri is meeting this target with only 7.0 percent of structurally deficient deck areas on NHS bridges.

Structurally deficient means there is a need for significant maintenance, rehabilitation, or replacement.

Low vertical clearances at overpasses can restrict truck traffic on highways. There are 73 low vertical clearance bridges in Missouri. This is less than one percent of all bridges in the State. None of these low clearance bridges cross interstates, but four (5 percent) of these bridges cross U.S. highways in Missouri.



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Low clearance bridges have a height restriction less than the standard 16 feet, 6 inches. In Missouri, the minimum clearance is 14 feet.

In addition to the 73 low clearance bridges, 4,849 load-restricted bridges can restrict truck traffic on highways in Missouri. These load-restricted bridges are about 20 percent of all bridges in the State. A total of 135 (three percent) of these bridges cross interstates, and 81 (2 percent) cross U.S. highways. A total of 44 of these load-restricted bridges are also low clearance bridges.

Load restriction means the bridge is only capable of safely supporting loads less than the posted or standard load weight of 80,000 pounds maximum.

Truck Bottlenecks

ATRI's (American Transportation Research Institute) Freight Performance Measures (FPM) database compiles anonymous trucking operations data from several hundred thousand trucks using Global Positioning System (GPS) data from onboard trucking systems, generating billions of data points annually. The truck GPS data gives an average speed and numerous position counts for every hour of the day based on where the trucks traveled across the 3,311 road segments in Missouri.

Peak travel times occur in the morning, midday, and evening.

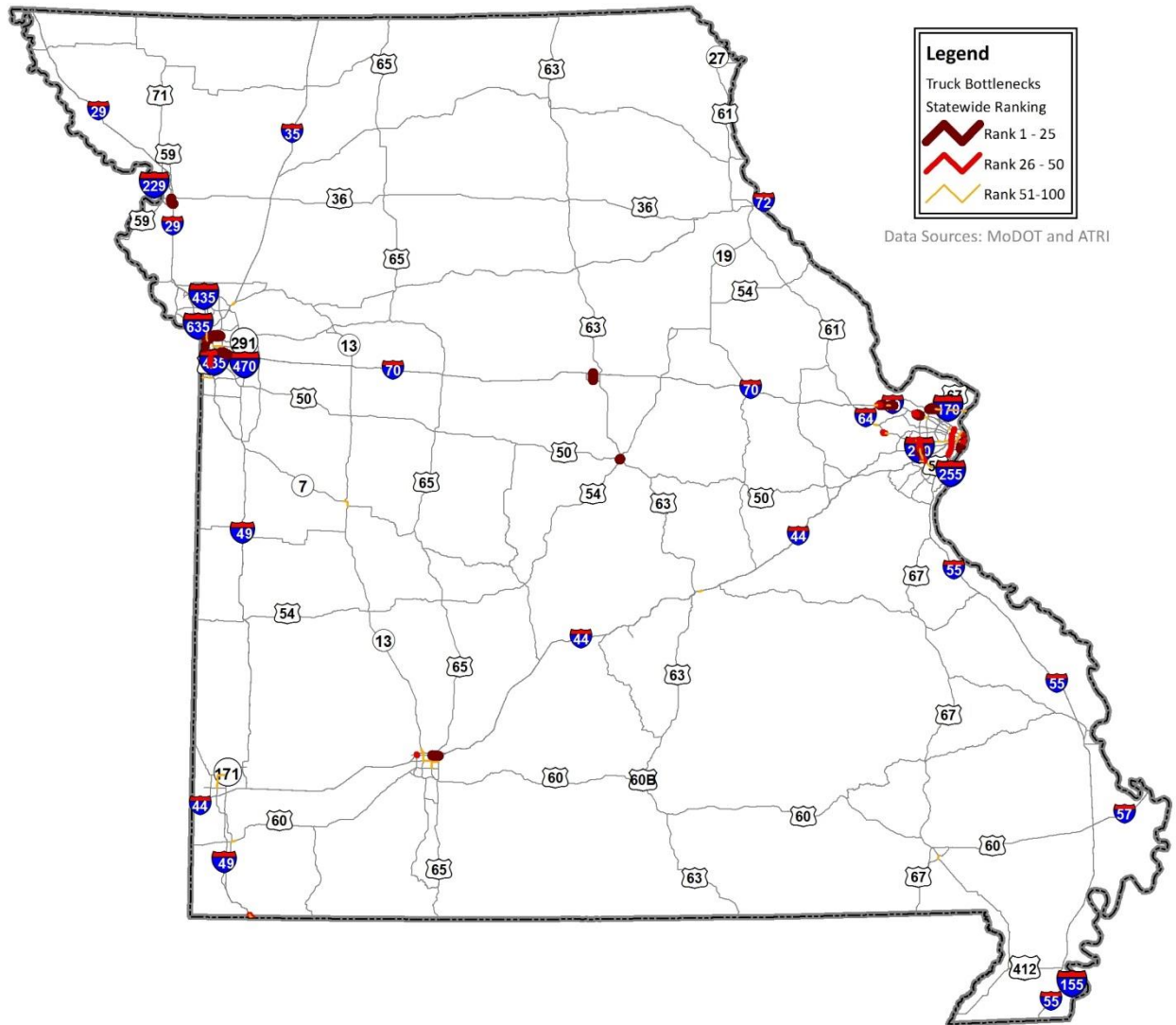
Using the ATRI data, the truck travel times per mile were calculated for these three periods and were then added together to calculate a total congestion index. Highway segments with highest total congestion indices reflect the most congested trucking bottlenecks in Missouri.

