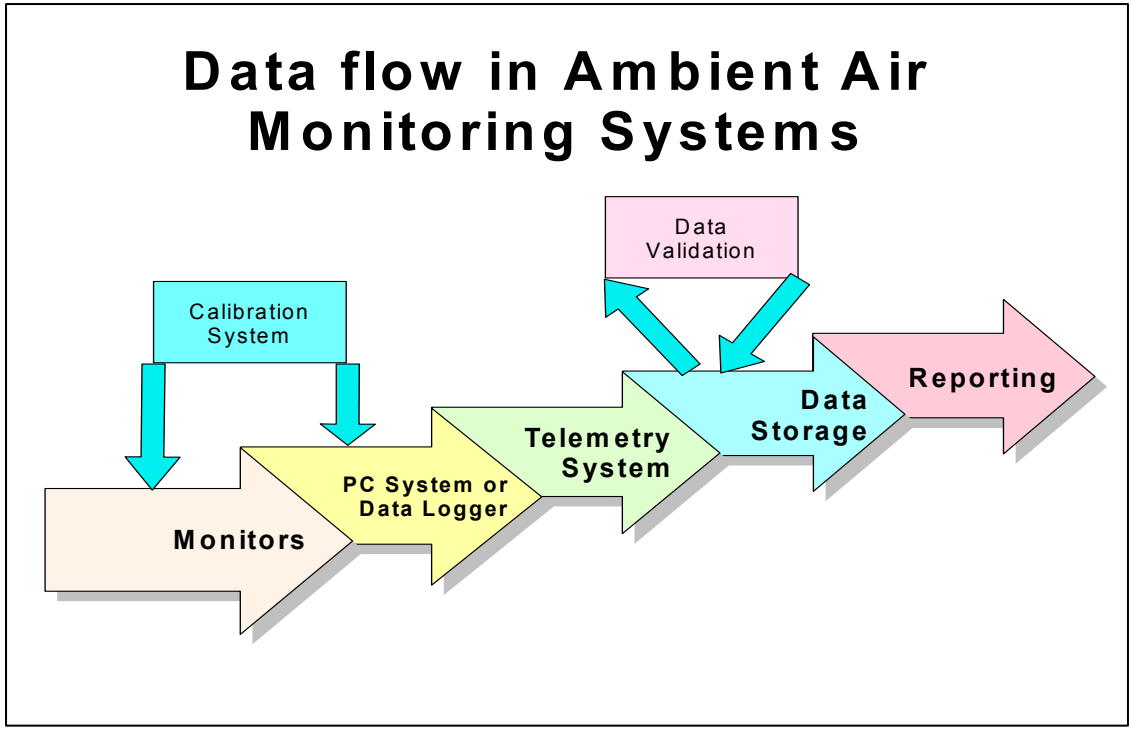
Data Acquisition Considerations in the NCore Monitoring Program



Data Acquisition System (DAS) Challenges in the NCore Program

- Many parameters per site.
- Trace level gas measurements near level of detection.
- Introduction of less familiar instrument types.
- More frequent requirement for quality control procedures.
- Greater role of automation in calibration and data quality control flagging.
- Potential future demands for near real-time data.
- Rural sites will be complex yet potentially remote.

