

# AGO Station Monitoring

## *Environmental and Instrumentation Parameters in “Real-Time”*

# Iridium Direct-IP SBD Feed

A. Gerrard, R. Melville, A. Stillinger, G. Jeffer  
*Center for Solar-Terrestrial Research,  
New Jersey Institute of Technology*

A. Weatherwax, *Siena College*



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# *Why Direct-IP for Short Burst Data (SBD)?*



## **Delivery Options:**

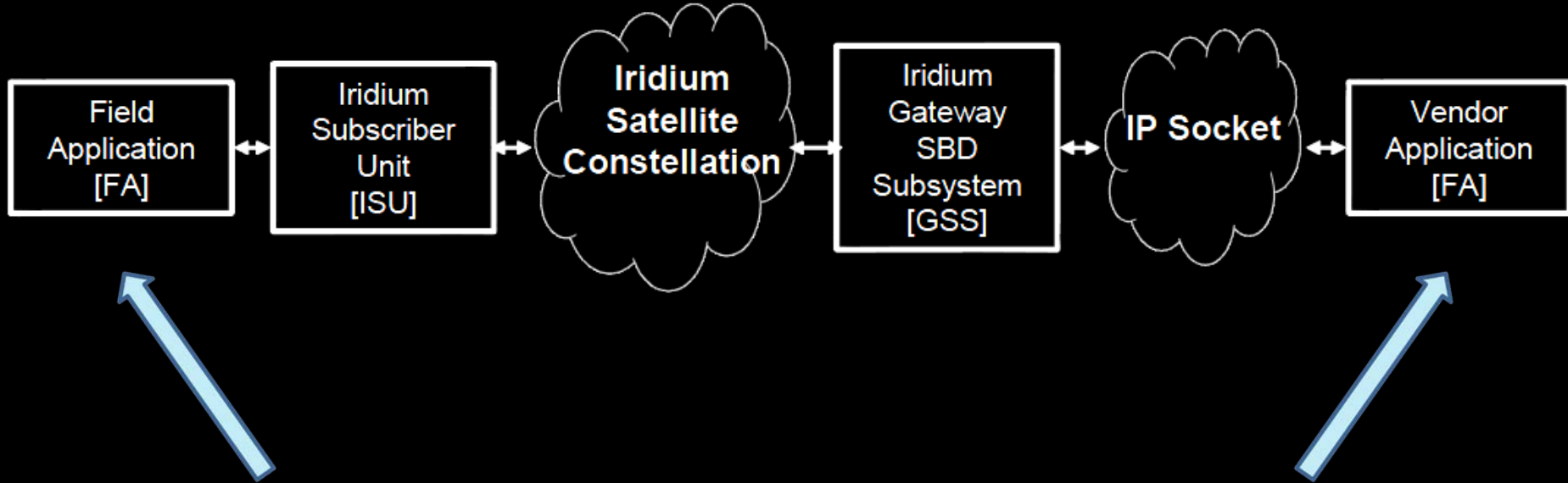
- **e-mail**
- **Direct-IP**

## **Advantages of Direct-IP:**

- **Low latency**
- **Robust - confirmation, retry**
- **Internal checks - confidence**
- **Binary packet - no text parsing**