The 100 segments with the highest total congestion indices were selected for further analysis. St. Louis and Kansas City contained 81 out of the State's 100 most congested truck bottlenecks; however, Springfield also contained several bottlenecks. The remaining bottlenecks were dispersed throughout cities and towns across the State. The 100 most congested trucking bottlenecks are shown on **Figure 4-3**. Further trucking bottleneck details are in Appendix A.

A bottleneck is a section of road where movement of traffic is limited by the road design. This is often a section of road with a fewer number of lanes, a sharp curve, or access points where traffic is entering or exiting the road. A bottleneck is the most vulnerable point for congestion in a road network and is also referred to as a chokepoint.

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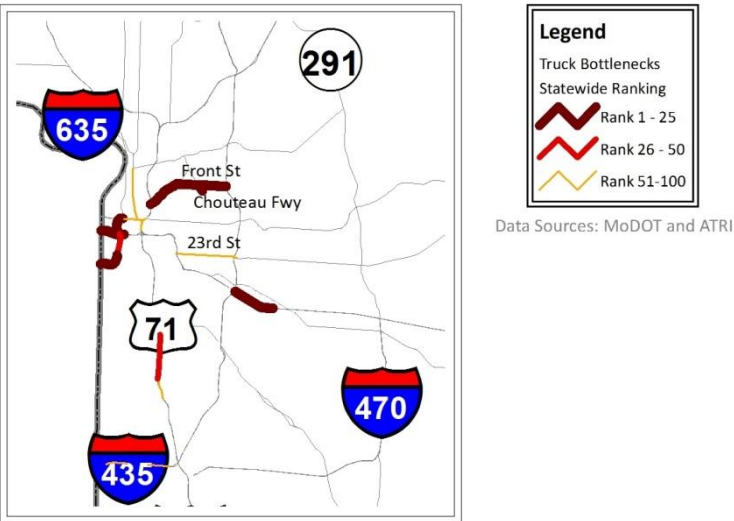
Figure 4-3: 100 Most Congested Trucking Bottlenecks in Missouri



Source: CDM Smith, ATRI, ESRI

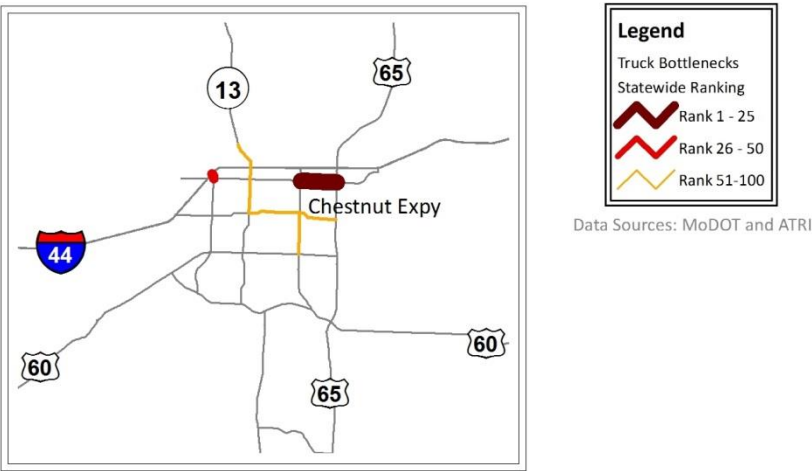
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Figure 4-3, a: Most Congested Trucking Bottlenecks in Kansas City