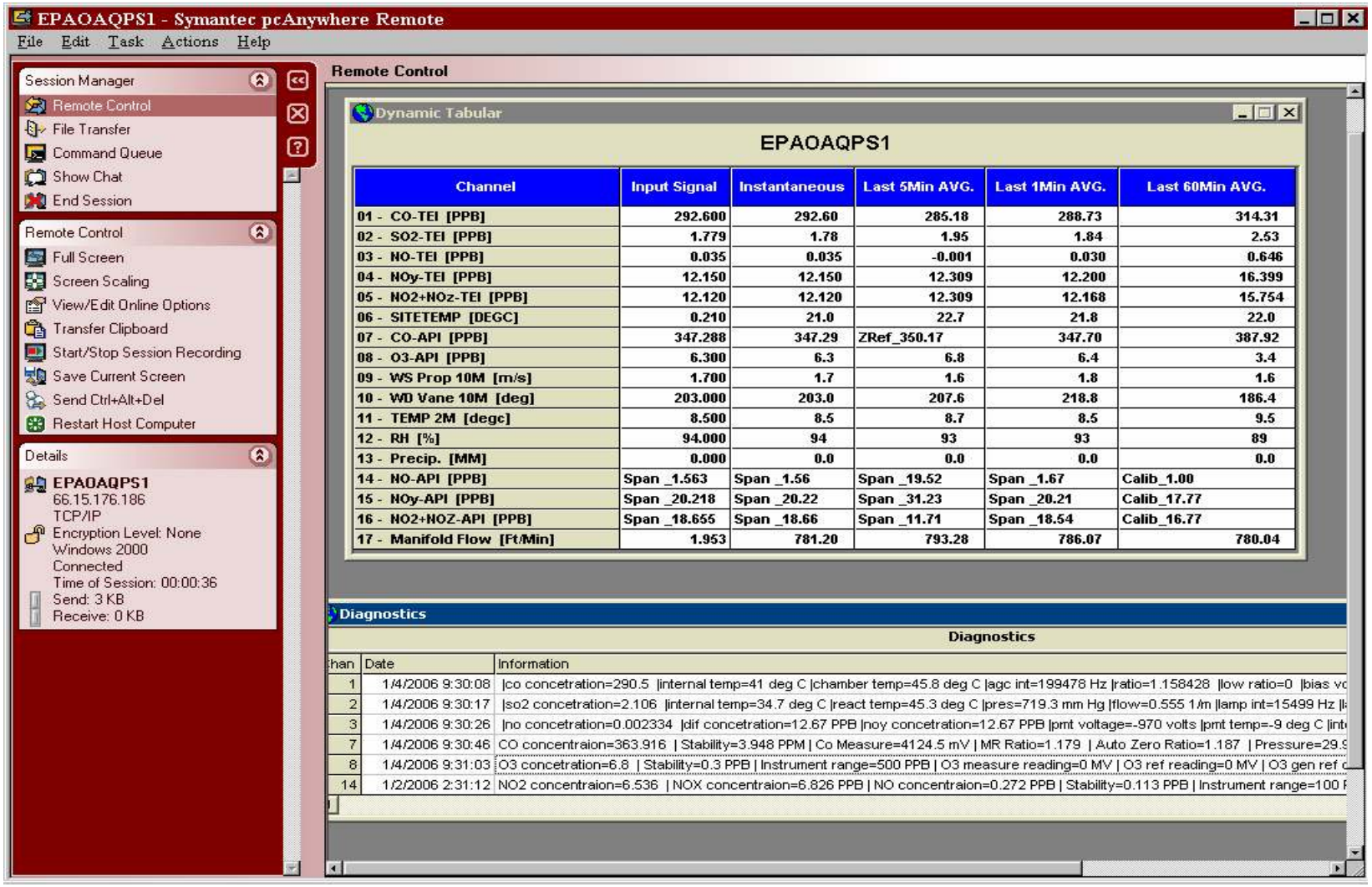
Important Elements of an NCore DAS (1 of 2)

- Robust hardware and software.
  - Stable systems that run flawlessly, restart automatically after power outages, and maintain precise time.
  - Easily configurable and upgradeable software/firmware with integrated security options.
  - Capable of storing and quickly moving large volumes of data through polling and/or pushing.
  - Useful on-site displays and record-keeping for operators and auditors.
  - Ability to poll and store instrument diagnostics as well as concentrations.
  - Multiple backup options to archive data and restore program functions in case of software problems
    - Redundant, swappable hard drives.
    - Restore programs (Norton Ghost).
    - Writeable CDs and DVDs for archive purposes.

Important Elements of an NCore DAS (2 of 2)

- Flexible connectivity for a wide range of gas monitors, PM samplers, met sensors, calibrators, and other external devices (solenoids, status indicators).
  - Digital connection via RS-232, USB, ethernet.
  - Analog connection for legacy devices.
- Remote accessibility for off-site troubleshooting.
- Interfaces with other database applications such as lab management, web support, instrument maintenance records, digital strip charts.
- Powerful and flexible data editing, analysis, and reporting capabilities.
  - AQS, AIRNow, agency web sites.