# *SBD Flow & Client Responsibility:*



**AGO application &  
Interface to sensors**

**Socket server application  
& handling received data**

# Implementing a Socket Server:

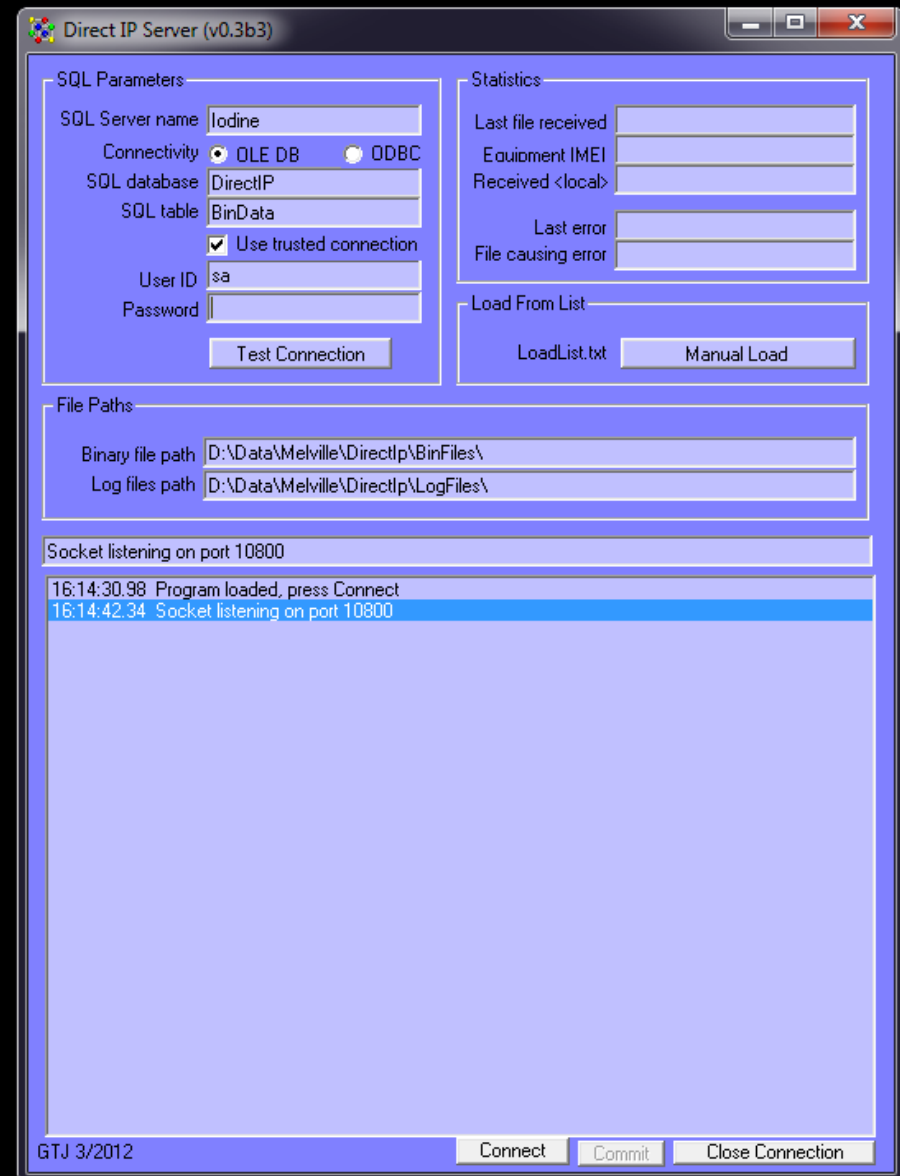
## TCP/IP Communication:

- Receive SBD packet
- Verify packet integrity
- Send confirmation

## Data Disposition:

- Write file to disk
- Write binary to SQL

Very low overhead . . .



# SQL Server is an Independent Process:

- Application inserts binary data, a SQL trigger is fired.
- Trigger code pull binary apart based on word size and inserts decoded numbers into decimal table.
- That triggers code to interpret the numbers as defined by the client, inserting these into the final tables.

## SQL Tables:

### BinData

Date from envelope, file , raw binary record

### DecData

Binary decoded into envelope (defined) & raw client numbers

### EnvAgo4 / 5

Interpreted values as defined by client.

```

use DirectIP
select top 5 * from BinData order by ID
select top 5 * from DecData order by BinDataID
select top 5 * from EnvAgo4 order by BinDataID
    
```

Id	FileDate	FileName	BinData
1	2012-03-08 02:04:41.000	D:\Data\Melville\DirectIp\BinFiles\Dip0000009.bin	0x01005B01001C2541F4293330303233343031303235343632300001DB00004F5833A703000B025220726152960000001002002B04012BAC00...
2	2012-03-08 02:06:05.000	D:\Data\Melville\DirectIp\BinFiles\Dip0000008.bin	0x01005B01001C254195CD33303032333430313032353936313000016500004F5827E203000B024D363D7B6D120000000202002B0401255500...
3	2012-03-08 02:06:32.000	D:\Data\Melville\DirectIp\BinFiles\Dip0000007.bin	0x01005B01001C2540616D33303032333430313032353936313000016400004F57FD7003000B024D0AD67821230000005B02002B0401231C00...
4	2012-03-08 02:07:14.000	D:\Data\Melville\DirectIp\BinFiles\Dip0000006.bin	0x01005B01001C254050F73330303233343031303235343632300001DA00004F57FB2C03000B02530E3D6BB679000000C202002B0401232B1...
5	2012-03-08 02:07:37.000	D:\Data\Melville\DirectIp\BinFiles\Dip0000005.bin	0x01005B01001C253F1EB933303032333430313032353936313000016300004F57D30B03000B024D38887BA1BC0000000402002B04011AAE0...

