Telecommunications GIS projects for the State of Arizona and City of Phoenix

Arizona State Mall Complex

Since 1988 FSI (Fiber Specialists Inc.) has been building and maintaining the Telecommunications structure for the Arizona State Mall Complex. Drafting this onto large paper sheets. Up until 2002 the State was still relying on those paper as-builds. In 2001 FSI made an investment in GIS technology. Bringing on a experienced GIS manager with a strong background in survey and field data collection FSI set out to develop a method to accurately and efficiently create GIS data that represents the real world telecommunications infrastructure that exists at The Arizona State Mall Complex.

City of Phoenix

Telecom Outside Plant

The entire Out Side Plant Telecommunication for the City of Phoenix is being mapped and as-built. These data are being put into an ESRI ArcMap Telcordia GIS. FSI uses telecommunication professionals that build networks to create data for the GIS. The tools being utilized in the field are ArcPAD, PenMap, Trimble DGPS and Total Stations. If you collect good data, it will show connectivity and flow in fiber and copper networks.

Telecom Inside Plant

All Inside Plant Telecommunication and Data wiring is being inventoried for the City of Phoenix. This data is being fed into an accounting program (SAP) to become the main facilities management system. This data is being collected with ArcPad and uses a geographic component. The geographic component is stored in SAP and will be fed into ArcMap Telecordia Network Engineer.
FIBER SPECIALIST INC. built most of the Telecom network at the State Capital. FSI has been involved in Arizona Telecommunications for 3 decades.

In 1988 FSI was asked to as-build the telecom network at the State Mall Complex. FSI hired a draftsman and put the telecom crews to work building Fold Flats. The end result was a beautiful hand drawn series of maps that depicted the network in every way. It took an enormous amount of time and effort. The only problem was they soon became outdated. This outdated set of as-builds was still being used up until 2002.

There had to be a better way!

In 2000 FSI invests in GIS by bringing in Me, Michael Maier. My background is GIS and Survey. I have worked on many projects building all kinds of unique GIS applications from teaching Jamaican Bauxite miners GIS to GIS/GPS data collection for the US army. One of the
toughest things to tear into is GIS telecom! It is very complex and difficult to model. One key component to building a useful telecom GIS is making that information represent the network. This is how we did it.

Blue light special on GIS

Since we are a multi hundred dollar company we wasted no time throwing $1200 bucks at software. We purchased ESRI ArcView 8.0 GIS. Now this was back in 2000. I have been using ArcView for years before that and was able to get the “newer” ArcView 8 under my belt and make sure that this was the application for us before investing into the more capable ArcEdit and ArcInfo. The newer versions of ESRI’s (ArcView, ArcEdit, ArcInfo) ArcMap suite are much better suited for telecom GIS than the older versions of ArcView or ArcInfo. We also put ArcPad and PenMap into action with Trimble GPS and a Topcon Total Station for field data collection. FSI invested large sums in equipment and labor to develop this application. We were hoping that our ideas would be valuable.
In a hole!

We put crews of installers in the field and had them map the inside of the manholes. We call these Fold Flats. A fold flat looks like the Red Cross symbol. Imagine if you were able to lay down all four walls of a manhole on a piece of paper. That would be a fold flat. They then diagram the path each cable takes. These alone are very valuable sets of information. This is THE main source of data and where the majority of records are made! If you put an experienced telecom person in the hole, good data will flow. When doing this there was one big issue and that was making sure that each experienced telecom person used comparable naming conventions in each cable found. This was an important step in solving the puzzle. Once the Fold Flats are created on paper we need to verify the conduits and cables running between each manhole. We used AutoCAD and CAD lisp to enable the telecom personnel to digitize the manhole into a drawing file. This drawing file enables us to relate manholes to each other in relational space.
Locate the duct banks

While in a manhole we hook up radio detection equipment to the cables. Using this equipment we then traced the path that the conduit takes to the other manholes and buildings. We marked with paint the path along the ground and then later surveyed in the path. To survey in the path we used DGPS [DGPS] or a Total Station [Total Station], since working in-between tall buildings can be a little too challenging for DGPS. We used two different types of data loggers ArcPad and PenMap.

Field Data Collection Software

What can I say about field data collection? I am a big proponent of taking your data to the field. What are we doing here? We are building models that represent the real world. Say the name with me Geographic Information Systems. Take your data to the field! What better way to see if what your doing is accurate? We took advantage of Air photos, old cad drawing and out dated site plans and built our data by constantly taking our GIS project to the field.

**ArcPad** is ESRI’s field data collection software made to run on Microsoft’s pocket PC operating system. The best thing about ArcPad is the fact that you can run it on an iPAQ [iPAQ]. Solid state no moving hard drive and cheap. ArcPad itself is a bit clumsy. It is hard to make an end user application that doesn’t take a lot of maintenance. We created VB [VB] programs to automate the process as much as possible. One problem we found is that many of the customization files are split between the operating system and the program files. In the latest release of ArcGIS 8.3 a new ArcPad Wizard came out. This is neat. It allows you to export data from a database, create and update in the field and the Wizard brings the data right back in replacing updated objects.