Moxa Smart RS-232 PCB for PC's



Channel	Input Signal	Instantaneous	Last 5Min AVG.	Last 1Min AVG.	Last 60Min AVG.
01 - CO-TEI [PPB]	292.600	292.60	285.18	288.73	314.31
02 - SO2-TEI [PPB]	1.779	1.78	1.95	1.84	2.53
03 - NO-TEI [PPB]	0.035	0.035	-0.001	0.030	0.646
04 - NOy-TEI [PPB]	12.150	12.150	12.309	12.200	16.399
05 - NO2+NOz-TEI [PPB]	12.120	12.120	12.309	12.168	15.754
06 - SITETEMP [DEGC]	0.210	21.0	22.7	21.8	22.0
07 - CO-API [PPB]	347.288	347.29	ZRef_350.17	347.70	387.92
08 - O3-API [PPB]	6.300	6.3	6.8	6.4	3.4
09 - WS Prop 10M [m/s]	1.700	1.7	1.6	1.8	1.6
10 - WD Vane 10M [deg]	203.000	203.0	207.6	218.8	186.4
11 - TEMP 2M [degc]	8.500	8.5	8.7	8.5	9.5
12 - RH [%]	94.000	94	93	93	89
13 - Precip. [MM]	0.000	0.0	0.0	0.0	0.0
14 - NO-API [PPB]	Span _1.563	Span _1.56	Span _19.52	Span _1.67	Calib_1.00
15 - NOy-API [PPB]	Span _20.218	Span _20.22	Span _31.23	Span _20.21	Calib_17.77
16 - NO2+NOZ-API [PPB]	Span _18.655	Span _18.66	Span _11.71	Span _18.54	Calib_16.77
17 - Manifold Flow [Ft/Min]	1.953	781.20	793.28	786.07	780.04

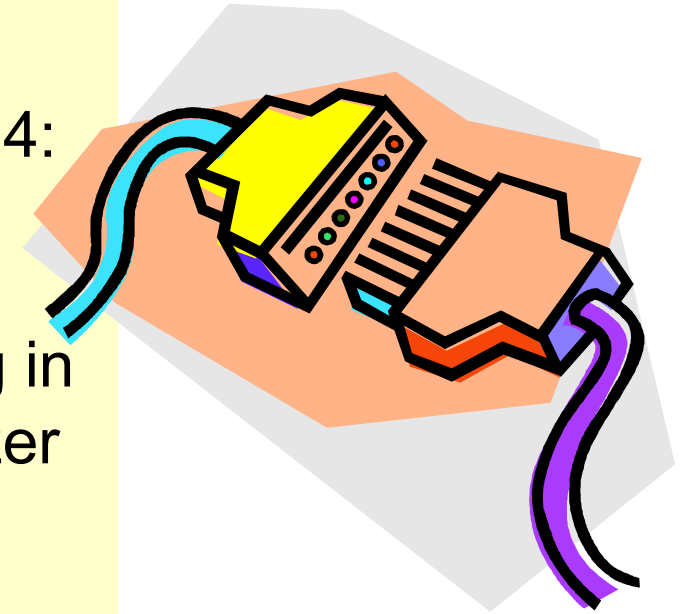
Chan	Date	Information
1	1/4/2006 9:30:08	|co concetration=290.5 |internal temp=41 deg C |chamber temp=45.8 deg C |agc int=199478 Hz |ratio=1.158428 |low ratio=0 |bias vo
2	1/4/2006 9:30:17	|so2 concetration=2.106 |internal temp=34.7 deg C |react temp=45.3 deg C |pres=719.3 mm Hg |flow=0.555 1/m |lamp int=15499 Hz |l
3	1/4/2006 9:30:26	|no concetration=0.002334 |dif concetration=12.67 PPB |noy concetration=12.67 PPB |pmt voltage=-970 volts |pmt temp=-9 deg C |int
7	1/4/2006 9:30:46	CO concentraion=363.916 | Stability=3.948 PPM | Co Measure=4124.5 mV | MR Ratio=1.179 | Auto Zero Ratio=1.187 | Pressure=29.9
8	1/4/2006 9:31:03	O3 concetration=6.8 | Stability=0.3 PPB | Instrument range=500 PPB | O3 measure reading=0 MV | O3 ref reading=0 MV | O3 gen ref c
14	1/2/2006 2:31:12	NO2 concentraion=6.536 | NOX concentraion=6.826 PPB | NO concentraion=0.272 PPB | Stability=0.113 PPB | Instrument range=100 P

