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AUDIO SERVICES DIVISION

Albert Shuldiner
Vice President & General Counsel

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April 6, 2001

Magalie R. Salas
Secretary
Federal Communications Commission
445 12th Street SW
Room TW-B204
Washington DC 20554

RE: MM Docket No. 99-325
KLLC (FM), San Francisco, CA (Facility ID 9624)

Dear Ms. Salas:

Enclosed for filing is an experimental report on iBiquity Digital Corporation's recent field tests conducted in San Francisco, California. These field tests provided new evidence of the superior performance of iBiquity's IBOC DAB technology.

Any questions concerning this material should be directed to the undersigned.

Sincerely,

Albert Shuldiner

/enc

cc: Brian Butler

8865 Stanford Boulevard • Suite 202 • Columbia MD 21045 • Phone 410 872 1536 • Fax 410 872 1560

FM Hybrid IBOC Field Test Results

iBiquity IBOC System Performance

KLLC – San Francisco

November / December 2000

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1 Overview

This report documents the results of additional iBiquity FM hybrid IBOC field tests. These results are important because they further verify the performance of a physical implementation of the design under real-world conditions.

These tests were performed to verify that iBiquity FM hybrid IBOC system demonstrates these features. The Digital Coverage test illustrates that the DAB audio quality exceeds that of an existing analog FM signal, and shows that IBOC offers coverage comparable to existing analog service.

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2 Definitions and Assumptions

2.1 DAB Signal

The desired hybrid IBOC signal is comprised of an analog FM host and a baseline DAB signal. The analog FM host signal, present in all tests, is unchanged. The total power in the baseline DAB signal is 22 dB below the total power in the analog host. The DAB signal was generated using a iBiquity FM IBOC exciter. Figure 1 depicts a spectral representation of the FM hybrid. The rectangular areas contain the DAB subcarriers, and the triangular area comprises the analog host FM signal.

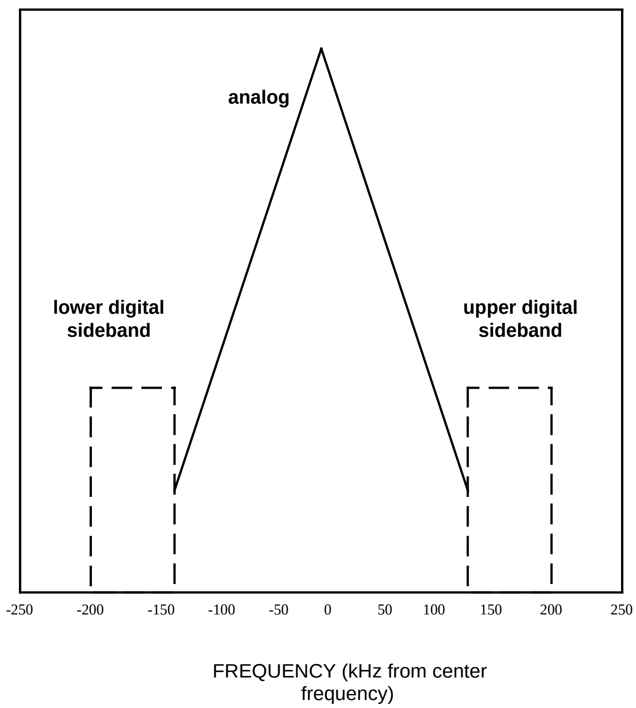

Figure 1 - FM Hybrid IBOC Spectrum

2.2 Digital Coverage

The iBiquity IBOC system employs a time-diversity blend function which allows graceful degradation of the digital signal as the receiver nears the edge of a station's coverage. When the primary digital signal is sufficiently corrupted, the receiver blends to analog audio.

Performance in a given environment is measured using block error rate. [1] The receiver uses this metric to determine the appropriate time to commence a blend to analog. As the digital signal approaches TOA [2], blending will occur with increasing frequency. The edge of digital coverage is defined as the point at which the receiver no longer blends back to digital.

[1] Blocks are simply large groups of information bits at the input to the audio decoder. Each block has an assigned cyclic redundancy check ("CRC"). If the block's CRC is incorrect, the block is deemed in error.

[2] **T**hreshold **O**f **A**udibility

3 Test Setup

3.1 Transmitter Test Sites

KLLC, a class C FM commercial radio station which broadcasts 82.0 kW Effective Radiated Power (“ERP”), with a transmitter power output of 20 kW at 97.3 MHz in the San Francisco, CA metropolitan area, was used for the Digital Coverage test. The transmitter is located at 37^{o} 51’ 03” N latitude and 122^{o} 29’ 51” W longitude.

The power in each of the DAB sidebands was 25 dB (or PdB $_{(sideband)}$) below the total power in the analog host (or $P_{(analog)}$):

Total DAB power = $[P_{(analog)} / (\text{Log}^{-1}_{10}\,(PdB_{lsb}/10))] + [P_{(analog)} /(\text{Log}^{-1}_{10}\,(PdB_{usb}/10))]$.

Thus the total power in the DAB sidebands is 25 dB + 25 dB = 22 dB below the analog host.

In the case of KLLC:

Total DAB Power (ERP) = $[82{,}000 / (\text{Log}^{-1}_{10}\,(25/10))] + [82{,}000 /(\text{Log}^{-1}_{10}\,(25/10))]$

Total DAB Power (ERP) = [82,000 / (316.227))] + [82,000 /(316.227))]

Total DAB Power (ERP) **=** [259.307] + [259.307] = **518.614 Watts (ERP)**

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3.2 Station Configuration

KLLC was modified, as shown in Figure 2, to generate the FM hybrid IBOC signal. Figure 3 shows that, when the source audio enters the iBiquity IBOC exciter, it is split into two paths.

The first path routes the audio out of the DAB exciter to the DAB audio processor. The processed audio is then returned to the iBiquity IBOC exciter, where audio encoding and DAB modulation is applied to produce the digital portion of the hybrid signal. The output of the IBOC exciter is then amplified by a linear HPA, and then filtered to remove spurious artifacts, before being routed to the high-power combiner.

The second path routes the audio to the diversity delay for blend before sending it to the analog audio processor. The processed analog audio is then input to the analog FM exciter and FM transmitter to produce the host portion of the hybrid signal. Finally, the analog host portion is combined with the DAB to produce the final IBOC FM hybrid signal.

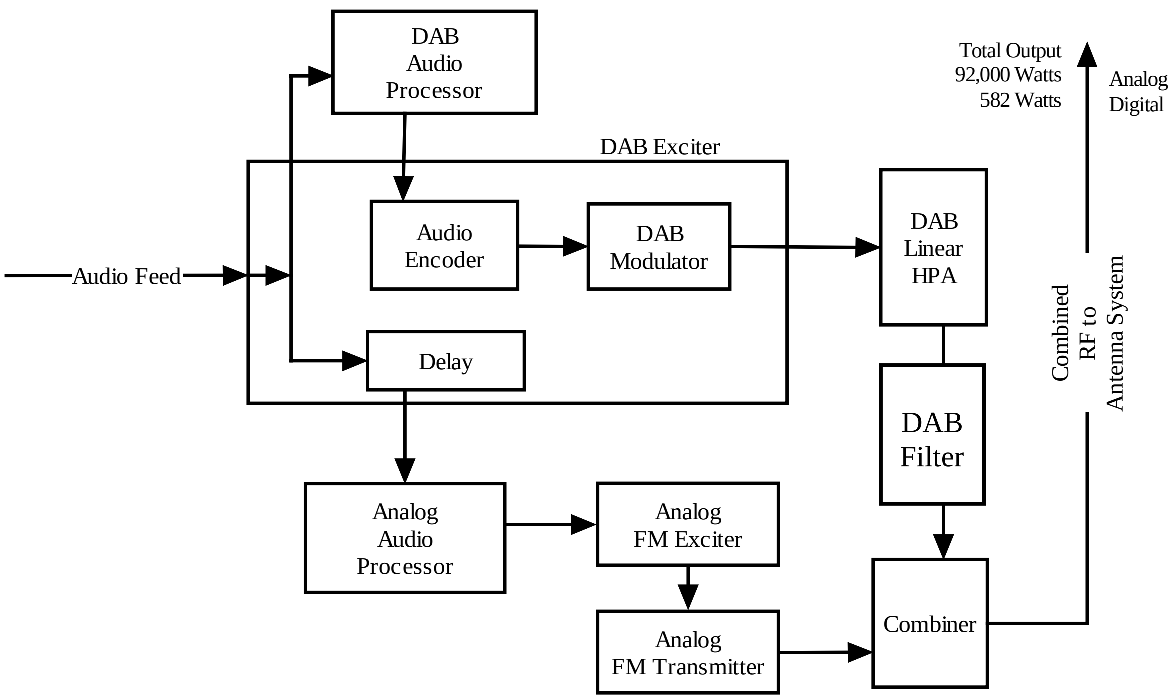

Figure 2 - Diagram of Typical FM Transmitter Setup

3.3 Van Configuration

Mobile test platforms were created to collect data while performing field tests. Test vans were equipped to support the equipment and interfaces shown in Figure 3. Test data was acquired and stored using the iBiquity Field Test PC application. Table 1 describes the manufacturer and model number of the test equipment in the van.

The Field Test PC provides a Graphical user interface ("GUI"), as shown in Figure 4. This application controls and collects data from three sources:

- GPS receiver
- Spectrum analyzer
- IBOC receiver

3.3.1 GPS Receiver Data and Processing

The following data is collected by the GPS receiver over an RS-232 interface[3]:

- GPS time
- GPS position (latitude and longitude)

During setup, the operator enters the position of the transmitter. Current latitude and longitude are then taken directly from the GPS receiver and displayed. The application uses this information to compute and display the current distance from the transmitter.

3.3.2 Spectral Data and Processing

The following data is collected by the Spectrum Analyzer over a GPIB interface:[4]

- Lower first adjacent signal level
- Upper first adjacent signal level
- Lower second-adjacent signal level
- Upper second-adjacent signal level
- Desired signal level

This data is then displayed directly by the Field Test PC application.

[3] RS-232 is an industry standard serial communications link used by PCs and test equipment.

[4] GPIB is a communications protocol and interface used by PCs to communicate with test equipment.

3.3.3 DAB Receiver Data and Processing

The following data is collected from the DAB receiver over an RS-232 interface:

- Desired signal strength
- DAB receiver audio mode (digital or analog)
- Cumulative blend counter, which increments whenever the receiver changes its blend status.

3.3.4 PC Application

This application displays new data from each device every eight seconds. All data shown on the display is also stored to a file. The data stored in this file is then re-formatted to generate a strip-chart recording, which plots the variation of select parameters with time over the length of the test.