Source: CDM Smith, ATRI, ESRI

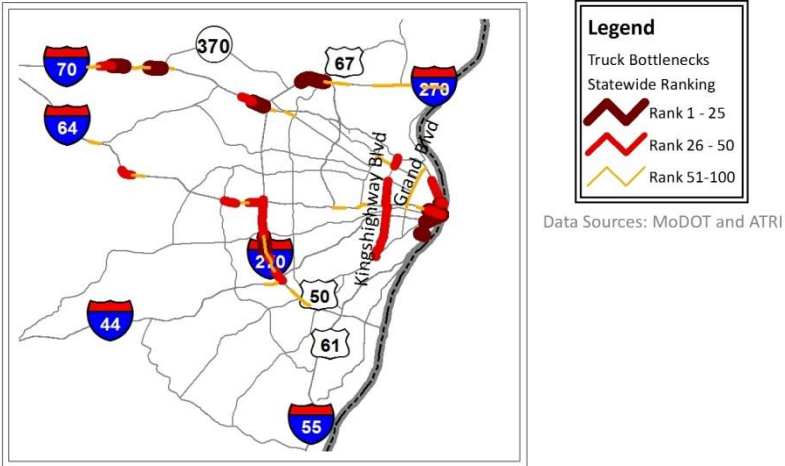
Figure 4-3, b: Most Congested Trucking Bottlenecks in Springfield



Source: CDM Smith, ATRI, ESRI

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Figure 4-3, c: Most Congested Trucking Bottlenecks in St. Louis



Source: CDM Smith, ATRI, ESRI

Highway Safety

A three-year crash rate (2010-2012) was calculated for highway segments proposed for the Missouri Freight Network. Crash rates were calculated for both directions for each highway segment. The three highway segments with the largest Commercial Motor Vehicle (CMV) crash rates are shown in **Table 4-1**.

Table 4-1: Highway Segments with the Largest Commercial Motor Vehicle Crash Rates in Missouri

Interstate Segment	Direction	To	From
I-55	North	I-44	I-70
I-55	South	I-70	I-44
I-29	South	I-435 (north)	I-35 split

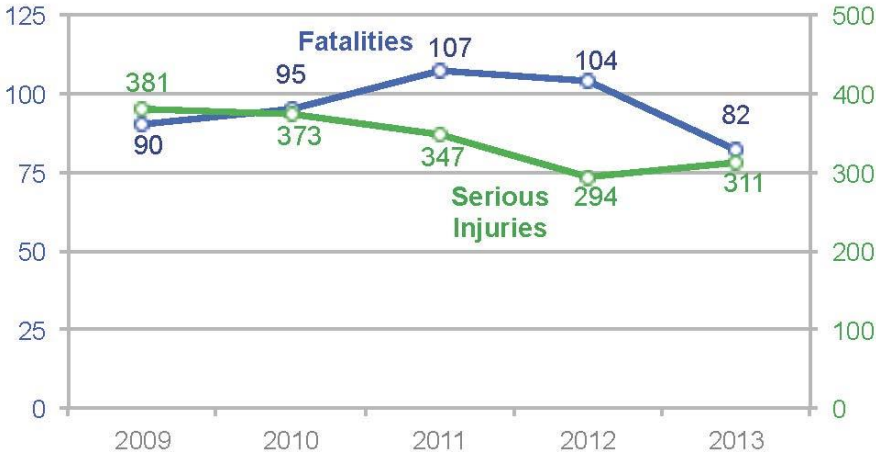
US/MO Route Segment	Direction	To	From
MO 13	South	I-44	US 60
MO 210	East	I-435	MO 291
MO 13	North	US 60	I-44

Source: CDM Smith, 2010-2012

The number of commercial vehicle crashes that resulted in fatalities and serious injuries during the 2009-2013 time period is shown in **Figure 4-4**. MoDOT uses this information to target educational, enforcement, and safety improvement features. Both the rates of fatalities and serious injuries decreased between 2009 and 2013.

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Figure 4-4: Number of Commercial Vehicle Crashes Resulting in Fatalities and Serious Injuries in Missouri



Source: MoDOT Tracker, July 2014 edition

Truck Freight Performance

In 2011, the Missouri highway freight system supported over 40.6 million truck trips carrying more than 500.4 million tons valued at \$710.9 billion. The top five truck commodities by tonnage, units, value, and growth are provided in Appendix A. In addition, Chapter 6 of this plan highlights the truck hours of delay and reliability index on key Missouri interstates.