Remote access programs can save time by helping to diagnose instrument problems, solve DAS configuration issues, and support upgrades and patches.

Analog versus Digital Connectivity

From the Technical Assistance Document (TAD) for Precursor Gas Measurements in the NCore Multi-pollutant Monitoring Network, Version 4:

"The recommended data acquisition approach for precursor gas monitoring in NCore is a system that records analyzer readings and diagnostic information in digital form….."



Analog Connectivity

Susceptible to noise affecting the data stream, particularly in precursor gas applications where signal exists at bottom of usable voltage range.	
Requires numerous wires to accommodate multiple data channels. Prone to loose or broken connections.	
Requires analog to digital calibrations to match instrument outputs to DAS readings.	
May not be available on newer instruments or may be an extra-cost option. Limited output capabilities in some instruments.	
May limit or prevent acquisition of diagnostic information.	
Familiar and relatively simple to configure in many cases.	
May be only data-out option in older equipment.	

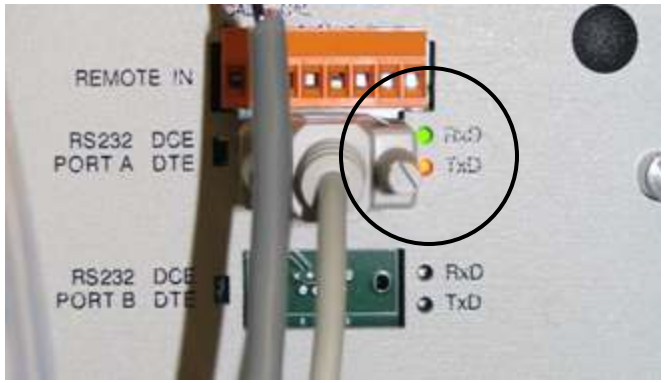
Digital Connectivity

Multiple data types can stream across single physical connection (concentrations, diagnostics, status).	
No risk of data corruption due to analog noise at very small voltage signal levels.	
D/A calibrations not required. Data system values always match analyzer values.	
Addressable monitors can be individually interrogated through multi-dropped wiring. Additional flexibility in tracking over-range conditions where analog signal “pegs.”	
Facilitates remote access capabilities.	
Initial configurations can be challenging. Digital systems can be sensitive to changes in instrument firmware and output formats.	
Requires some enhanced understanding of communication protocols and connector options.	

Making the Digital Connection Work for You

- Insure that logger RS-232 ports are properly configured.
- Mark your cables and use the right types.
- Fully understand the syntax used by your instruments.
- Utilize latest DAS and instrument firmware.
- Let DAS vendors do some of the legwork for you.
- Troubleshoot configurations in the lab then export to field sites after debugging.
- Make friends with an electronics technician.
- Once you get successful communications, it should always work.