Type	Manufacturer	Model
Spectrum Analyzer	Hewlett Packard	HP-8591
GPS Receiver	Garmin	GPS II

Table 1 – Test Equipment Manufacturer and Model numbers

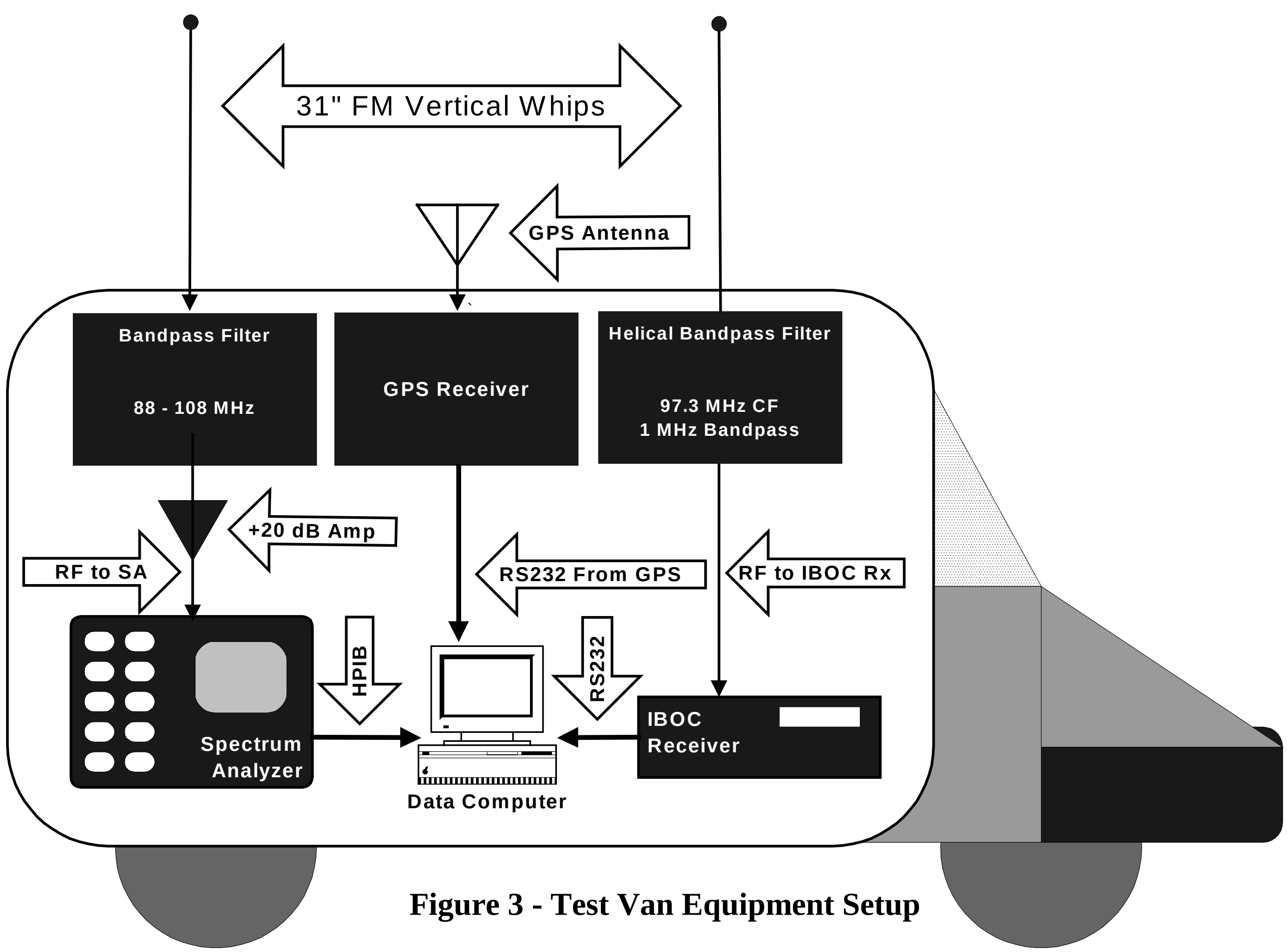

Figure 3 - Test Van Equipment Setup

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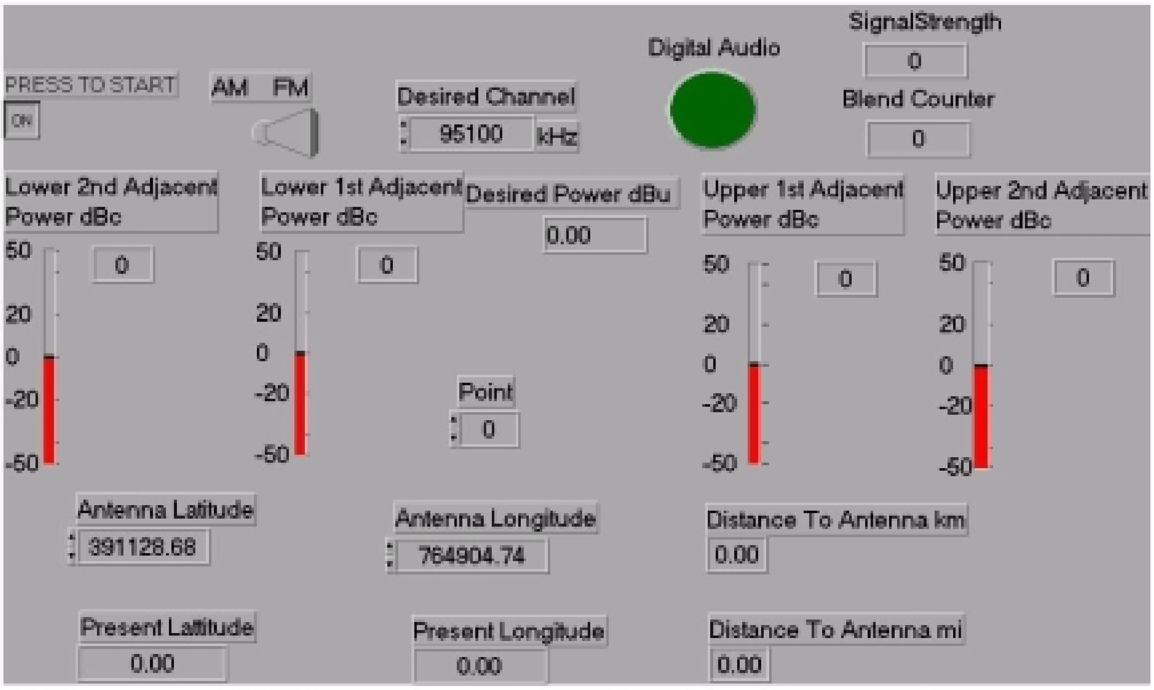

Figure 4 - iBiquity Field Test PC Application Display (GUI)

4 Digital Coverage Test

4.1 Overview

This test measures the digital coverage of the KLLC hybrid iBiquity IBOC signal. During the testing the following data from the Field Test PC application was stored:

- Time
- RF Sample Location (latitude and longitude coordinates from GPS)
- IBOC receiver blend status (digital – green / analog – red)
- Signal level in dBu of the following:

  - 2nd Lower Adjacent (96.9 MHz)
  - 1st Lower Adjacent (97.1 MHz)
  - Desired Signal (97.3 MHz – KLLC)
  - 1st Upper Adjacent (97.5 MHz)
  - 2nd Upper Adjacent (97.7 MHz)

4.2 Route Selection

The test loops contained in this program were chosen by the National Radio Systems Committee (a joint committee of the receiver manufacturers and broadcasters) in 1995 and were used for testing non-IBOC systems. Due to severe multipath and terrain shielding conditions, San Francisco is regarded by many as the most challenging radio market in the United States. The NRSC designed the six test loops to cover a variety of geographic or environmental areas that would challenge present analog systems and the proposed Eureka 147 system. These environments included the following:

- Terrain "shadowing", which occurs at numerous locations in the mountainous San Francisco Bay area.
- Specular multipath, which is common in areas with tall buildings that produce strong singular reflections with deep nulls.
- Diffuse multipath, which is common in areas bordered by mountains that produce an infinite number of reflectors and wideband nulls.

The original routes were carefully calculated from the 1995 documentation and driving instructions from commercial mapping software were obtained for each "loop". These routes are outlined below:

4.2.1 Perimeter Loop

- Begin just south of Golden Gate Bridge on Highway 101
- Take Highway 1 (19th Avenue) exit south through Golden Gate Park.
- Continue south to Brotherhood Way and take Brotherhood Way east to 1-280 North
- Transition to Highway 101 north.
- Transition to I-5O east; take I-5O east to 4th Street (last San Francisco exit).
- At end of exit ramp, turn left on Bryant Street to The Embarcadero.

- Turn left on The Embarcadero and travel into Wharf area.
- Turn left on Bay Street at Pier 31.
- Turn right onto Laguna Street; travel two blocks to Marina Boulevard (Marina District).
- Turn left onto Marina Boulevard, which becomes Highway 101 north.

Approximate driving time: 45 minutes

4.2.2 Downtown Loop

- Begin at easternmost end of Market Street
- Take Market Street southwest.
- Transition to Portola Avenue.
- Transition to Woodside Avenue to end.
- Turn right on Laguna Honda at Dewey.
- Take next right onto Clarendon.
  (Clarendon becomes Twin Peaks Boulevard, Clayton Street, then Ashbury Street).
- Turn right on Frederick Street; travel two blocks to Masonic Avenue.
- Turn left on Masonic Avenue and travel to Bush Street.
- Turn left after one block onto Presidio Avenue.
- Turn right after two blocks onto California Street.
- Take California Street east to Sansome Street.
- Take Sansome Street north to Jackson Street.
- Take Jackson Street east to Battery Street.
- Take Battery Street south to Pine Street.
- Take Pine Street west to Sansome Street.
- Take Sansome Street north to Jackson Street.
- Take Jackson Street east to Battery Street.
- Take Battery Street south to Market Street.

Approximate driving time: 1 hour

4.2.3 West Loop

- Take I-280 to Highway 1 south, near Pacifica.
- Continue south on Highway 1 along coast to Half Moon Bay.
- Turn left on Highway 92, heading east, crossing under I-280 to Highway 101
- Take Highway 101 north to I-380
- Take I-380 west to 1-280 north, back to the starting point.

Approximate driving time: 1 hour, 15 minutes

4.2.4 South Loop

- Begin at junction of Highway 101 and Highway 84 (Dumbarton Bridge exit) east
- Cross Dumbarton Bridge to Fremont, then travel south on 1-880; transition to Highway 237

- Take Highway 237 west to Lawrence Expressway (also known as County Road 02)
- Take Lawrence Expressway south to 1-280; take 1-280 north to Highway 85 north
- Take Highway 85 north to Highway 101 north
- Back to Dumbarton Bridge exit.

Approximate driving time: 1 hour

4.2.5 East Loop

- Begin on I-80 at San Francisco side of Bay Bridge
- Cross bridge (lower deck) to 1-580
- Take 1-580 east to Highway 24
- Take Highway 24 east to 1-680
- Take 1-680 south to 1-580, near Dublin
- Take 1-580 west to Bay Bridge (Oakland side)
- Cross bridge (upper deck) and end on San Francisco side.

Approximate driving time: 1 hour

4.2.6 North Loop

- Begin at junction of Highway 101 and 1-580 in San Rafael
- Take Highway 101 north to Highway 37
- Take Highway 37 east to Highway 29 south
- Connect to I-5O in Vallejo, then south to Central Avenue west
- One block to 1-580 west
- Take 1-580 west across the Richmond Bridge
- Transition to Highway 101.

- *Approximate driving time: 1 hour, 15 minutes*

4.3 Test Procedure

a) At the starting location, tune the PC and the IBOC receiver to the desired operating frequency. Enter the GPS coordinates of the transmitter site into the PC. All notes, tapes, and data should have the same time reference, which is derived from the GPS. Be sure all clocks are synchronized.
b) Begin recording on the PC.
c) Follow driving instructions for the selected loop. Proceed to the end of the planned route.
d) Close all files.

e) Repeat steps a) through e) for all loops.

4.4 Test Results

4.4.1 Overview

Each of the five test loops covers a different geographic or environmental area of the San Francisco Bay Area. These environments include the following:

- City streets (Downtown San Francisco shadowed by tall buildings)
- Pacific Coastline (Characterized by extreme instantaneous terrain elevation changes)
- High Desert (Large plain areas bordered by mountains)
- Rolling hills (Characteristic of the "North" loop and Sonoma Valley)

The robust performance of the iBiquity IBOC system largely overcomes many of the terrain-related challenges that have always plagued traditional analog systems. While no transmission system can provide satisfactory performance in areas of little or no signal, the iBiquity IBOC system continues to supply CD quality audio in areas of severe analog impairment. The following narratives describe IBOC system performance over the six San Francisco routes.

4.4.2 Routes - Narrative

4.4.2.1 Perimeter Loop

- **98.9% Digital by Distance**
- **Exhibits 0, 1 & 8**
- **Chart 1**

The KLLC Perimeter Loop began at a call box located 100 feet north of the MacArthur Tunnel. The loop traveled south through the tunnel on Route 1. This area was characterized by extreme and abrupt elevation changes that shadow the KLLC transmission and produced multipath induced impairment. The loop then headed East on route 280 until intersection with route 101. At a point along 280, adjacent to the Mt. Sutro transmitting tower, there was a short distance where the receiver front end overloaded, causing a momentary blend to analog. The rest of the route, however was characterized by robust digital reception.