**PenMap** is field data collection software that runs on a tablet pen computer. PenMap runs on Windows operating system. It brings a lot of power into the field. PenMap is a full survey tool; it has many high-level survey functions as well as handles GIS very well. PenMap works with ArcGIS and shape files. The only real problem with PenMap is the tablet PC’s are expensive and have a lot of moving parts. If you have a problem shutting down takes time, its heavy and the batteries are a concern.

We use PenMap with the total station and DGPS. ArcPad works with DGPS. Both have real capabilities of taking your data to the field.

You have to realize that GIS is just not that simple. Getting your data from the desktop to the field and back is complex. But you can automate getting people to update your attributes. One big ingredient to a successful GIS is getting the valuable data people have who perform the daily task of running your city. There are many ways to collect data and if you want to empower your work force you need open a path into your GIS.

**Desktop GIS**

All this data we collected went into an ArcView 8.0 project. We created a personal geodatabase. The personal geodatabase is essentially an MS Access database with a binary shape field that holds the geographic components of the data. This is very powerful, (hmmm... an Access data base, we did more with this later). We made a Span layer and a manhole layer. To show the duct we made a Access table
“ducts” and populated it with a field that we could relate to the “span” layer. We then created a “cable” table in Access and related it to the “duct” it belongs to. End result was a one-to-many relational database that if you clicked down through the related tables you would see the contents of each duct. Now this is good. We also hyper linked the CAD drawings to the manholes. We built a very complete GIS using ArcView.

Share your data with the World!

Being that same multi hundred-dollar company, we once again made the big commitment and purchased a $300 dollar software package that publishes our ArcGIS project into an HTML web page. This software is HTML ImageMapper[1]. We published our project and made a wonderful HTML web page.

Now people could see our wonderful GIS project but rather than having to re-publish the data every time a cable was added we used Microsoft Active Server Pages to read the data right from (Access database!) geodatabase. Now we maintain an ArcGIS project and anybody with the proper login can access data that shows accurate and up to date information. The Active Server Pages can be edited from any desktop at the Arizona State Mall. We also published the AutoCAD drawings of the Fold Flats to the DWF[8] format and hyper linked them to the manholes. These also contain digital photos of all the manholes.

This data is published on a server at the Data Center for State of Arizona. Any State employees that need this data, can get it at any workstation on the Mall’s network. The State of Arizona has an easy to maintain Geographic inventory of the telecom system. There is still work that can be done. We would like to educate more people on how utilize that data.

City of Phoenix Telecommunications GIS project

The City of Phoenix (COP) is inventorying their entire telecom network. The inside plant into SAP and the out side plant into Telcordia[9].

SAP

SAP is the main accounting software for the City of Phoenix. The inside telecom is being inventoried and input into SAP. Once into SAP the City’s Telecom dept will maintain work orders and daily operation. To get this data into SAP we are going building to building to locate and collect data. We start with a LIM[10] dump. The LIM data comes out as a flat text file. We import that into ArcView giving each phone jack a 0,0 coordinate location. We also import the floor plans from AutoCAD for that building. Many of these older buildings don’t have an AutoCAD drawing but we are finding the fire evacuation maps and digitizing those. We import all this data into ArcPad. We used
Daniel Elroy[1] of Elroy Consulting to help us customize ArcPad. Daniel wrote a program that finds the phone numbers in the database and prompts the user to relocate that jack on the map where it goes. Basically it moves the jacks from the 0,0 coordinate onto the map. Then a form pops up asking the user for jack information. This is working very well. It solved many problems. One problem was when working a big building knowing where you've been already is a really big deal. Your playing phone detective. You have to find all the jacks, and ports and verify the working connection. We are finding many old connections that are no longer used thus allowing the city to start saving money right away. To verify the port to jack connection and cross-connect to the LIM we have an experienced phone person in the data closet. We built an Access form to enter data that controls the input very tightly. This data gets combined with the jack data from ArcPad. Now we have a geographic component in the database coming from the field. Putting this data in ArcView helps eliminate problems. We run a series of checks in the Field Calculator. We bring all this data together and upload it to SAP. We save the geographic component in SAP and any time we need it, we can dump this data into Telcordia. And although the City maintains this data in SAP, using Telcordia to graphically tear into the data is extremely valuable in maintaining the SAP database integrity.

**Telcordia**

We are creating fold flats, mapping and locating Outside Plant for the entire City. We are doing much the same as we did for the state Capital. One big difference is Telcordia. Telcordia is an application that runs on top of ArcGIS. We are very happy to be entering our data into an evolved telecom application. This makes the job easier. The end result will be a cable level inventory for the entire City.

[1] Fold Flat is a diagram of a manhole. “As to lay the manhole flat”


[7] For more information on HTML ImageMapper see [www.alta4.com](http://www.alta4.com)

Telcordia is a Telecom extension to ArcGIS [http://www.telcordia.com/](http://www.telcordia.com/)

LIM is the computer that controls all the phone numbers

[www.elroi.com](http://www.elroi.com)

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