Freight Generators

ATRI’s Freight Performance Measures (FPM) database was also used to identify where most freight activity occurs in Missouri. A detailed analysis of this data identified the 100 most intense freight generators in Missouri. The analysis found that the majority of key freight generators were located along major roadways. Furthermore, urban areas such as St. Louis and Kansas City contained the greatest share of freight generators, although several other notable freight-generating locations were identified throughout the State. The top 100 freight generators are shown in **Figure 3-9** in Chapter 3.

Rail

The State of Missouri has significant freight rail infrastructure with six Class I freight railroads currently in operation of 4,218 miles of main track rail lines, 2,500 rail yard track miles, and approximately 5,697 public and private rail-highway crossings within the State. There are no Class II railroads operating in Missouri; however, five short line railroads serve Missouri. These short line systems include 426 track



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miles, ranging from 33 to 331 track miles per operator. **Figure 3-3** in Chapter 3 displays the rail lines and ownership in Missouri.

Rail Condition and Performance

Railroads are categorized as Class I, II, or III depending on operating revenues. In 2012 dollars, a railroad with operating revenues greater than \$433.2¹ million for at least three consecutive years is a Class I railroad. A railroad with revenues greater than \$34.7 million but less than \$433.2 million is a Class II railroad, commonly referred to as a “regional” railroad. A railroad not within the Class I or II categories is considered a Class III railroad, also known as a “short line.”

Railroads provide important connections to water ports and intermodal terminals. In Missouri, there are five Missouri water ports that have direct rail access and eight National Highway System Designated (NHS) Truck/Rail Intermodal Facilities in Missouri.

The National Rail Freight Infrastructure Capacity and Investment Study, prepared by the Association of American Railroads (AAR), developed a methodology for determining the level of service (LOS) for a specific freight rail corridor. The basis for determining the level of congestion on a rail corridor is a calculated volume-to-capacity (V/C) ratio. For Missouri, rail capacity assessments considered three factors: ratio of the number daily trains to the number of tracks, train control system, and train type. See **Figure 4-5**.

Level of service (LOS) is a measure by which transportation planners determine the quality of service on a given facility. The transportation LOS system uses the letters A through F, with A being uncongested and F being extremely congested.

The 2012 Missouri State Rail Plan provides LOS based on rail line V/C ratios for railroads operating in Missouri.² Some of this LOS data may have changed since 2012 due to changes in the economy and demand of specific goods. Regardless, it appears that some rail lines will be reaching or exceeding capacity. The rail lines that should be monitored for potential capacity concerns are:

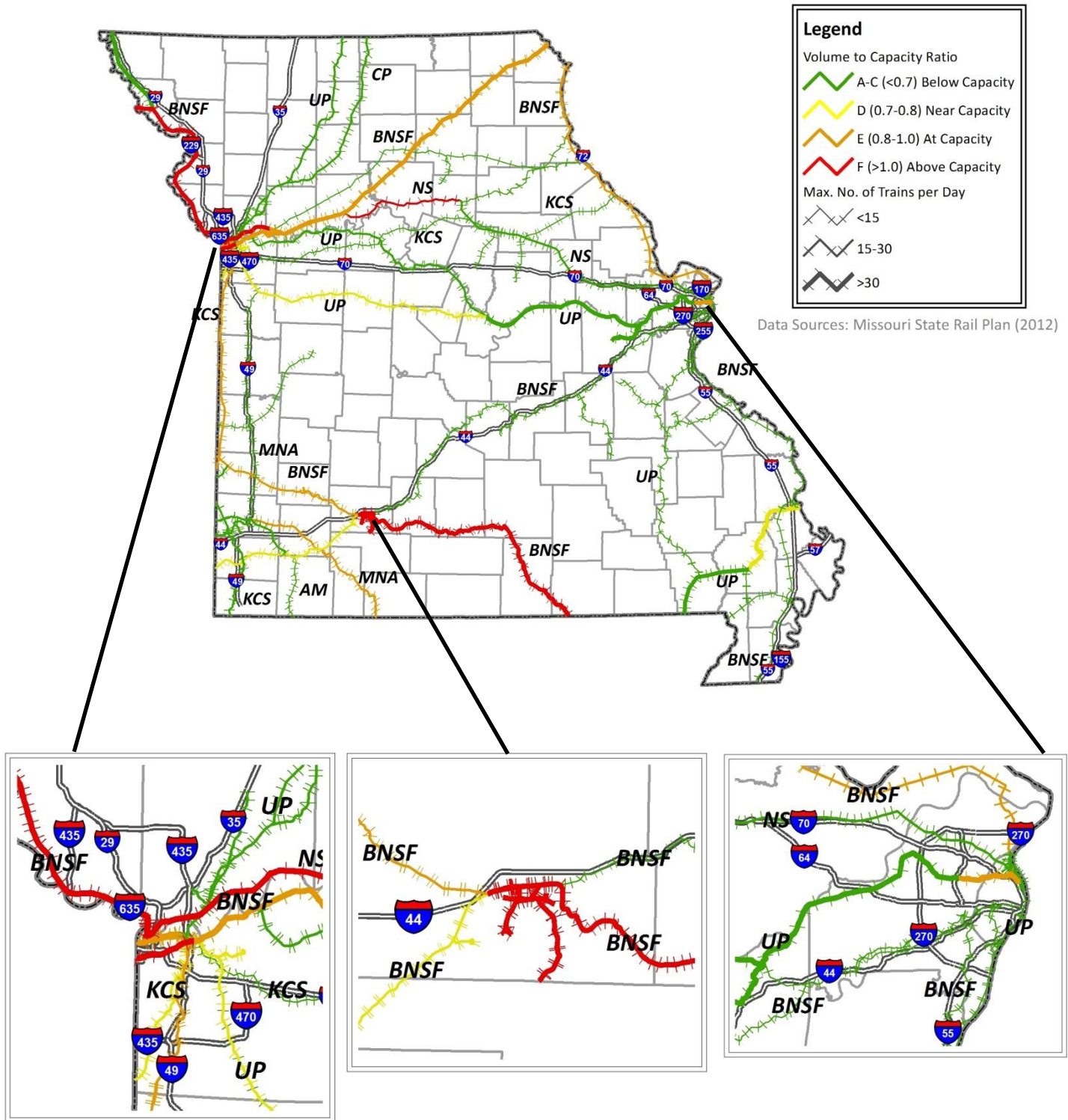
- BNSF –Thayer North Sub (from Springfield to Arkansas state line to south)
- BNSF – St. Joseph Sub (from Kansas City to Nebraska state line to northwest)
- UP – Chester Sub (from Dexter to Illinois state line to east)
- UP – Hoxie Sub (from Dexter to Arkansas state line to south)
- UP – Sedalia Sub (from Jefferson City to Kansas City)
- NS – Kansas City District (from Moberly to Kansas City)
- KCT – Kansas City (from I-435 to Kansas state line to west)

¹ http://www.aslrra.org/about_aslrra/faqs/

² Missouri State Rail Plan, MoDOT, 2012

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Figure 4-5: Rail Corridor Volume Capacity

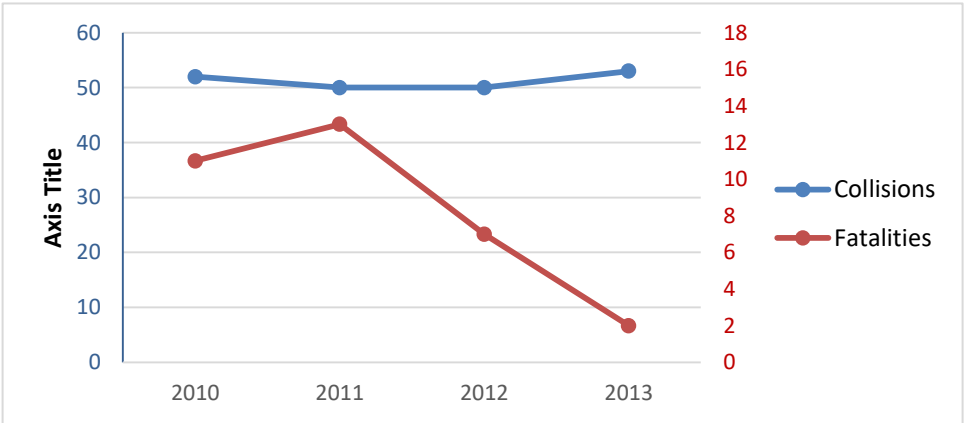


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Rail Safety

The number of train-vehicle collisions and fatalities at public railroad crossings in Missouri are shown in **Figure 4-6**. This data drives the development and focus of a portion of the Missouri Highway Safety Plan. Although the number of collisions has remained relatively constant, the number of fatalities dropped between 2011 and 2013.

Figure 4-6: Number of Highway-Rail Crossing Collisions and Fatalities in Missouri



Source: <http://safetydata.fra.dot.gov/OfficeofSafety/publicsite/>

Rail Freight

With the given condition and performance of the rail system in Missouri, 8.2 million rail cars carried 458.1 million tons of freight valued at \$465.0 billion in 2011. Freight transport through the Missouri rail network increased most on the BNSF line connecting Kansas City and Chicago. The top five rail commodities by tonnage, units, value, and growth are provided in Appendix A.