4.4.2.2 Downtown Loop

- **97.9% Digital by Distance**
- **Exhibits 0, 2 & 8**
- **Chart 2**

The KLLC Downtown loop began near the Fisherman's Wharf Area of downtown San Francisco and followed Market Street southwest (through an urban "canyon" created by numerous tall buildings). The effect of multipath on the received signal here was shown by the spectrum analyzer. Observation of dynamic signal profile showed numerous instances of a complete loss or corruption of one of the IBOC carrier sets. Despite these severe impairments, there is no loss of the digital signal. The route continued up Mount Sutro, and rounded the base of the "candelabra" transmitting tower located there. High levels of radio frequency energy from the numerous radiators on this tower have the tendency to “overload” or produce intermodulation products in FM receivers. Despite potential impairments, the signal remained locked in digital except for five blends to analog. The route then headed North through residential areas. The loop then turned East and back towards Fishermans Wharf. The road is very steep and unimproved for most of this leg, but digital reception continued uninterrupted. The robust performance of the iBiquity IBOC DAB system in this impaired urban environment is a testament to its superiority over the traditional analog system.

4.4.2.3 West Loop

- **74.2% Digital by Distance**
- **Exhibits 0, 5, 7, 7A & 8**
- **Chart 5**

The KLLC West Loop began on I-280 and soon headed south on the Pacific Coast Highway. The signal was significantly shadowed by extreme terrain elevation fluctuations near the shoreline. Shortly after the Pacific coastline came into view, abrupt terrain shadowing caused loss of the digital signal and severe impairment of the analog. The remainder of the route along the ocean was intermittently shadowed with compromised analog performance. Even so, the IBOC system delivered digital reception at numerous locations along the beach. As Route 92 headed inland, it became completely terrain shadowed and the analog signal became unintelligible. As the elevation increased, line of sight to the transmitter is regained, with a corresponding acquisition of the digital signal. Route 92 turned into Highway 101, and the digital signal is relatively unimpaired until shadowed by Mt. Bruno as the route turned west (shortly after the airport). The remainder of the route remained unimpaired, with robust digital reception.

4.4.2.4 South Loop

- **98.7% Digital by Distance**
- **Exhibits 0, 4, 4A & 8**
- **Chart 4**

The KLLC South loop began at the end of the highway 101 exit ramp to highway 84 East (which crosses the Dumbarton Bridge to East Bay). This area experiences no terrain shadowing as the KLLC signal path is consistently over water. The route then headed south on Interstate 880, which follows a sea-level plain and also experiences no shadowing. A single blend to analog occured at a point about .5 kilometers North of the exit for Route 262. The course then turned West onto Highway 237 and another single blend to analog occured at a point .8 kilometers East of the intersection with Lafayette Street. The loop then headed South on the Lawrence Expressway (also known as County Road 02). The digital signal remained robust and unimpaired, despite relatively low signal levels, as the end of section of the loop is as far from the transmitter as any other point in the report (75 kilometers). The signal level at this point as calculated from the propagation prediction - (Exhibit 8) is only 40 dBu, a point at which analog reception is severely compromised. The route then headed West on Interstate 85. There are three points along this leg that the signal blended to analog. This (and the two previous blends are probably due to low signal level and the presence of a strong second adjacent interferer (KFFG – Exhibit 4A). The remainder of the route (as it turns up highway 101 and finally intersects with highway 84 again) was solidly digital.

4.4.2.5 East Loop

- **73.6% Digital by Distance**
- **Exhibits 0, 6, 7, 7A and 8**
- **Chart 6**

The KLLC East loop began on Interstate 80 Eastbound at the far Western end of the San Francisco Bay Bridge. Since the Eastbound lanes of the bridge are the lower levels of a double-decker span, the KLLC signal suffered extreme multipath from the bridge superstructure. Despite this harsh RF environment, only two blends occured. The route then turned on to I-580 and passed through a mountain range via the Caldecott Tunnel, which is approximately 1 kilometer in length. The first shadowing induced blends occured in this tunnel, which shielded all RF. After emerging from the East end of the tunnel, the route was severely shadowed by the mountain range. This area, near the city of Walnut Creek, is notorious for poor FM analog reception. Nevertheless, the IBOC signal remained primarily digital with a very low signal (as shown by the propagation prediction study – Exhibit 8). Despite impairments, the system maximized audio quality by gracefully blending back and forth from digital to analog. As the loop headed Southward on Route 24, the analog signal levels increased dramatically as shown by Chart 6. This was due to an on-channel booster installed by KLLC to provide coverage to an area that is normally completely terrain shadowed (see Exhibit 6). Unfortunately, the booster does not repeat the IBOC carriers, and does not aid digital coverage. The route then turned West onto Interstate 680. After a few kilometers, the signal path was no longer terrain obstructed and digital reception continued unimpaired until the route ended at the Western end of the Bay Bridge.

4.4.2.6 North Loop

- **100% Digital by Distance**
- **Exhibits 0, 3 and 8**
- **Chart 3**

The KLLC North loop circles the area around the North Bay and the Southern part of the Sonoma Valley. The KLLC signal was virtually unobstructed by terrain, as the signal travels across water for the majority of the loop. Correspondingly, digital reception was unimpaired, with no blends to analog.

4.4.3 Presentation

The results of these tests conducted with a transmitted IBOC power output of 518 watts are summarized by the IBOC coverage profile shown in Exhibits 1 thru 8. These maps, using data recorded by the Field Test PC application, color code the audio mode of the IBOC receiver along each of the six KLLC field test loops. Map 7 overlays data on a color coded terrain elevation matrix and Map 8 uses a computerized prediction of received signal strength. The audio mode colors signify two main regions of IBOC coverage:

- Region 1 (green) indicates the portion of the radial where digital audio is uninterrupted;
- Region 2 (red) indicates the portion of the radial where the audio has blended to analog.

4.4.4 Analysis

IBOC field performance may be further illustrated by analyzing the full suite of test data recorded along each of the six loops. In particular, the analysis will focus around critical locations along these radials. One point or more on each radial was chosen to illustrate the superior performance of the IBOC signal as referenced to analog. In each case, the digital audio shows little or no degradation while the analog is impaired.

The suite of test data is presented via strip-chart recording. The strip-chart recording, comprised of data logged by the Field Test PC application, is shown in Charts 1 thru 6. The strip chart displays the variation of selected parameters with time over the entire length of the loop. [5] The "X" axis of the chart displays elapsed time. The "Y" axis displays both signal strength in dBu (left scale) and distance from transmitter in km (right scale).

4.4.5 Observations

A couple of observations can be made regarding these strip charts:

The traces of the first adjacents do not accurately represent the actual interference environment over much of the radial, since the DAB sidebands are included in adjacent channel measurements. The upper and lower first adjacent traces are each about 25 dB below the desired signal, because this is the level of each DAB sideband relative to its host.

Also, the transition from Region 1 (digital) to Region 2 (blend) occurs as a result of a significant drop in received signal strength. When cross-referenced to the corresponding terrain profile, it is clear that blending begins at a point that experiences extreme terrain shadowing. In fact, the signal profile closely approximates the terrain profile, indicating that signal strength is proportional to elevation.

4.4.5.1 Comparison of IBOC Coverage to Existing Analog Signal Levels

To provide context to the measured IBOC coverage shown in Exhibit 0, iBiquity has superimposed the test loops on a Map which predicts the analog signal levels of KLLC (Exhibit 8).

This map, generated using propagation prediction software, displays the predicted analog signal strength at a given location using color-coded pixels. For example, green areas correspond to signal levels in the 50 to 59 dBu range; a location on the innermost portion of the green area would have a signal strength of 59 dBu, while a location on the outer edge of the green area would have a signal strength of 50 dBu.

The strip-chart recording of Charts 1 thru 6 can be used to confirm the validity of the propagation predictions in Exhibit 8. Charts 1 thru 6 indicate that the IBOC receiver begins to blend at desired signal levels of about 45 dBu. Exhibit 8 shows that blends for most radials commence in the center of the light-blue region, which corresponds to a 45 dBu signal level. Therefore, actual field measurements verify that the signal-strength prediction map of Exhibit 8 is indeed accurate.

4.4.5.2 Comparison of Measured Digital Performance with Existing Analog Service

Besides showing that the IBOC receiver begins to blend at a signal level of about 45 dBu, Exhibit 8 illustrates that the edge of digital coverage lies beyond the 40 dBu signal level, and that solid, unperturbed digital coverage extends to the 50 dBu signal level. It can be shown from Exhibit 8 that iBiquity IBOC digital coverage is comparable to existing analog coverage

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[5]
- Desired signal strength, in dBu (red)
- Upper (blue) and lower (yellow) first adjacent signal strength, in dBu
- Upper (black) and lower (magenta) second-adjacent signal strength, in dBu
- Distance from the transmitter, in km (orange)
- Receiver audio mode, digital or analog (green)

4.4.6 Test Results Summary

In regions denoted by green (digital) markers, the IBOC signal covers a huge area with no lapses in digital coverage; the audio is completely free of degradation that typically plagues existing analog service. Even in unimpaired conditions, the digital audio quality is superior to analog audio quality.

In regions denoted by instantaneous transitions between green (digital) and red (analog) markers, the iBiquity blend function exploits the availability of both the analog and digital portions of the hybrid signal. The receiver outputs unimpaired digital audio, and seamlessly blends to analog when the digital audio is sufficiently impaired. This maximizes the quality of the audio beyond that of existing analog service.

Regions outlined in red (analog) for longer distances, characterize areas of severely degraded reception. The digital signal cannot be recovered here, and the analog performance is very poor.

The results of the Digital Coverage field test have confirmed the findings of extensive simulations and laboratory performance tests. The audio quality of the iBiquity IBOC digital signal is superior to analog audio quality, and the digital coverage is comparable to that provided by existing analog service, with a digital reliability of over 88% throughout the test area.

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5 Field Test Summary

These field test results have demonstrated the superior performance of the iBiquity FM hybrid IBOC system in a real-world environment, and have validated the results of extensive simulations and laboratory performance tests. The Digital Coverage tests in this report illustrates that the IBOC audio quality exceeds that of an existing analog FM signal, and shows that IBOC offers coverage comparable to existing analog service.

Over the past four years, iBiquity has performed detailed analyses, run exhaustive simulations, implemented its IBOC design in receivers and exciters, verified the simulations and analyses in laboratory tests, and validated all results through real-world field testing. The collective evidence from all of these sources mutually confirms the fact that the iBiquity FM IBOC system performs as designed, offering an excellent path for broadcasters and listeners into the future of radio – a digital future that is secured by the superior performance of the iBiquity IBOC system.

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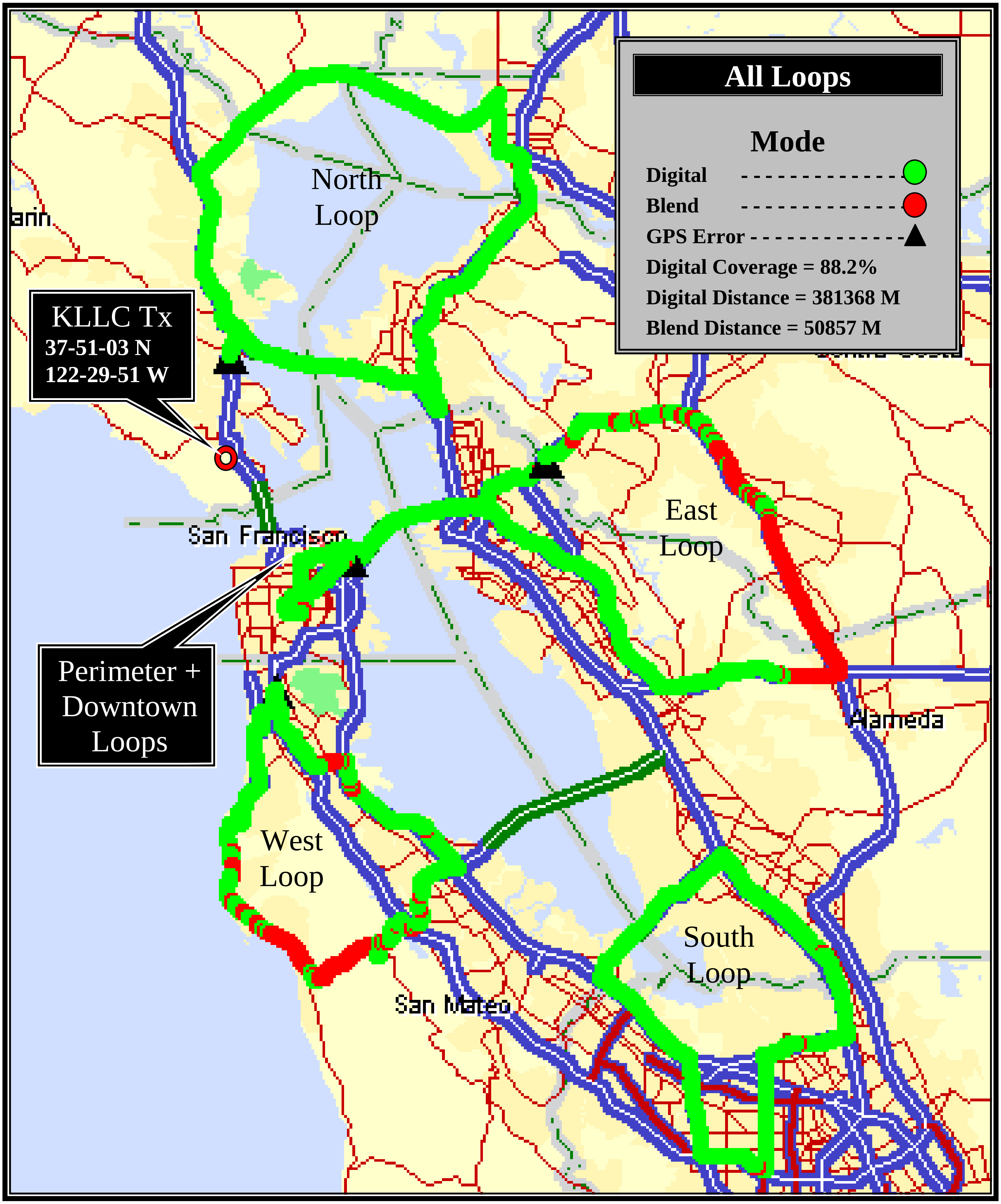