A recipe for trouble……

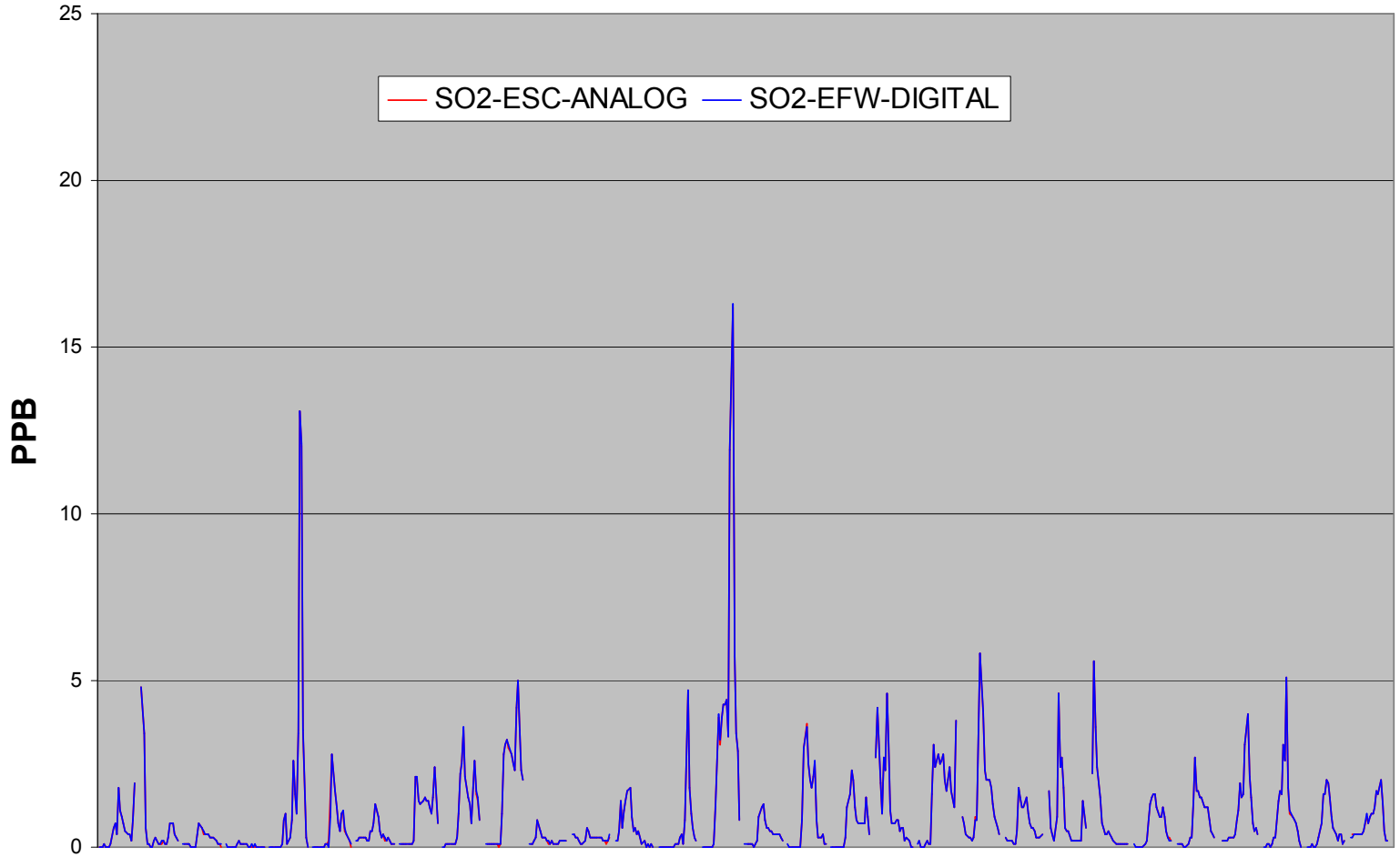


Helpful RxD and TxD lights

Building Redundancy into your DAS Configurations

- Consider retention of analog connections when deploying digital-based based DAS.
  - Use analog system to monitor voltage outputs (where available) and archive for backup/comparison purposes.
  - Need to coordinate status flags and calibration schedules to avoid "spoiling" analog data.
- Configure internal monitor data storage for useful averaging periods (1-minute, 1-hour).
  - Manually download during operator visits or remotely.
  - Validation during off-line periods can be problematic.
- Document alternative data retrieval procedures in SOP and QAPP before you actually need to report such data.
- EPA station uses Envidas for Windows PC-based system as primary digital system and ESC 8832 logger monitoring analog signals as secondary system.
  - TEI and API monitors also configured to store averages.