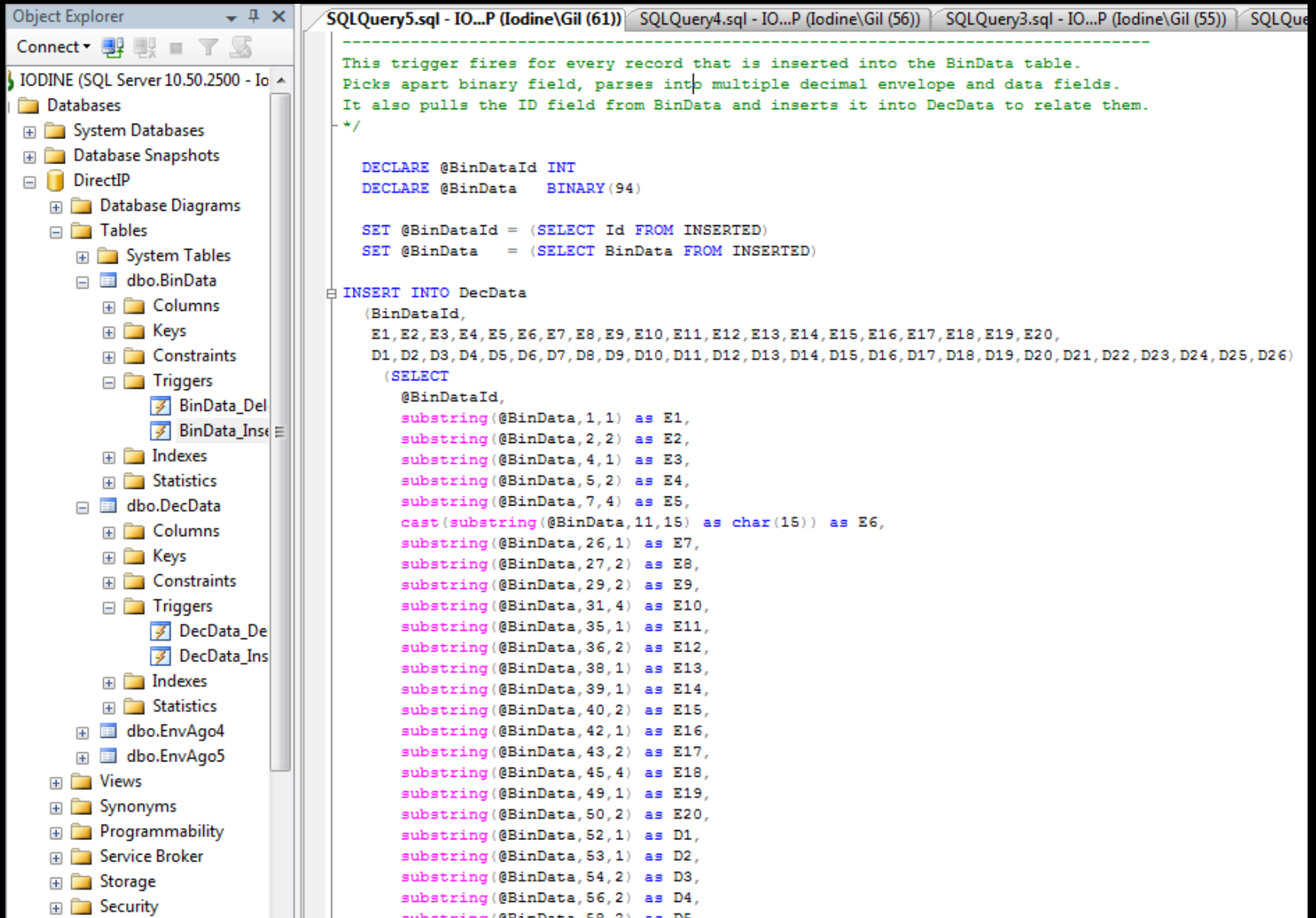
  

BinDataId	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12	E13	E14	E15	E16	E17	E18	E19	E20	D1	D2	D3	D4	D5	D6	D7	D8
1	91	1	28	625079337	300234010254620	0	475	0	1331180455	3	11	2	82	8306	97	21142	16	2	43	4	1	11180	11	2567	4645	10264	771	
2	91	1	28	625055181	300234010259610	0	357	0	1331177442	3	11	2	77	13885	123	27922	2	2	43	4	1	9557	13	3258	13	10198	1027	
3	91	1	28	624976237	300234010259610	0	356	0	1331166576	3	11	2	77	2774	120	8483	91	2	43	4	1	8988	13	3488	14	10161	1024	
4	91	1	28	624972023	300234010254620	0	474	0	1331165996	3	11	2	83	3645	107	46713	194	2	43	4	1	9003	6668	2491	4704	10270	770	
5	91	1	28	624893625	300234010259610	0	355	0	1331155723	3	11	2	77	14472	123	41404	4	2	43	4	1	6830	13	1066	13	10185	1021	