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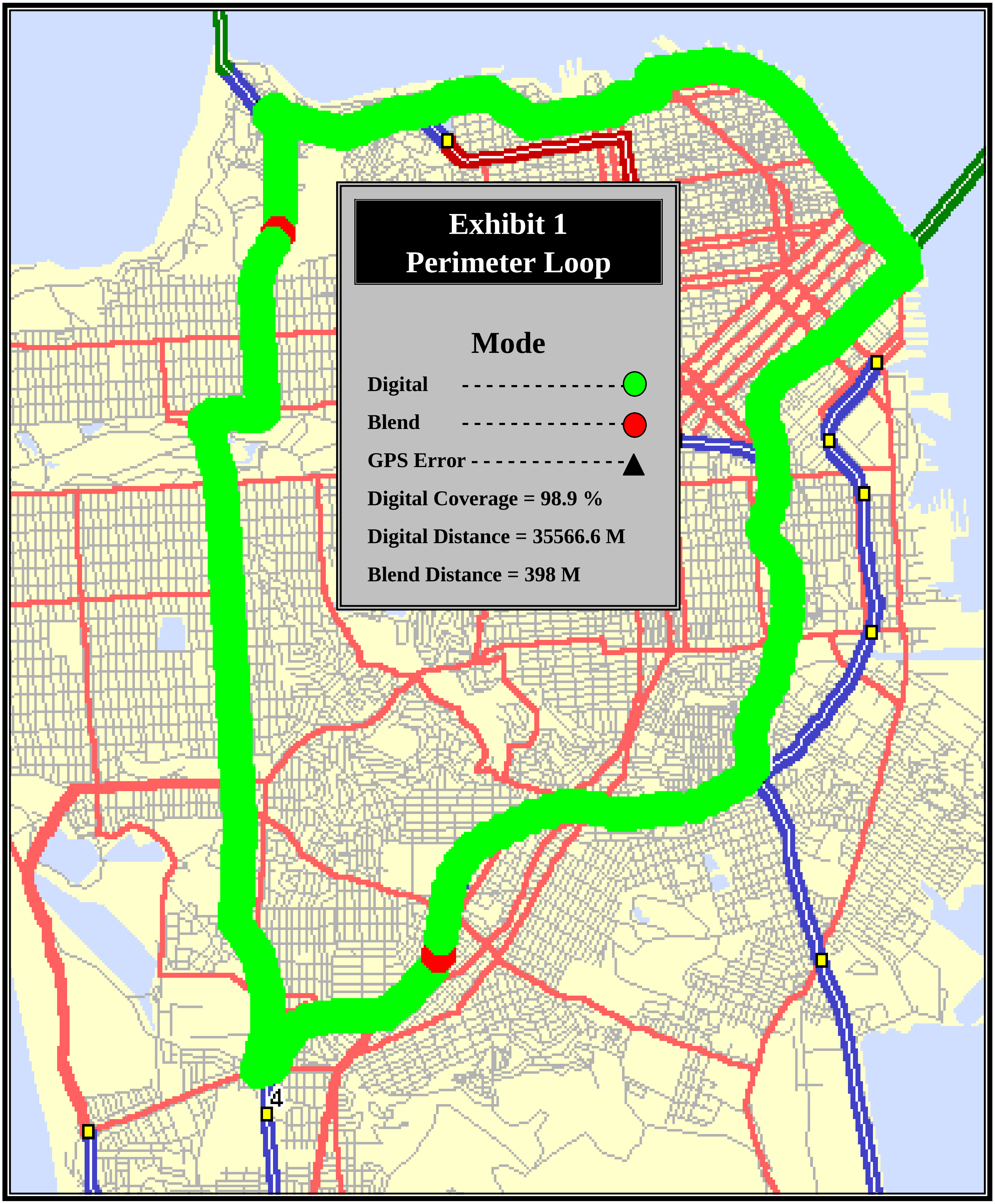
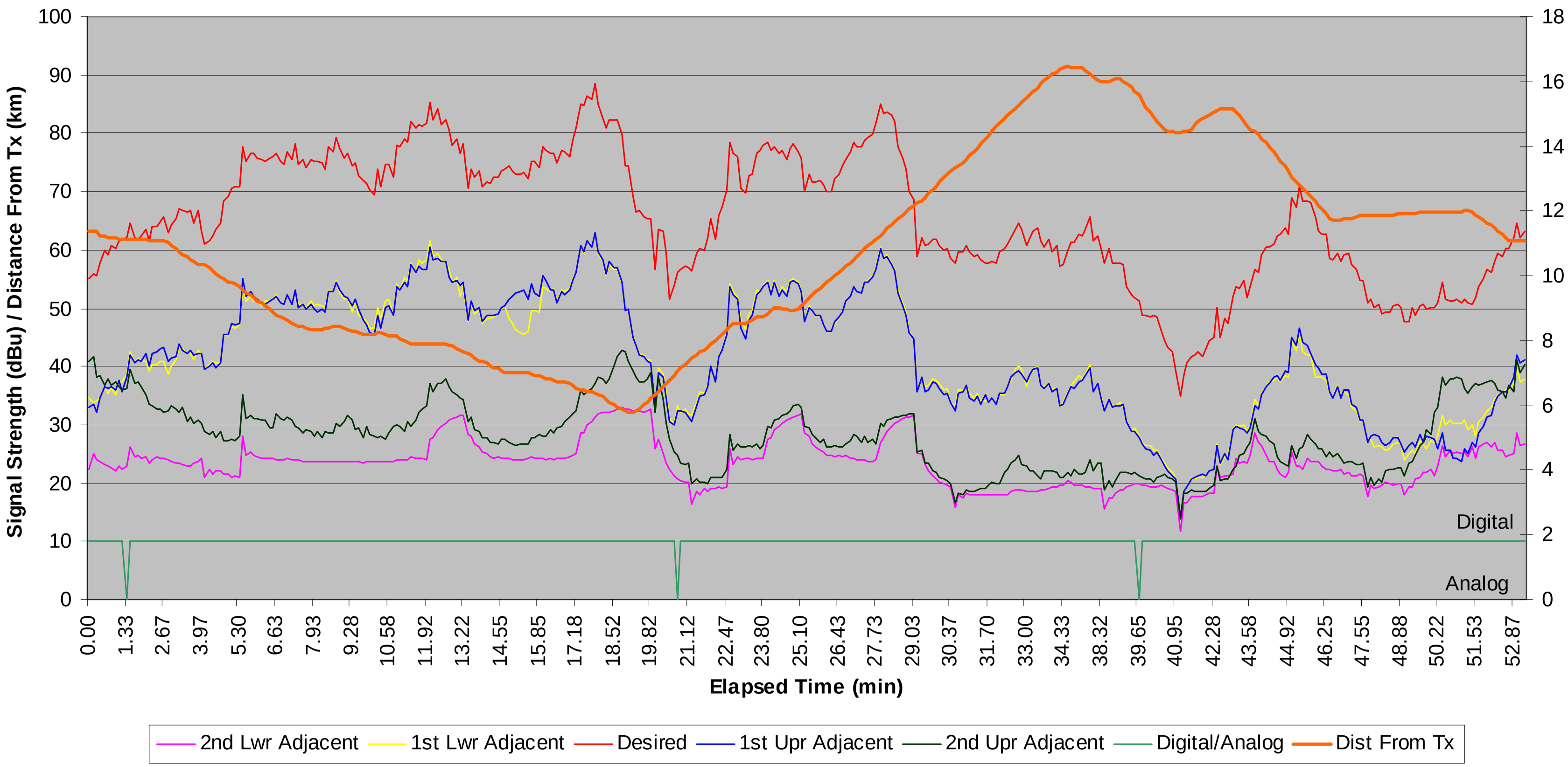