SO_2 Data (Analog vs. Digital Trace Comparison)



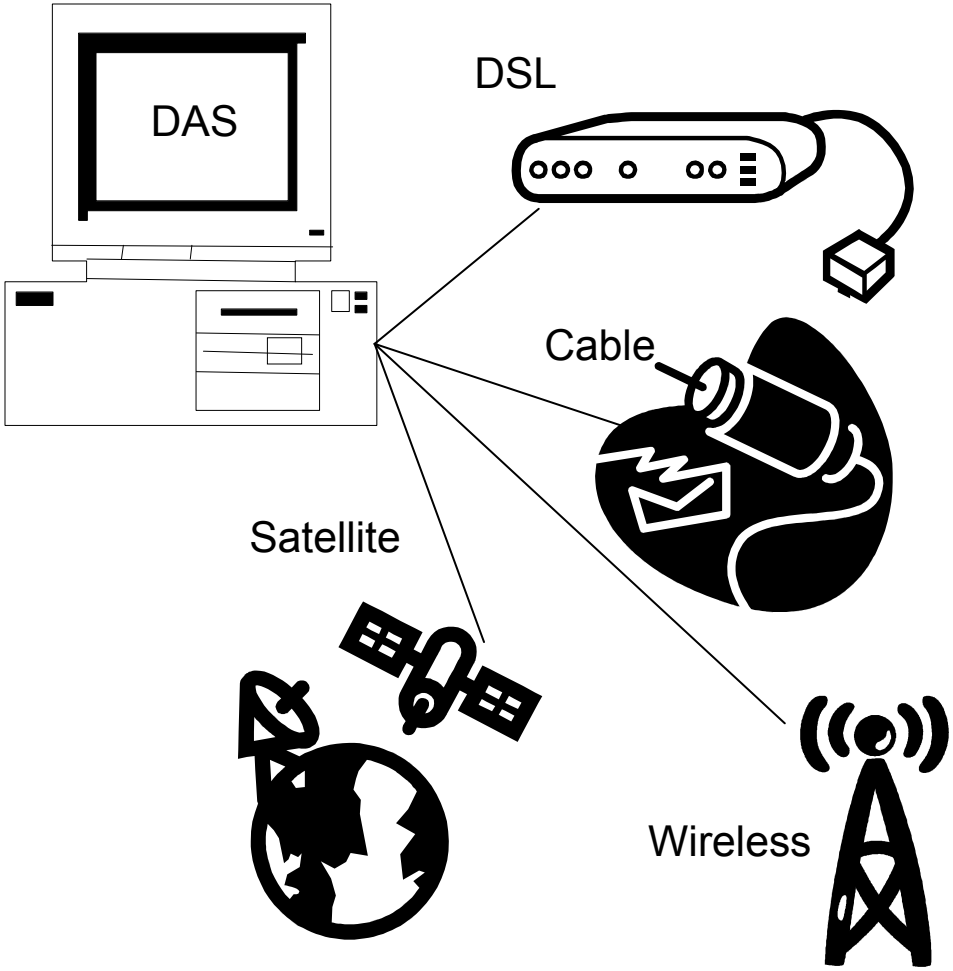
EPA Burden's Creek Monitoring Site – September 2006

Value of Diagnostic Polling (API-400E O3) Can Identify and Potentially Troubleshoot from Remote Location