BinDataId	DipDate	Station	Version	WindTurb_amp	RegInrt_amp	PhotoVoltaic_amp	Inst_amp	Batt_amp	Baro_mbar	MainBatt_volt	Prog_volt	Ad8_volt	Pri_volt	SbdInt_deg	Ext_deg	Shlr_deg
1	2012-03-08 04:20:55.000	4	1	27.30	0.03	1.11	0.91	0.03	612.97	26.83	0.03	0.00	26.09	-8.82	-46.91	-28.78
2	2012-03-08 00:19:56.000	4	1	21.99	16.28	1.08	0.92	0.03	612.82	26.87	4.04	0.00	26.13	-11.98	-49.84	-31.53
3	2012-03-07 20:19:02.000	4	1	24.15	1.16	0.00	0.91	-0.14	613.11	26.83	4.01	0.00	26.10	-8.54	-51.28	-31.10
4	2012-03-07 16:18:05.000	4	1	14.86	15.12	0.01	0.94	0.00	612.97	26.86	3.97	0.00	26.13	-13.42	-51.03	-31.50
5	2012-03-08 08:22:01.000	4	1	34.84	16.57	1.06	0.91	0.03	612.82	26.87	0.06	0.00	26.13	-12.45	-44.96	-27.80

# Trigger on BinData insert: to DecData



The screenshot displays the SQL Server Enterprise Manager interface. On the left, the Object Explorer shows the database structure for 'IODINE (SQL Server 10.50.2500 - Io...P)'. The 'dbo' schema is expanded, showing tables 'BinData' and 'DecData', and triggers 'BinData\_Del', 'BinData\_Inse...', 'DecData\_De...', and 'DecData\_Ins...'. The main window shows the SQL script for a trigger named 'BinData\_Inse...'. The script includes comments, variable declarations, and an INSERT statement into the 'DecData' table.

```
SQLQuery5.sql - IO...P (Iodine\Gil (61)) SQLQuery4.sql - IO...P (Iodine\Gil (56)) SQLQuery3.sql - IO...P (Iodine\Gil (55)) SQLQue

This trigger fires for every record that is inserted into the BinData table.
Picks apart binary field, parses into multiple decimal envelope and data fields.
It also pulls the ID field from BinData and inserts it into DecData to relate them.
-*/

DECLARE @BinDataId INT
DECLARE @BinData BINARY(94)

SET @BinDataId = (SELECT Id FROM INSERTED)
SET @BinData = (SELECT BinData FROM INSERTED)

INSERT INTO DecData
(BinDataId,
E1, E2, E3, E4, E5, E6, E7, E8, E9, E10, E11, E12, E13, E14, E15, E16, E17, E18, E19, E20,
D1, D2, D3, D4, D5, D6, D7, D8, D9, D10, D11, D12, D13, D14, D15, D16, D17, D18, D19, D20, D21, D22, D23, D24, D25, D26)
(SELECT
@BinDataId,
substring(@BinData, 1, 1) as E1,
substring(@BinData, 2, 2) as E2,
substring(@BinData, 4, 1) as E3,
substring(@BinData, 5, 2) as E4,
substring(@BinData, 7, 4) as E5,
cast(substring(@BinData, 11, 15) as char(15)) as E6,
substring(@BinData, 26, 1) as E7,
substring(@BinData, 27, 2) as E8,
substring(@BinData, 29, 2) as E9,
substring(@BinData, 31, 4) as E10,
substring(@BinData, 35, 1) as E11,
substring(@BinData, 36, 2) as E12,
substring(@BinData, 38, 1) as E13,
substring(@BinData, 39, 1) as E14,
substring(@BinData, 40, 2) as E15,
substring(@BinData, 42, 1) as E16,
substring(@BinData, 43, 2) as E17,
substring(@BinData, 45, 4) as E18,
substring(@BinData, 49, 1) as E19,
substring(@BinData, 50, 2) as E20,
substring(@BinData, 52, 1) as D1,
substring(@BinData, 53, 1) as D2,
substring(@BinData, 54, 2) as D3,
substring(@BinData, 56, 2) as D4,
substring(@BinData, 58, 2) as D5,
```