Chart 1

KLLC Perimeter Loop



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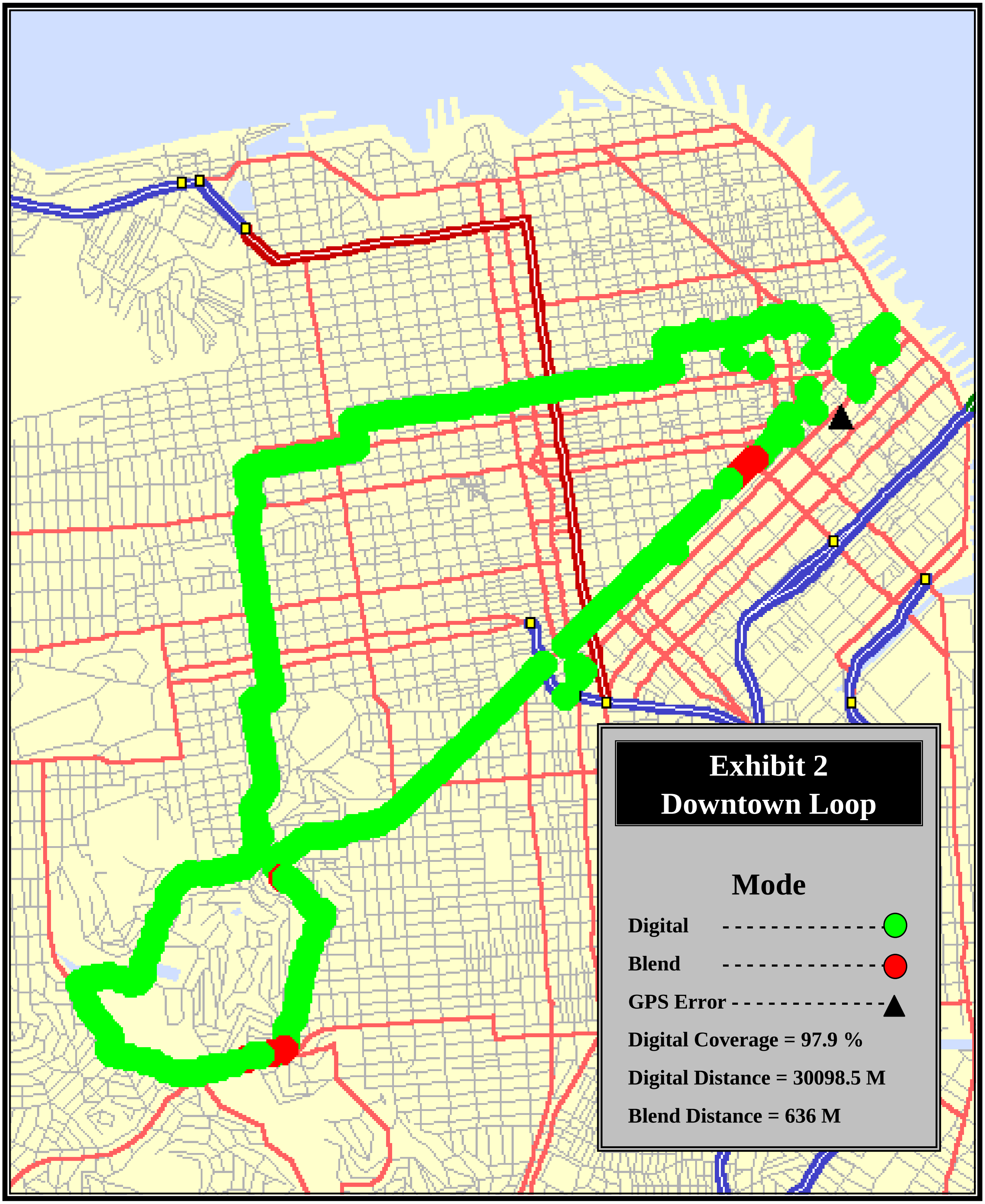
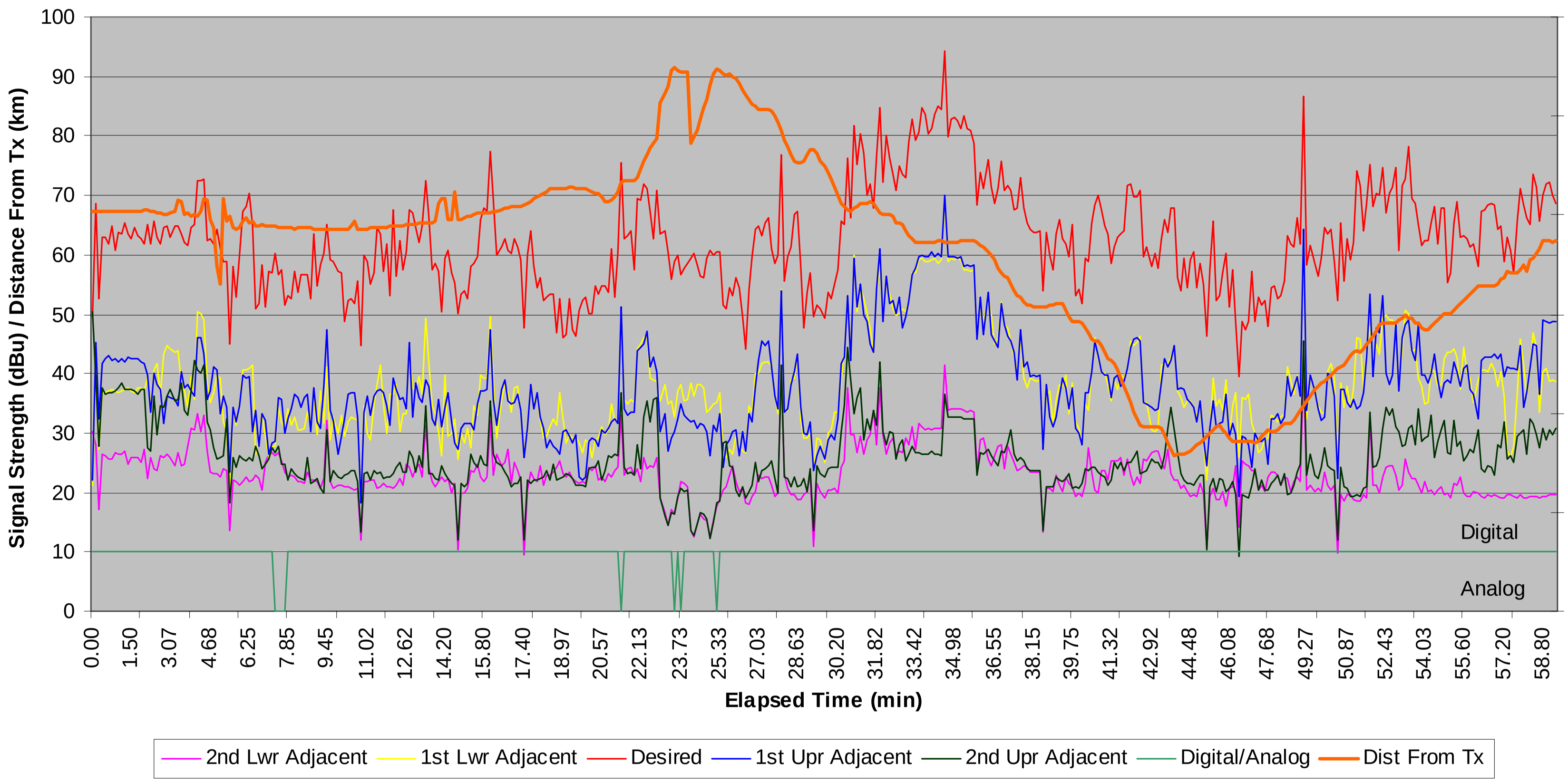


Chart 2

KLLC Downtown Loop



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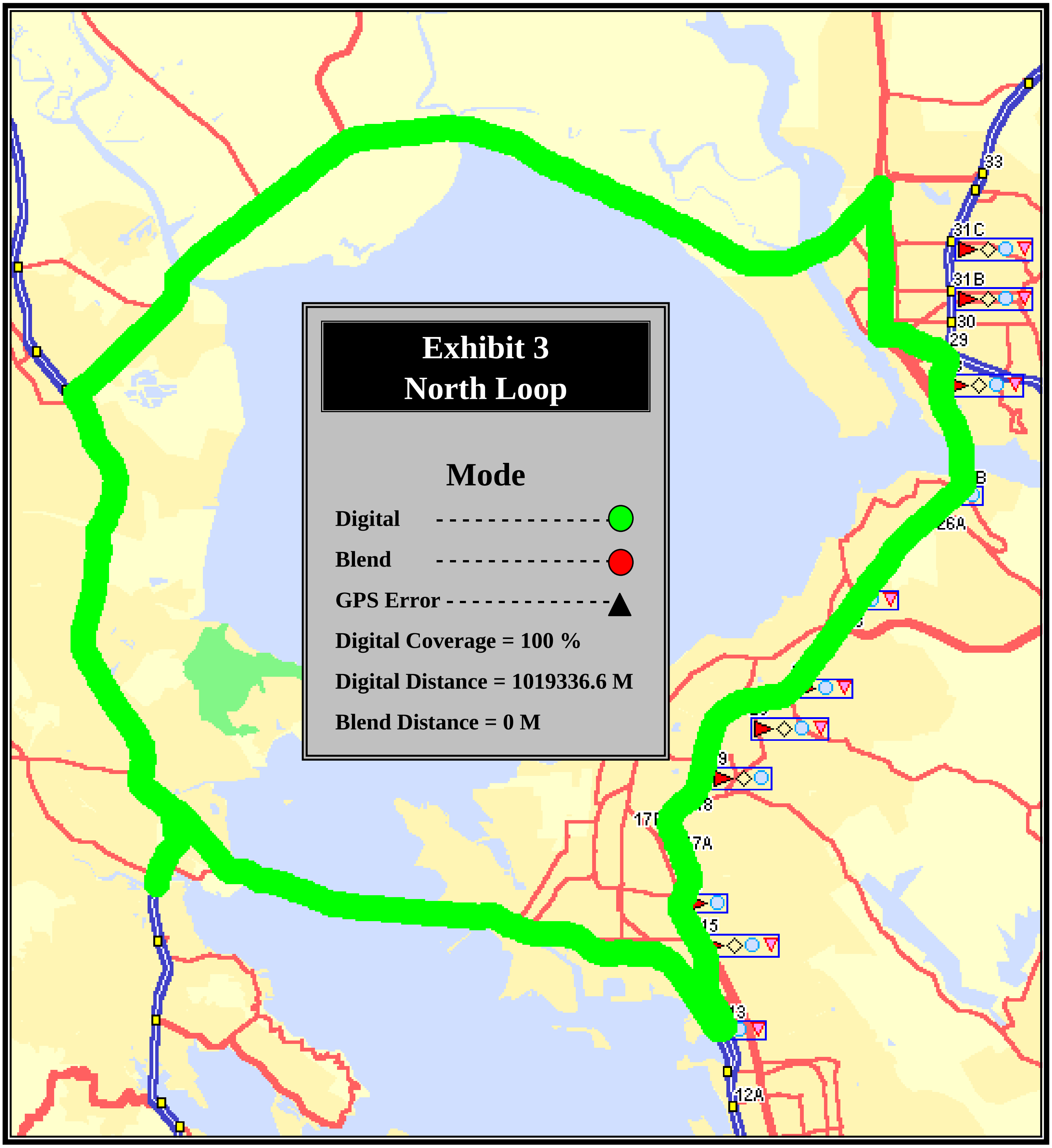
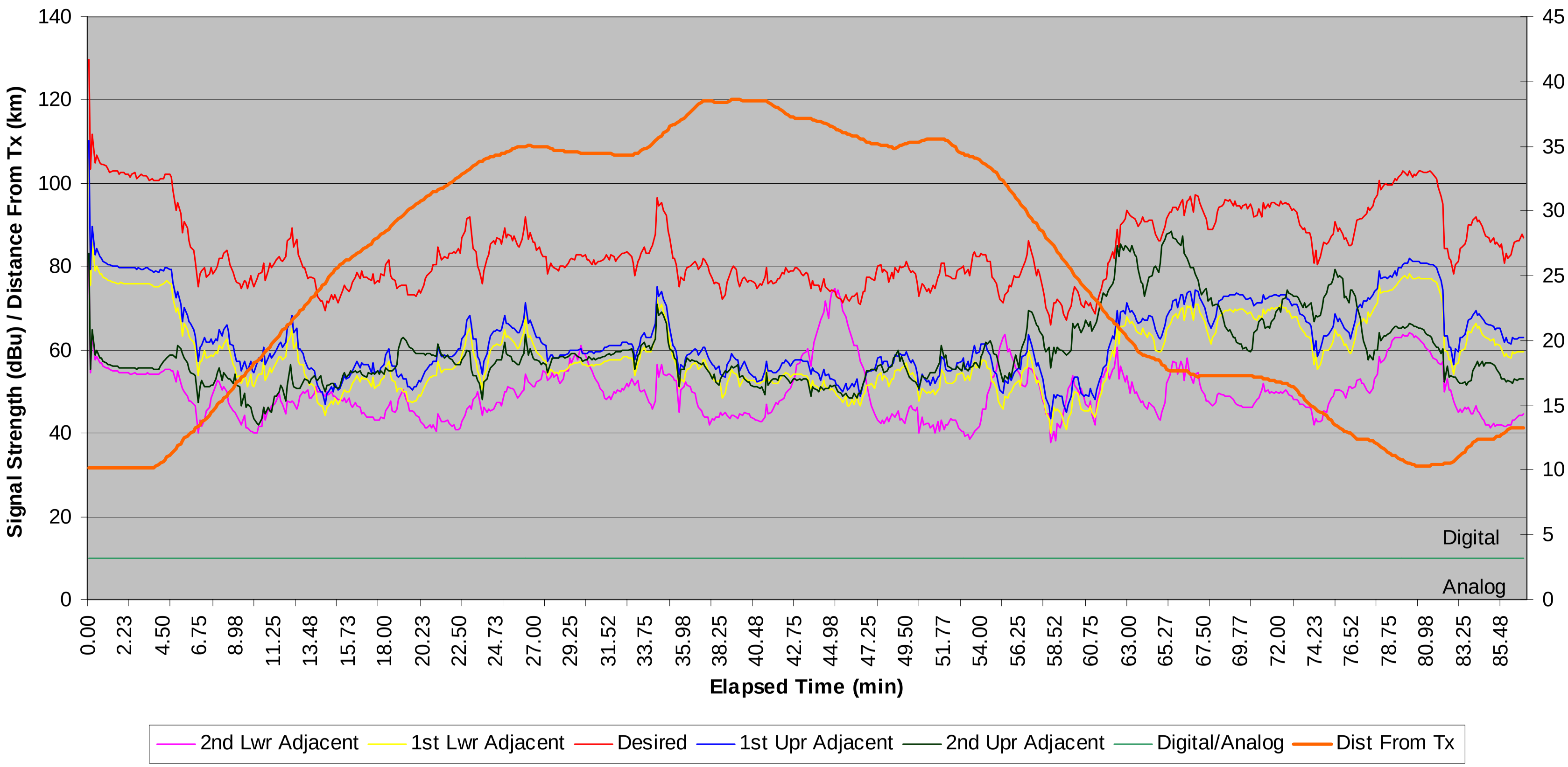