Waterway

The State of Missouri contains 1,050 miles of navigable rivers, including 500 miles of the Mississippi River and 550 miles of the Missouri River. A total of 14 public port authorities and more than 200 private ports can be found along Missouri’s waterways. Three public port authorities and more than 50 private ports operate along the Missouri River; 11 public port authorities and more than 150 private ports operate on the Mississippi River.

Waterway Condition and Performance

The lock and dam system, under the jurisdiction of the U.S. Army Corps of Engineers, was designed to control the river levels to maintain a minimum nine-foot deep channel on the Upper Mississippi River for more reliable navigation. The majority of the locks and dams were constructed in the 1930s and are aging. The locks and dams are in need of major rehabilitation or replacement, which is an expensive undertaking. Replacement may be the most economical and feasible option as many of the locks are undersized at 600 feet long and cannot accommodate standard 15-barge tow configuration, which is 1,200 feet. This causes operators to have to run smaller configurations or break down the barges to



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transport them through the locks, adding time to a shipping method that is already slower than other methods.

The seven locks and dams in or near Missouri are part of the Upper Mississippi River, starting just north of St. Louis and continuing to the Iowa border, and are listed in **Table 4-2**. **Figure 4-7** shows the age and location, as well as the annual volume of trade versus delays for the Upper Mississippi River locks and dams. The Lower Mississippi River (south of St. Louis) and the Missouri river contain no locks or dams.

Table 4-2: Upper Mississippi Locks and Dams in or Near Missouri

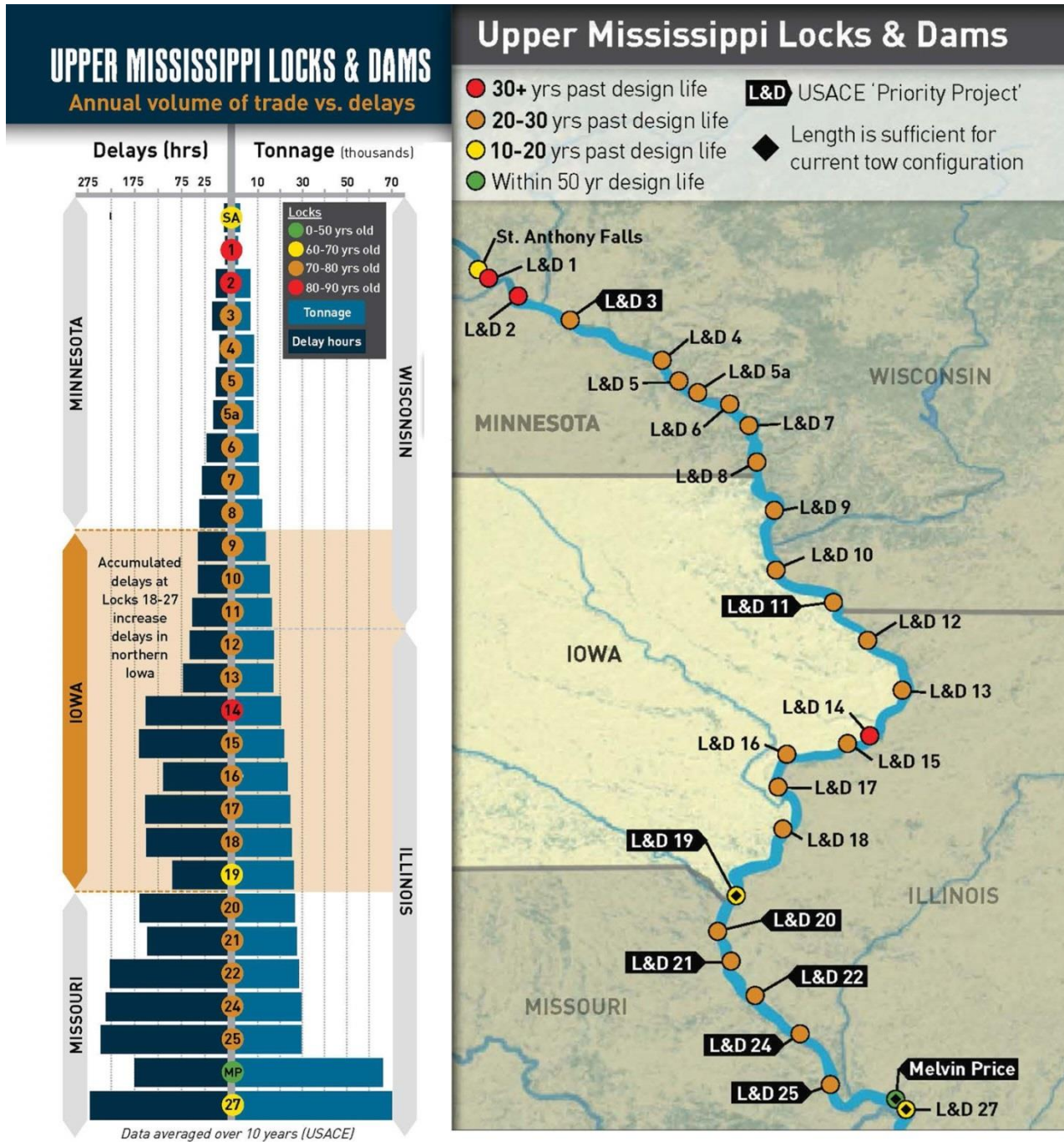
Lock/Dam Number	Location
No. 20	Canton, MO
No. 21	Quincy, IL
No. 22	Saverton, MO
No. 24	Clarksville, MO
No. 25	Winfield, MO
No. 26 (Melvin Price)	East Alton, IL
No. 27 (Chain of Rocks Dam)	Glasgow Village, MO
No. 27 (Chain of Rocks Lock)	Granite City, IL