# Trigger on DecData insert: to EnvAgo#:

The screenshot displays the SQL Server Enterprise Manager interface. On the left, the Object Explorer shows the database structure for 'IODINE (SQL Server 10.50.2500 - Io...P)'. The 'Triggers' folder under 'dbo.DecData' is expanded, showing 'BinData\_Del' and 'BinData\_Inse'. The main window shows the SQL script for 'SQLQuery6.sql - IO...P (Iodine\Gil (58))'. The script defines a trigger for the 'EnvAgo4' table, which is triggered on insert of 'DecData'. The trigger body consists of an 'INSERT INTO' statement for 'EnvAgo4' with columns: BinDataId, DipDate, Station, Version, WindTurb\_amp, RegInt\_amp, PhotoVoltaic\_amp, Inst\_amp, Batt\_amp, Baro\_mbar, MainBatt\_volt, CfProg\_volt, Ad8\_volt, Pri\_volt, SbdInt\_degc, Ext\_degc, Shltr\_degc, Rack\_degc, Irid\_degc, SelfChk\_volt, Dig, Frp, Comms\_cnt, NoNet\_cnt, CsBad\_cnt, RcBad\_cnt, Succs\_cnt, Cs\_avg. The values for these columns are derived from a 'SELECT' query that takes parameters from the 'DecData' table and performs various calculations. The trigger is named 'BinData\_Inse' and is set to fire on insert.

```
SQLQuery6.sql - IO...P (Iodine\Gil (58))
SQLQuery5.sql - IO...P (Iodine\Gil (61))
SQLQuery4.sql - IO...P (Iodine\Gil (56))
SQLQuery3.sql - IO...P (Iodine\Gil (55))

IF @E6 = '300234010254620' --IMEI for Ago4
BEGIN
    INSERT INTO EnvAgo4
    (BinDataId, DipDate,
    Station, Version, WindTurb_amp, RegInt_amp, PhotoVoltaic_amp, Inst_amp, Batt_amp, Baro_mbar,
    MainBatt_volt, CfProg_volt, Ad8_volt, Pri_volt, SbdInt_degc, Ext_degc, Shltr_degc, Rack_degc,
    Irid_degc, SelfChk_volt, Dig, Frp, Comms_cnt, NoNet_cnt, CsBad_cnt, RcBad_cnt, Succs_cnt, Cs_avg
    )
    (SELECT
    @BinDataId AS BinDataId,
    DATEADD(s, @E10, '1/1/1970 12:00:00 AM') AS DipDate,
    @D1 AS Station,
    @D2 AS Version,
    50 * (@D3 / 5.0) / 4095.0 AS WindTurb_amp,
    50 * (@D4 / 5.0) / 4095.0 AS RegInt_amp,
    (100 * (@D5 / 5.0) / 4095.0) * (1 / 11.3) AS PhotoVoltaic_amp,
    (100 * (@D6 / 5.0) / 4095.0) / 25.0 AS Inst_amp,
    (100 * ((2.5 * (@D7 / 5.0) / 4095.0 - 1.25) / 1.25)) / 10.0 AS Batt_amp,
    500 + ((5 * @D8 / 4095.0) / 5.0) * 600 AS Baro_mbar,
    37.5 * @D9 / 4095.0 AS MainBatt_volt,
    5 * @D10 / 4095.0 AS CfProg_volt,
    5 * @D11 / 4095.0 AS Ad8_volt,
    37.5 * @D12 / 4095.0 AS Pri_volt,
    ((2.5 * @D13 / 4095.0) / 6.0 - 0.2) / 0.005 AS SbdInt_degc,
    ((2.5 * @D14 / 4095.0) / 4.0 - 0.4) / 0.005 AS Ext_degc,
    ((2.5 * @D15 / 4095.0) / 4.0 - 0.4) / 0.005 AS Shltr_degc,
    ((2.5 * @D16 / 4095.0) / 4.0 - 0.4) / 0.005 AS Rack_degc,
    ((2.5 * @D17 / 4095.0) / 4.0 - 0.4) / 0.005 AS Irid_degc,
    2.5 * @D18 / 4095.0 AS SelfChk_volt,
    @D19 AS Dig,
    @D20 AS Frp,
    @D21 AS Comms_cnt,
    @D22 AS NoNet_cnt,
    @D23 AS CsBad_cnt,
    @D24 AS RcBad_cnt,
    @D25 AS Succs_cnt,
    @D26 / 8.0 AS Cs_avg
    )
END

IF @E6 = '300234010259610' --IMEI for Ago5
BEGIN
    INSERT INTO EnvAgo5
    (BinDataId, DipDate,
```