Chart 3

KLLC North Loop



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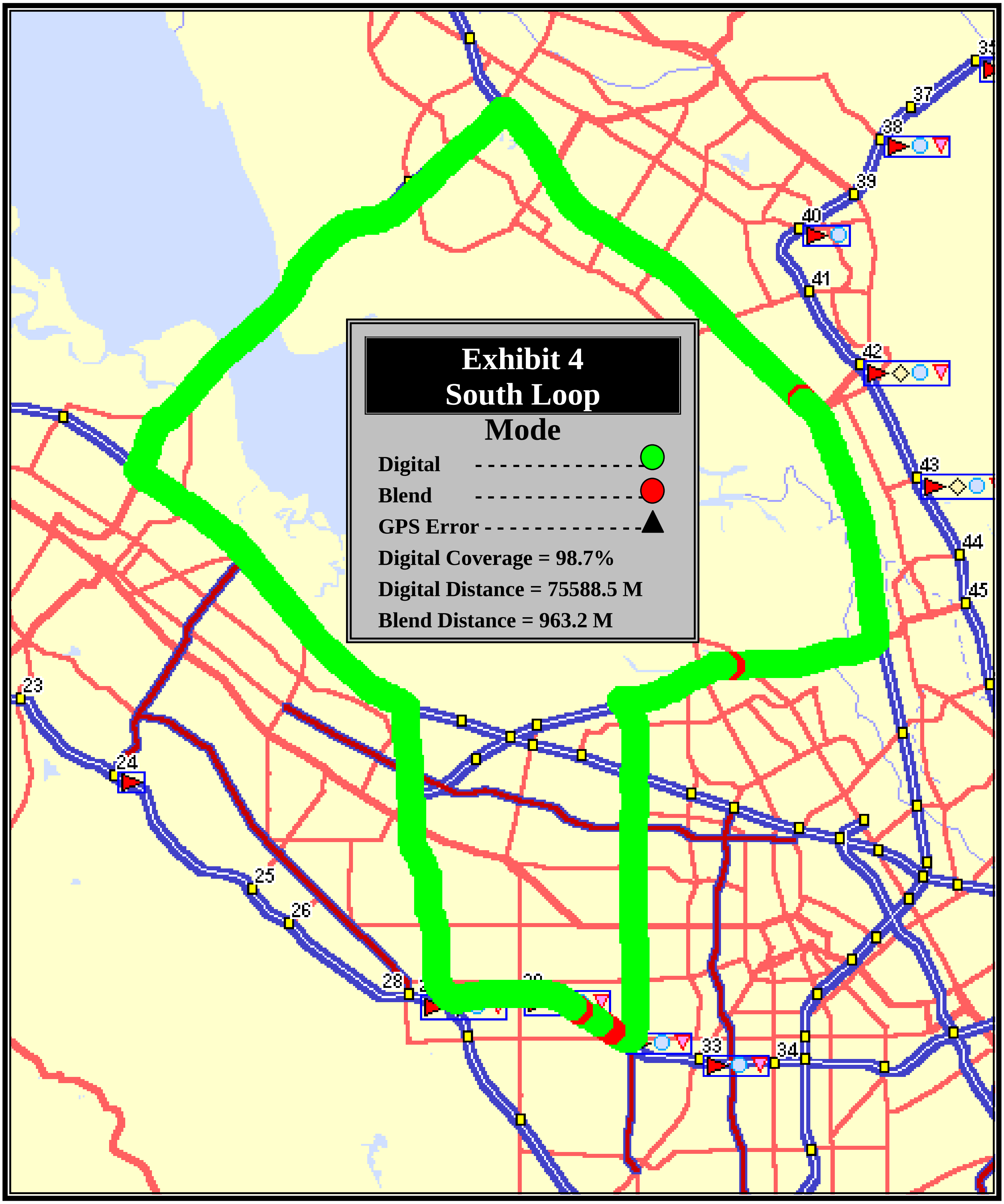

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Exhibit 4A – KLLC South Loop – 2nd Adjacent Interferer

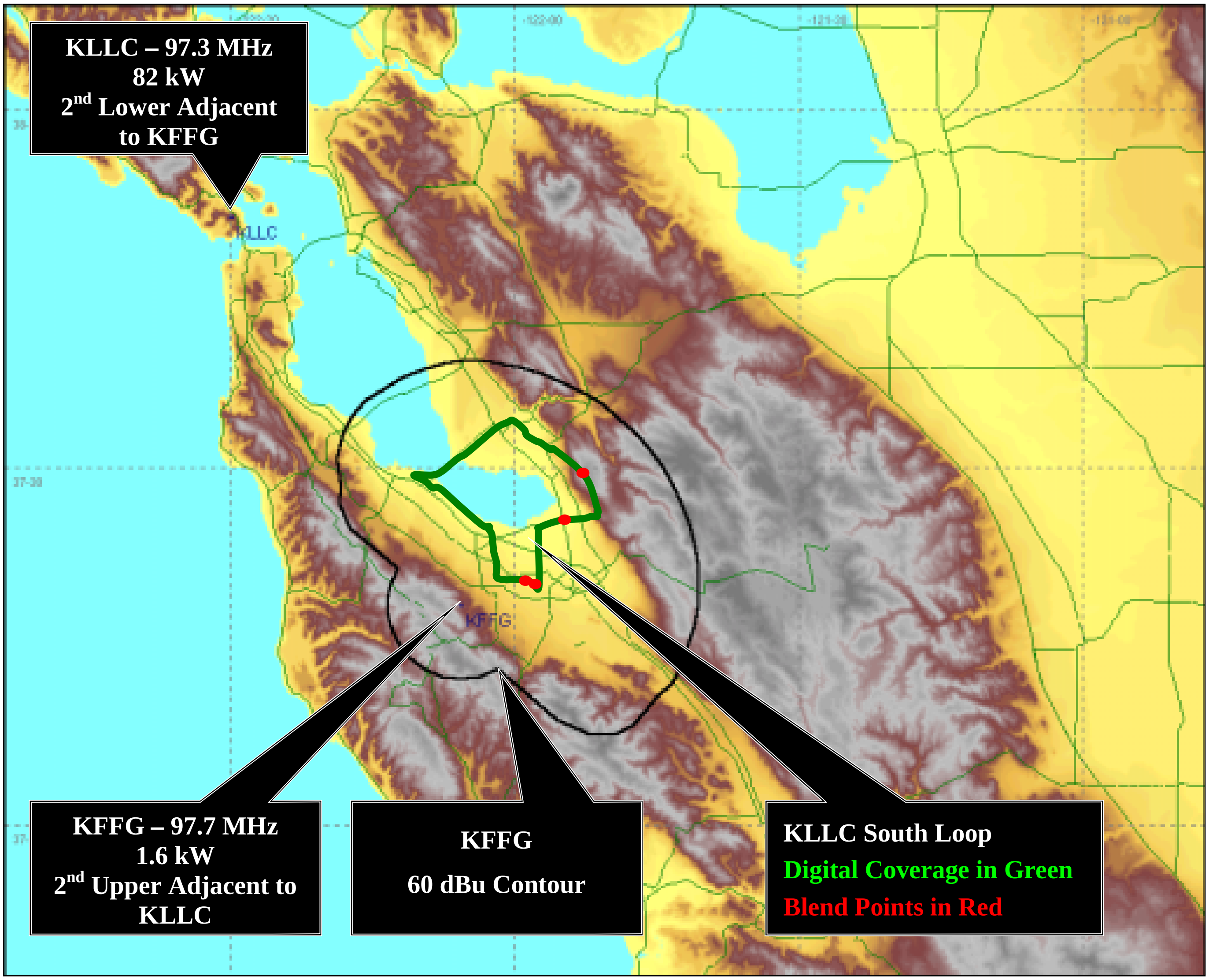
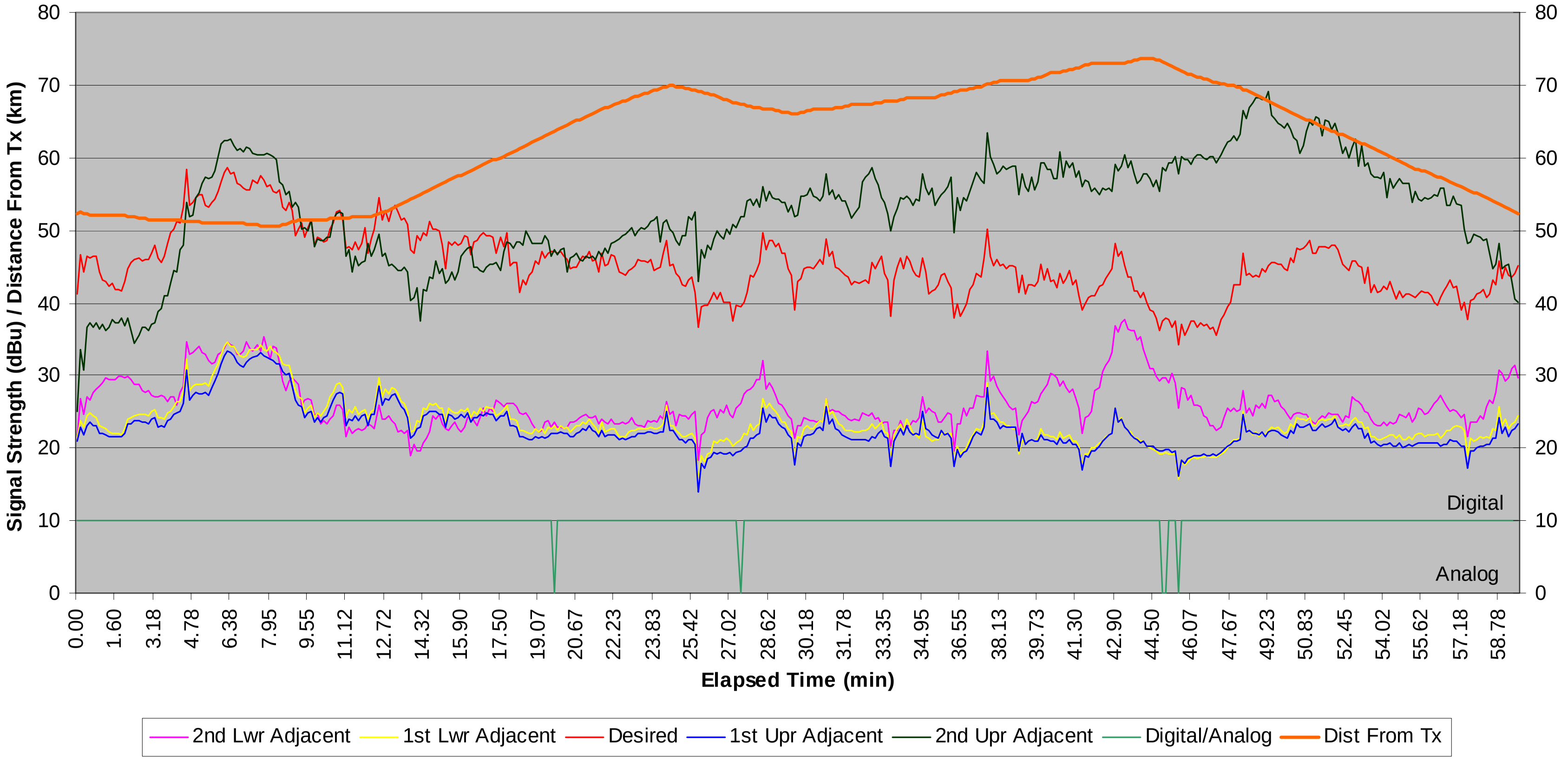