Source: U.S. Army Corps of Engineers



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Figure 4-7: Status of Upper Mississippi Locks and Dams



Source: "A River Run Dry," Iowa Department of Transportation, 2013

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The maintenance needs of the aging infrastructure are increasing at a rate much greater than the operations and maintenance funding provided for the waterway system. This adversely affects the reliability of the system. Long-established programs for preventive maintenance of major lock components have given way to a fix-as-fail strategy, with repairs sometimes requiring weeks or months to complete. Depending on the malfunction, extended repairs can have major consequences for shippers, manufacturers, consumers, and commodities investors.

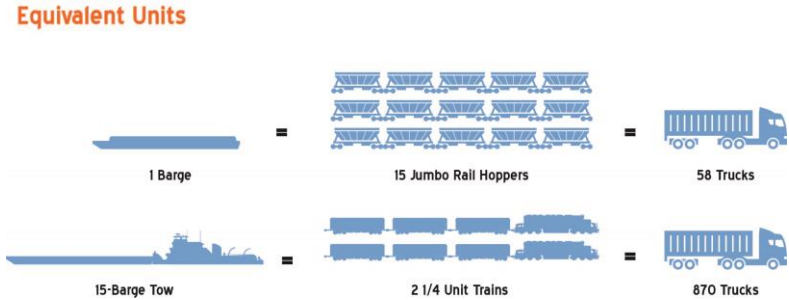


Lock and Dam #25 at Winfield, Missouri

Waterway Capacity

A barge offers greater freight capacity than other freight transportation modes, as shown in **Figure 4-8**. A “standard” tow is 15 barges with a total capacity of 22,500 tons or 45 million pounds. “Large” tows on the Mississippi River below St. Louis can be as large as 40 barges. It would take 225 railroad cars or 870 semi-trucks to carry the same amount of cargo as a standard tow. The benefits of

Figure 4-8: Model Capacity Comparison



Source: www.celticmarine.com

moving freight on the inland waterways include: a separation from highways and railways, efficient fuel consumption and low GHG emissions, and excellent safety record. Reducing fuel and labor costs reduces transportation costs, which in turn improves the profits for both commercial and agricultural industries. Waterways are the original Missouri transportation system. This resource led to wealth and development that then spread outward from Missouri’s rivers.

Waterways are comparable in capacity and importance to interstate highways. Annual cargo through Missouri’s ports is worth billions of dollars. Waterways are currently uncongested and have capacity to move substantially more freight. Like other transportation networks, Missouri’s waterways, private ports, and public ports are important due to their significant economic impact.



Missouri River Barge

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Maintaining Navigation

Three public port authorities identified improving navigation on the Missouri River as an important performance issue. The Missouri River has potential to serve Missouri’s agriculture industry; however, many competing demands for use of the Missouri River have made it difficult to maintain this waterway as a reliable means of freight transportation. Further, public and private port authorities have expressed concern about floodplain development restrictions that impede construction of cargo handling infrastructure.