# *Why SQL, why multiple tables?*

- **Socket Server application overhead minimized; The receive and write completed in milliseconds.**
- **Interpretation of data separated from receiver. SQL inherently multi-user, anyone can hit data.**
- **Auditing - ID field links all tables together, and reference them back to the originally received file.**
- **Standardized - maintained by IT department without the need for specific application training.**
- **SQL Reporting Services . . .**

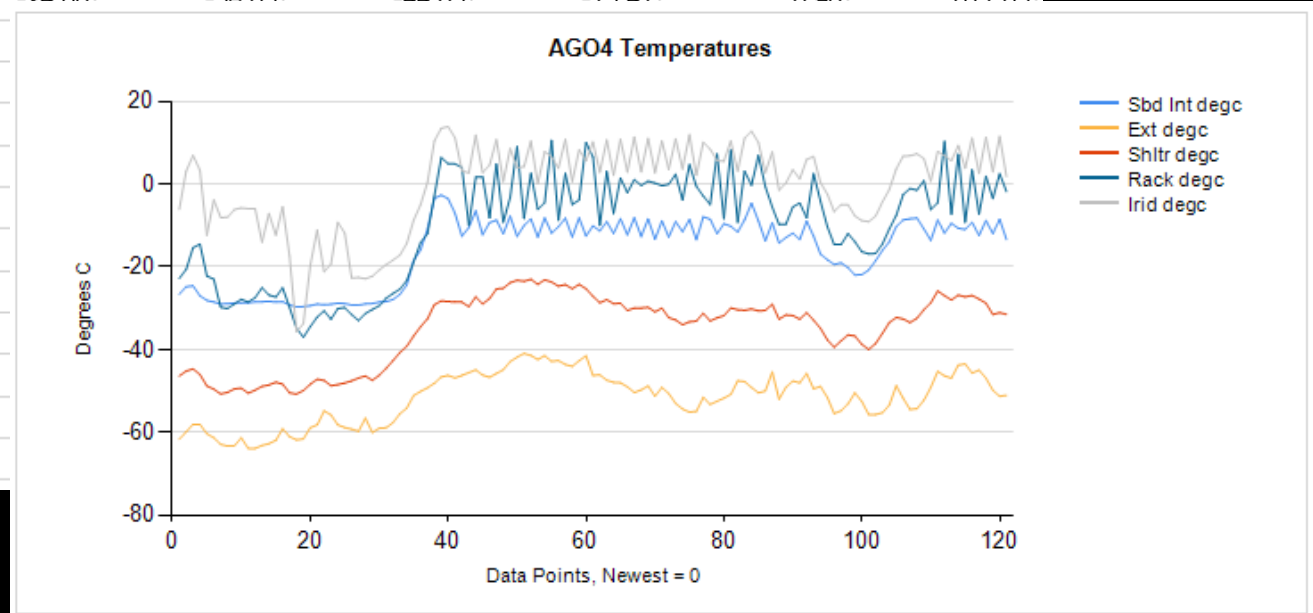


# SQL Reporting Services, Publishing:

- Develop dynamically updating reports, available locally, emailed, on intranet, or on the Internet.
- Supports drill-down, subscriptions, and fully interactive, ad-hoc reporting with user selections.

## AGO4 Environment - Temp (deg C), Barometer (mbar)

Date Time	SBD Int.	External	Shelter	Rack	Iridium	Barometer
2012-03-30 06:37:04	-26.63	-61.65	-46.39	-22.83	-6.16	611.65
2012-03-30 02:36:10	-24.82	-59.91	-45.20	-20.66	3.09	611.06
2012-03-30 10:35:14	-24.60	-58.05	-44.65	-15.41	6.00	611.65
2012-03-30 06:34:11						
2012-03-30 02:33:09						
2012-03-29 10:32:14						
2012-03-29 06:31:16						
2012-03-29 02:30:21						
2012-03-29 10:29:20						
2012-03-29 06:28:14						
2012-03-29 02:27:11						
2012-03-28 10:26:14						
2012-03-28 06:25:10						
2012-03-28 02:24:05						





For program information, see:  
***[AntarcticGeospace.org](http://AntarcticGeospace.org)***



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Center for Solar-Terrestrial Research, New Jersey Institute of Technology

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