Chart 4

KLLC South Loop



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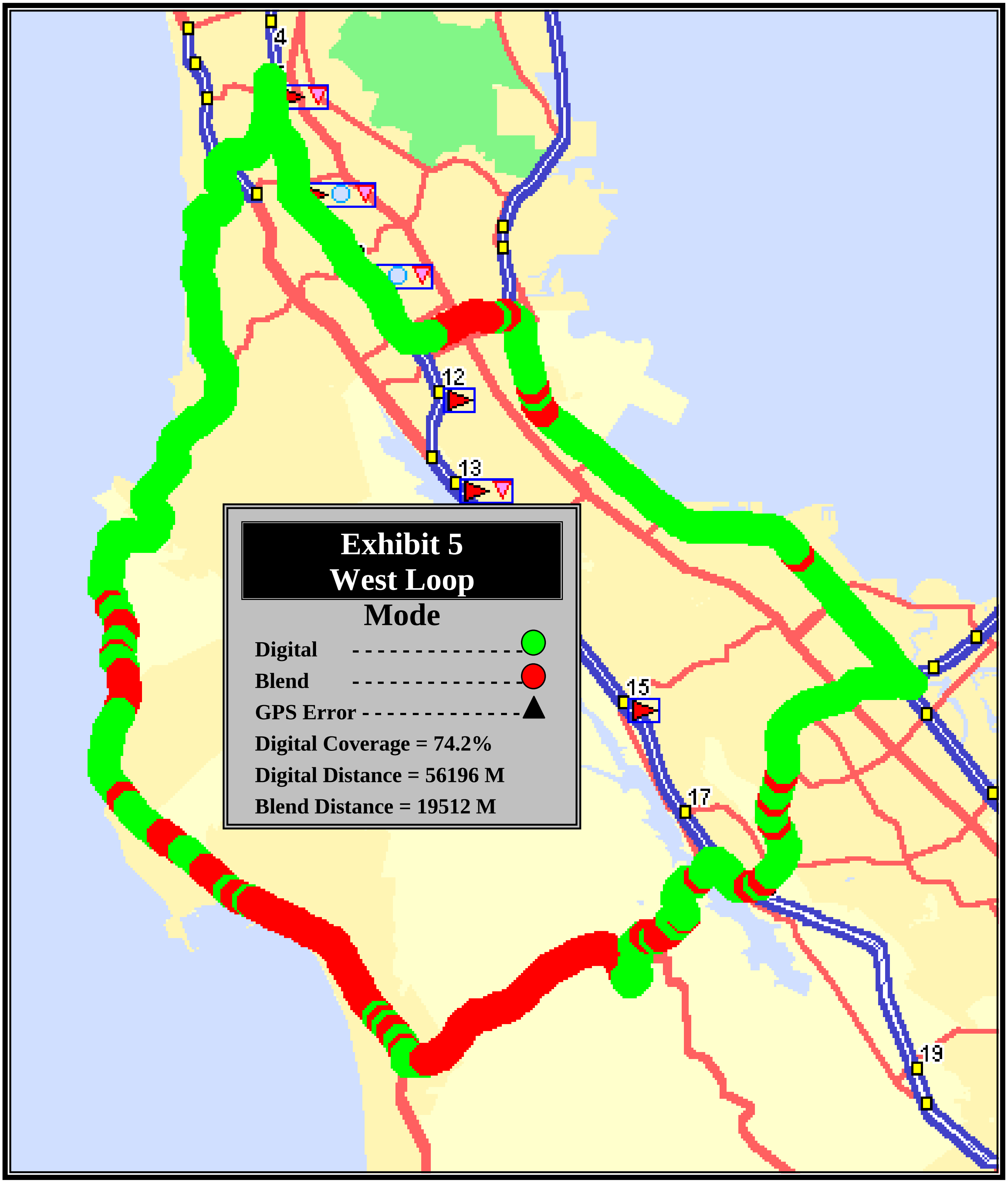
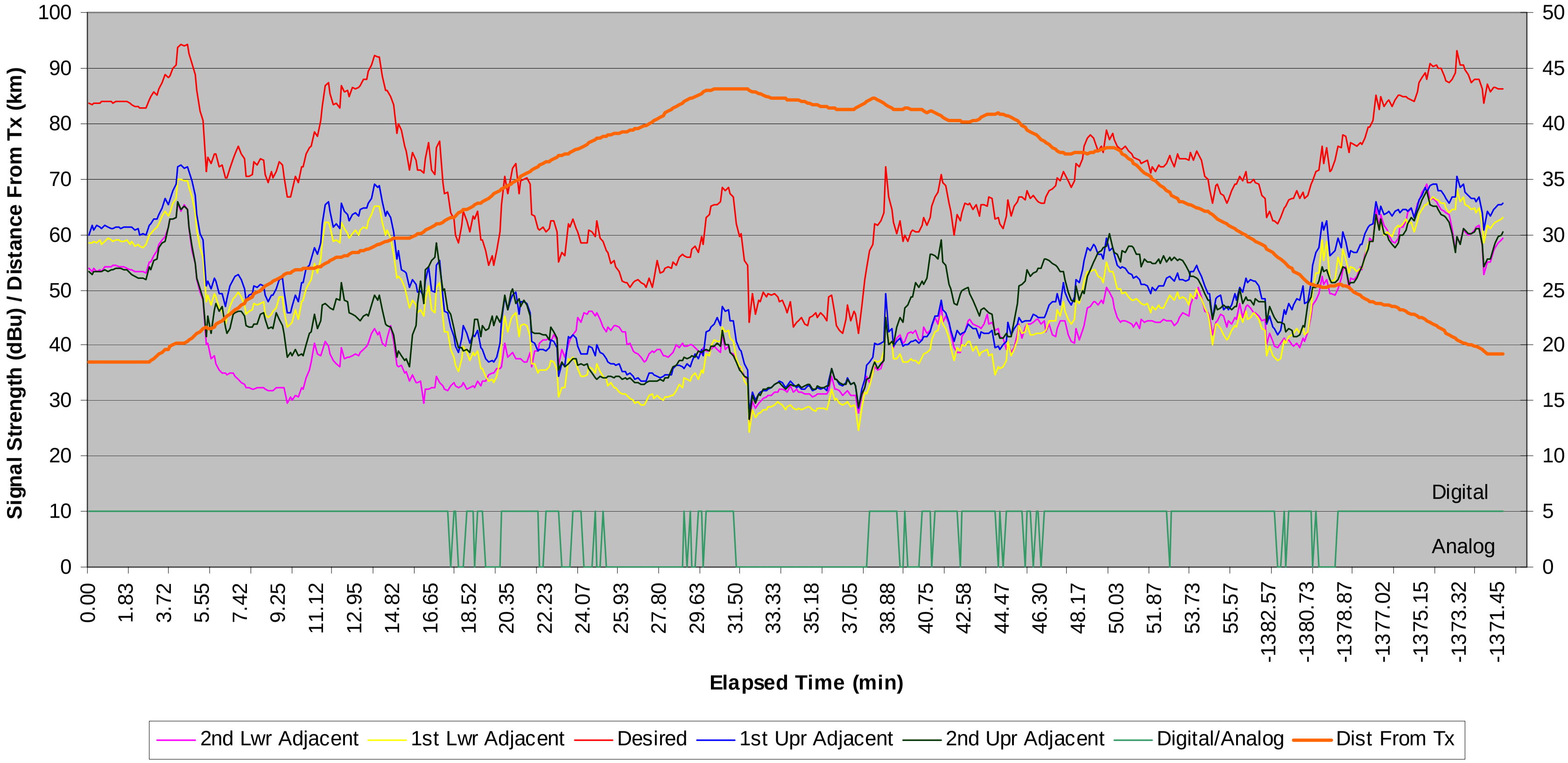


Chart 5

KLLC West Loop



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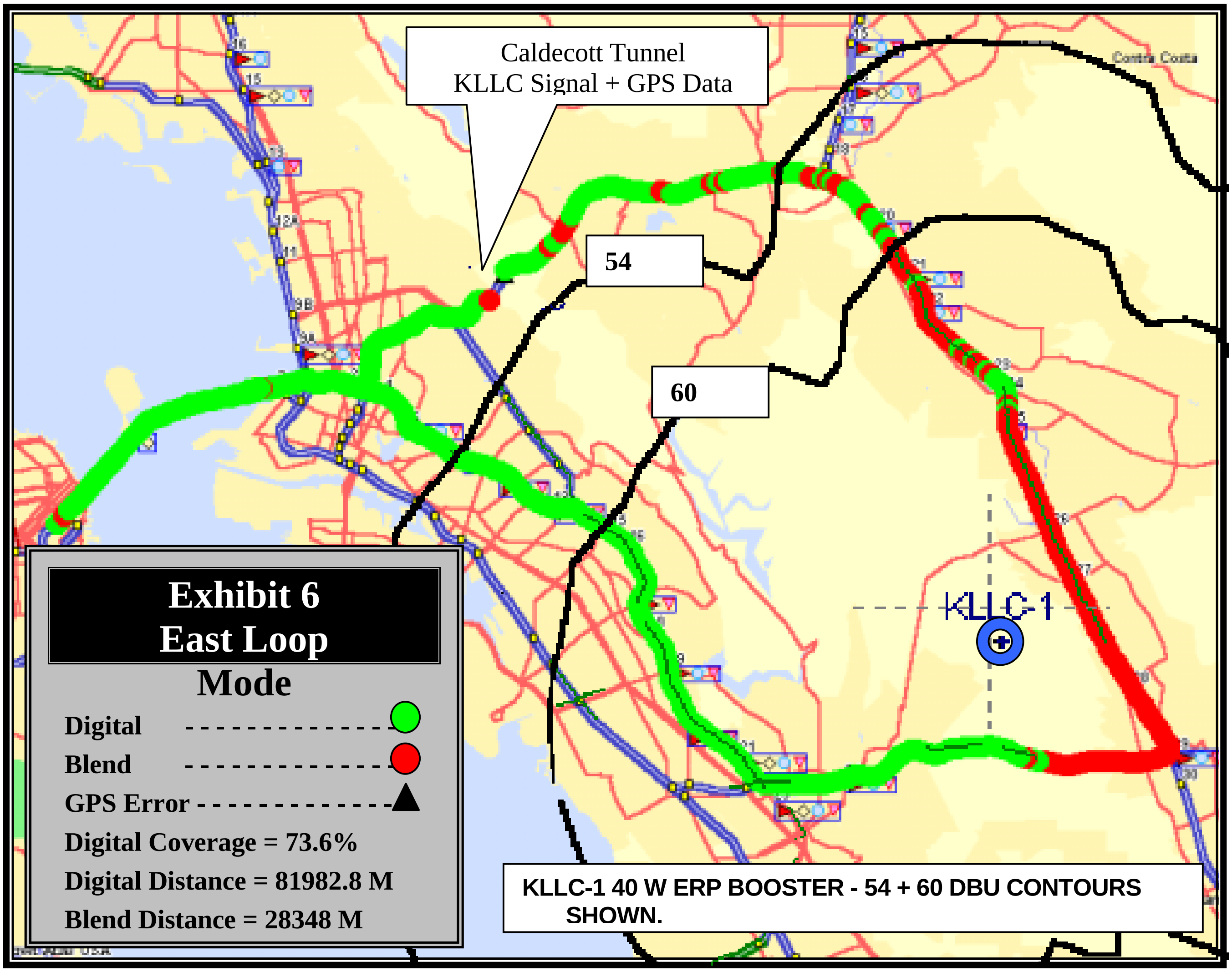