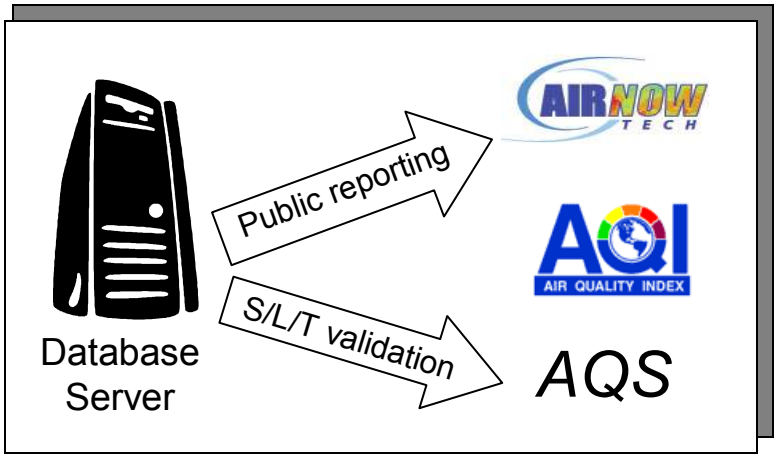
Date	Time	O3 concentration	Stability	O3 measure reading	O3 ref reading	Sample pressure	Sample flow rate	Sample temp	Analyzer lamp temp	Internal box temp	Slope	Offset
			PPB	MV	MV	IN-HG-A	CC/M	C	C	C	UNITS	UNITS
5/3/2006	24:00	-3.7	2.8	3696.4	3696.2	29	455	34.8	58	28.9	1.038	-3.1
5/3/2006	01:00	20.3	0.5	3695.3	3696	29	455	34.6	58	28.5	1.038	-3.1
5/3/2006	02:00	25.1	0.6	3695.2	3696	28.9	457	34.6	58	28.7	1.038	-3.1
5/3/2006	03:00	24.8	0.7	3695.3	3696	28.9	456	34.6	58	28.6	1.038	-3.1
5/3/2006	04:00	15.4	1.2	3695.5	3696	29	456	34.8	58	29	1.038	-3.1
5/3/2006	05:00	11.5	0.5	3695.7	3696.1	28.9	457	34.7	58	28.8	1.038	-3.1
5/3/2006	06:00	7.3	0.6	3695.9	3696	28.9	456	34.6	58	28.7	1.038	-3.1
5/3/2006	07:00	6.9	0.6	3695.9	3696	29	456	34.5	58	28.5	1.038	-3.1
5/3/2006	09:00	50.1	0.4	3692.4	3694.1	28.1	825	34.7	58	28.9	1.038	-3.1
5/3/2006	10:00	54.1	0.4	3691.2	3693.1	27.9	820	35.1	58	29.5	1.038	-3.1
5/3/2006	11:00	56.2	0.4	3689.7	3691.8	28	817	35.4	58	29.7	1.038	-3.1
5/3/2006	12:00	57.1	0.7	3685.5	3687.5	28.1	817	35.2	58	29.4	1.038	-3.1
5/3/2006	13:00	55	0.6	3690.2	3692.2	28	825	35.1	58	29.2	1.038	-3.1
5/3/2006	14:00	56.4	0.5	3691	3693	27.9	814	34.6	58	28.8	1.038	-3.1
5/3/2006	15:00	54.6	0.5	3690	3691.9	28	815	34.7	58	28.9	1.038	-3.1
5/3/2006	16:00	57.6	0.5	3689.4	3691.4	28.1	823	34.6	58	28.8	1.038	-3.1
5/3/2006	17:00	56.2	1	3688	3690	28	822	34.6	58	28.6	1.038	-3.1
5/3/2006	18:00	58.1	0.5	3692	3694.2	27.9	815	34.5	58	28.5	1.038	-3.1
5/3/2006	19:00	55.2	0.4	3691.4	3693.5	28.1	819	34.9	58	29.1	1.038	-3.1
5/3/2006	20:00	49.5	1	3691.3	3693.1	28.1	826	34.8	58	28.9	1.038	-3.1
5/3/2006	21:00	37.1	1.1	3691.8	3693	27.9	827	34.8	58	28.7	1.038	-3.1
5/3/2006	22:00	30.5	0.5	3691.9	3693	28	824	34.8	58	28.7	1.038	-3.1
5/3/2006	23:00	26.2	0.4	3692.4	3693.3	28.1	819	34.9	58	29	1.038	-3.1

Replace sample flow orifice to clear low flow error message

Ditch the Dial-up Line



Reduce the time to collect and validate data for users.



Costs of wireless and/or broadband service may be competitive with traditional dial-up business lines.

Data Acquisition Session
November 8, 2006
8:00 am– 12:00 pm

Pete Babich (CT-DEP) and Lewis Weinstock (EPA)
Session co-chairs