Dredging has become a constant issue both in-channel on the Missouri and Lower Mississippi Rivers and at harbors on the Lower Mississippi River. In order to maintain navigation in these areas, dredging is often needed due to the regular flow of water and sometimes due to flood events. If a navigable channel cannot be maintained, freight moved on the water is slowed or stopped completely. This affects the performance of the waterways as a reliable method of shipping goods.

Waterway Freight

With the given waterway conditions and performance, Missouri’s waterways carried 49.9 million tons of freight valued at \$12.5 billion in 2011. The top five port commodities by tonnage, units, value, and growth are provided in Appendix A.

Air

Missouri is home to three of the top 110 cargo airports in North America in terms of total tonnage in 2012: Kansas City International Airport (MCI), Lambert-St. Louis International Airport (STL), and Springfield-Branson National Airport (SGF).

Air Condition and Performance

Missouri’s busiest cargo airports are located near major metropolitan areas that produce consistent passenger and air cargo traffic. Consequently, these facilities must be able to support large aircraft capable of accommodating market demand. The State’s smaller airports, generally located near Missouri’s medium-sized metropolitan areas, have infrastructure capable of supporting smaller-scale air cargo operations. These smaller airports can be, and often are, used to move cargo to larger Missouri airports or airports outside of the State.

Three Missouri cargo airports handled nearly 177,000 tons of total air cargo and mail in 2013, which reflects a 3.7 percent decrease annually since 2001. In this same time frame, Missouri’s fastest growing airport by total tonnage was SGF, which increased by 0.95 percent annually. MCI and STL both experienced losses in total air cargo from 2001-2013.

Two issues could affect cargo at Missouri airports. First, stakeholder input identified freight concerns regarding onsite facilities at STL. There is an interest in improving old, outdated facilities and relocating

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them to a new site at STL. Second, the potential reduction in tower operations at Springfield Airport would limit the available operating hours at the airport.

Air Freight

With the given air freight conditions and performance, Missouri's airports transported 73,000 tons of freight valued at \$11.4 million in 2011. The top five port commodities by tonnage, units, value, and growth are provided in Appendix A.

Pipeline

Approximately 10,700 miles of pipelines move natural gas, crude oil, and petroleum products throughout Missouri. The highest percentages of pipeline miles, according to the USDOT Pipeline and Hazardous Materials Safety Administration (PHMSA) Missouri Incident and Mileage Overview, are in St. Charles County (4.9 percent), Cass County (3.6 percent), Audrain County (3.5 percent), and Johnson County (3.4 percent), which are located in the northern half of the State where the majority of major pipelines pass.

Pipeline Condition and Performance

There are several major crude oil, petroleum product, and liquefied petroleum gas pipelines crossing the State. Many of the crude oil and petroleum product pipelines originate near the Gulf Coast (Texas), Oklahoma, or Canada, and pass through the State in route to Midwest refineries.

TransCanada's proposed Keystone XL pipeline would connect to the existing Keystone Pipeline in Steele City, Nebraska, and increase access to Midwest markets. The project is currently awaiting decision on a Presidential Permit application. Enbridge is currently constructing the Flanagan South Pipeline Project adjacent to their Spearhead Pipeline to provide more efficient transportation of oil from western Canada and North Dakota to refinery hubs in the Midwest and Gulf Coast. The Flanagan South Pipeline is planned to be in service in 2014.

Pipeline Freight

With the given pipeline conditions and performance, Missouri's pipelines totaled 8.3 million tons valued at \$5.8 million in 2011. The top five port commodities by tonnage, units, value, and growth are provided in Appendix A.

Intermodal

There are three key elements of the intermodal system: the facilities where commodities are transferred from one mode to another, designated intermodal connectors that connect the major intermodal facilities to the freight network, and the first/last mile connectors that connect all remaining freight origins or destinations.

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Facilities

Chapter 3 describes the details of the intermodal facilities in Missouri. **Figure 3-8** displays the location of these intermodal facilities.

Intermodal Connectors

The Missouri Freight Network includes the 15 NHS freight-related intermodal connectors that provide the integral connections between major intermodal facilities and the NHS roadways. The Federal Highway Administration designated NHS freight intermodal connectors provides landside access locations to and from intermodal facilities for rail, waterway ports, and airports.

First and Last Mile Connectors

The first and last mile connectors were determined by evaluating the locations of the top 100 freight generators and intermodal facilities in Missouri relative to their proximity to the rest of the Missouri Freight Network. The first and last mile connectors are part of the Missouri Freight Network; connectors link the freight generators and intermodal facilities with the Missouri Freight Network.