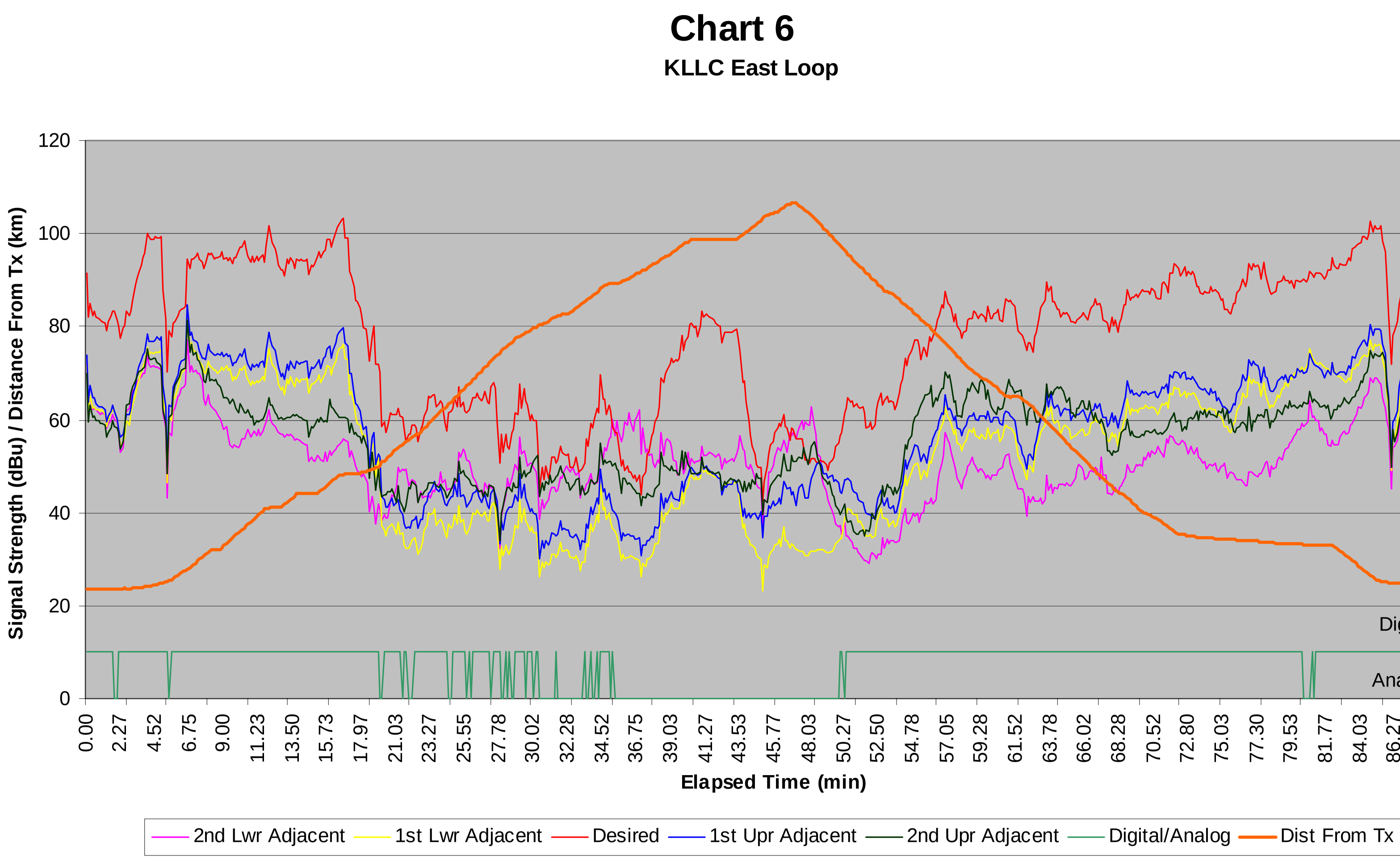
Chart 6
KLLC East Loop
Signal Strength (dBu) / Distance From Tx (km)
Elapsed Time (min)
Digital
Analog
2nd Lwr Adjacent
1st Lwr Adjacent
Desired
1st Upr Adjacent
2nd Upr Adjacent
Digital/Analog
Dist From Tx

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Exhibit 7 – San Francisco Terrain - West and East Loops

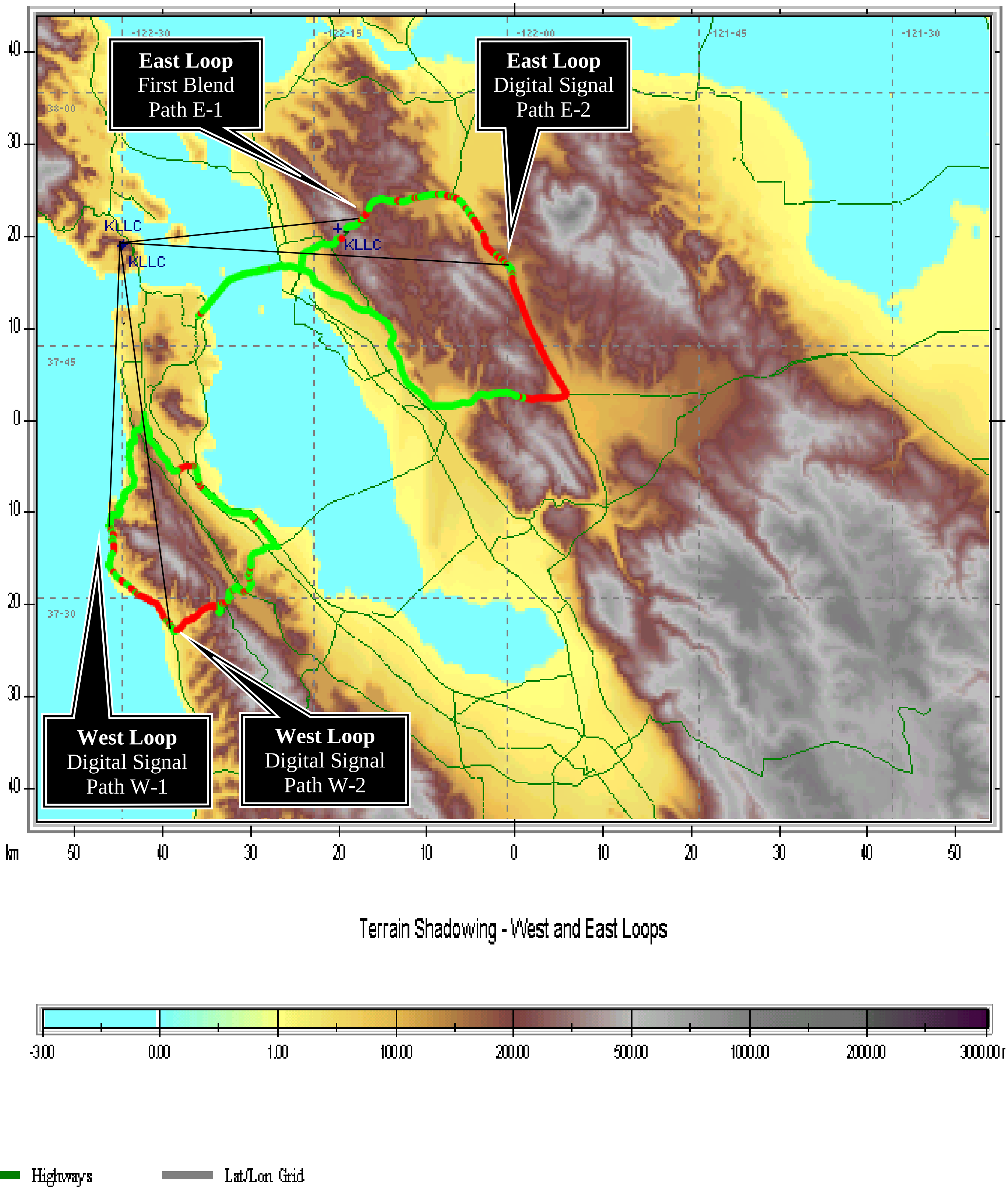

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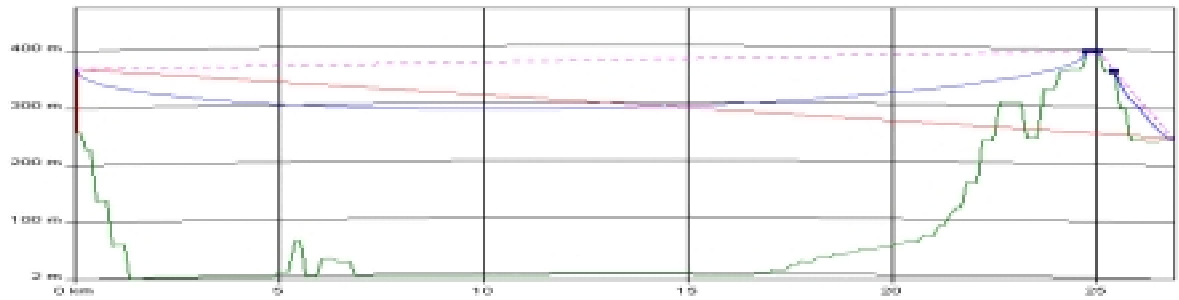
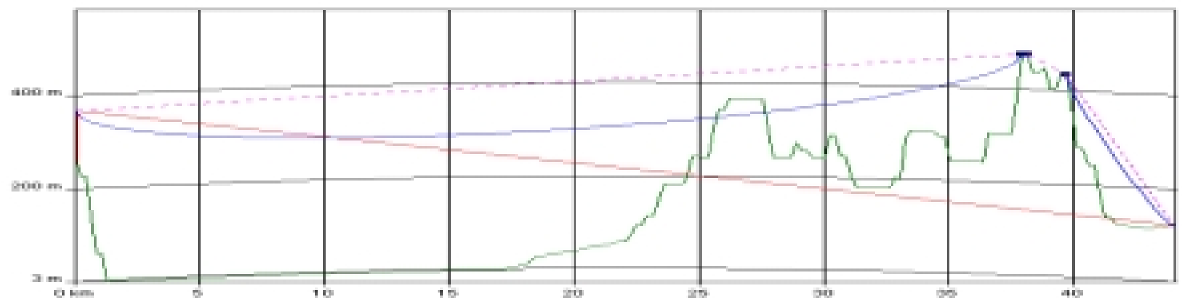
Exhibit 7A - KLLC Terrain Profiles – West and East Loops

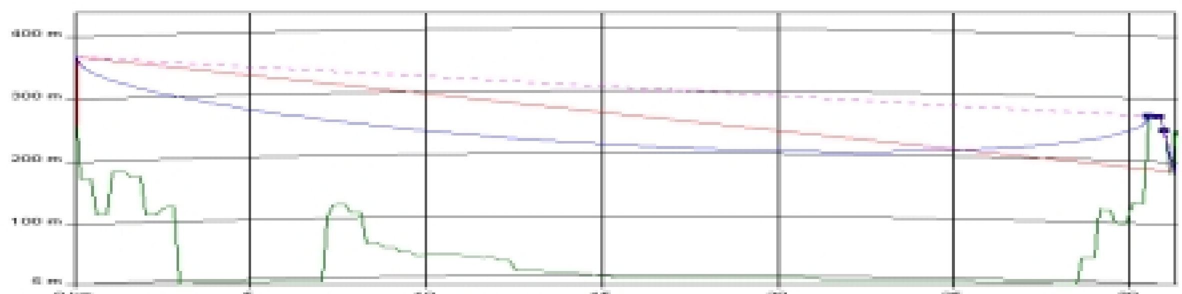
Path W1 - KLLC West Loop – Point of First Blend



Path W2 - KLLC West Loop – Digital Signal



Path E1 - KLLC East Loop – Point of First Blend



Path E2 - KLLC East Loop – Digital Signal

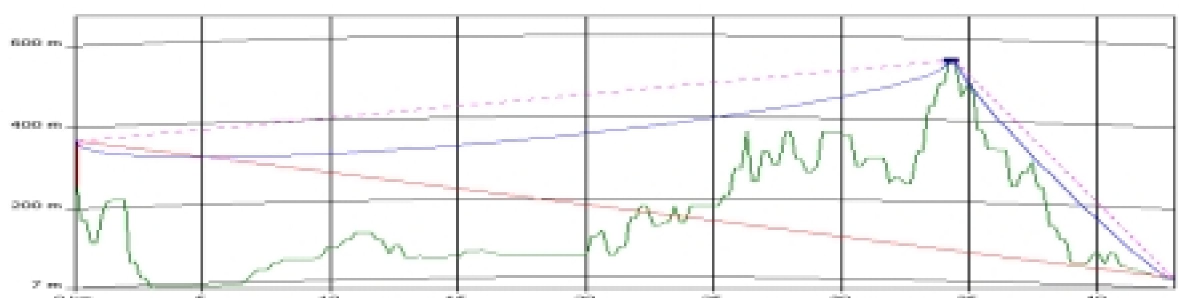


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Exhibit 8 – KLLC Propogation Prediction