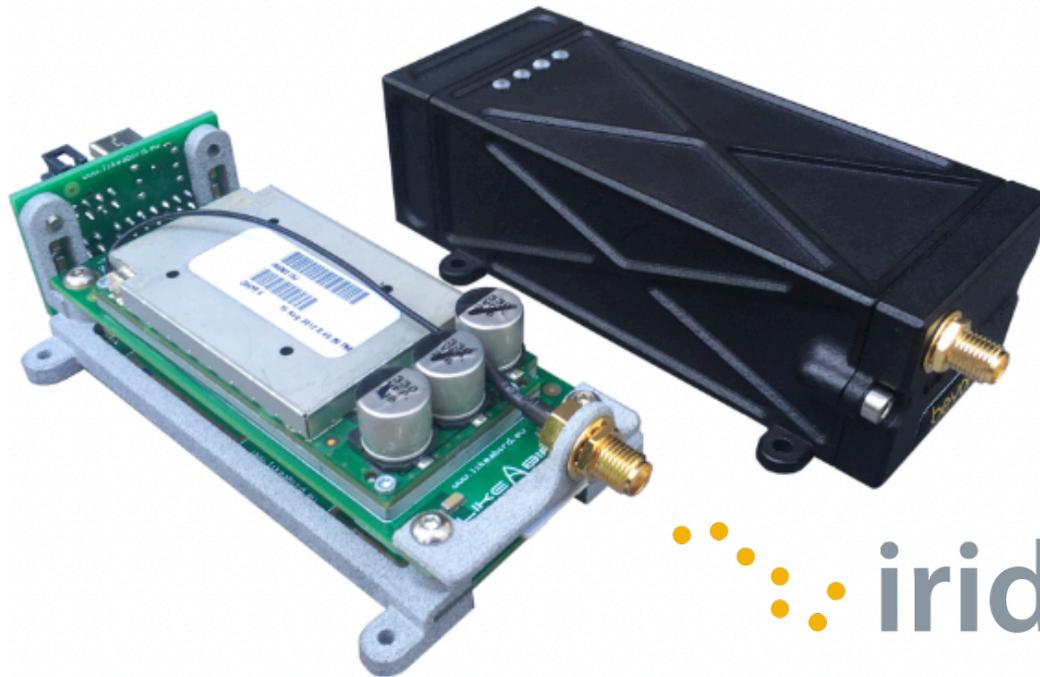


beySAT-NB - Narrow Band SATCOM



Quick Hardware Reference Guide

Rev01 – August 2022

Description

Designed for quick integration with minimal engineering effort, the beySAT-NB is a plug & play narrow band Iridium NEXT based satellite communication device. It provides simplicity and flexibility making it the easiest Iridium-enabling module on the market.

The beySAT-NB advanced data satellite module is small, light and powerful. Its compact footprint and simple connections offer our partners new opportunities to integrate Iridium NEXT directly on their unmanned systems and UAM platform for maritime, aviation and land applications.

Its modular design permits to easily customize either the I/O connectors to customer requirements or to integrate the CORE module on their printed circuit board (PCB) and to develop products that meet the needs of integrated solutions.

Main Features

The beySAT-NB provides the following features:

- Ultra compact form factor
- Multi-board design for maximum flexibility
- Voice, SBD and Circuit Switched Data capable
- Iridium Push-to-Talk (PTT) capability
- Direct PCB integration (CORE Module only)
- Pole-to-pole global coverage
- FCC, Industry Canada, CE, Anatel, and ITU approval
- Wide voltage supply range from 9 to 28V
- DIP switch to configure module I/O interfaces
- Extended Temperature: -30° to +70° C
- USB-C connector for easy bench operations
- Rugged Molex Nano-Fit connectors
- Mounting bracket included
- Size 102 x 40 x 26 mm
- Weight: 95g

Operational Requirements

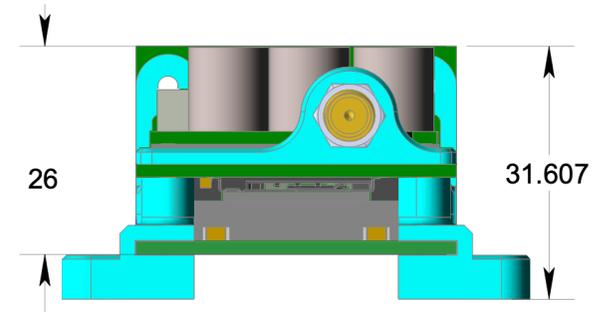
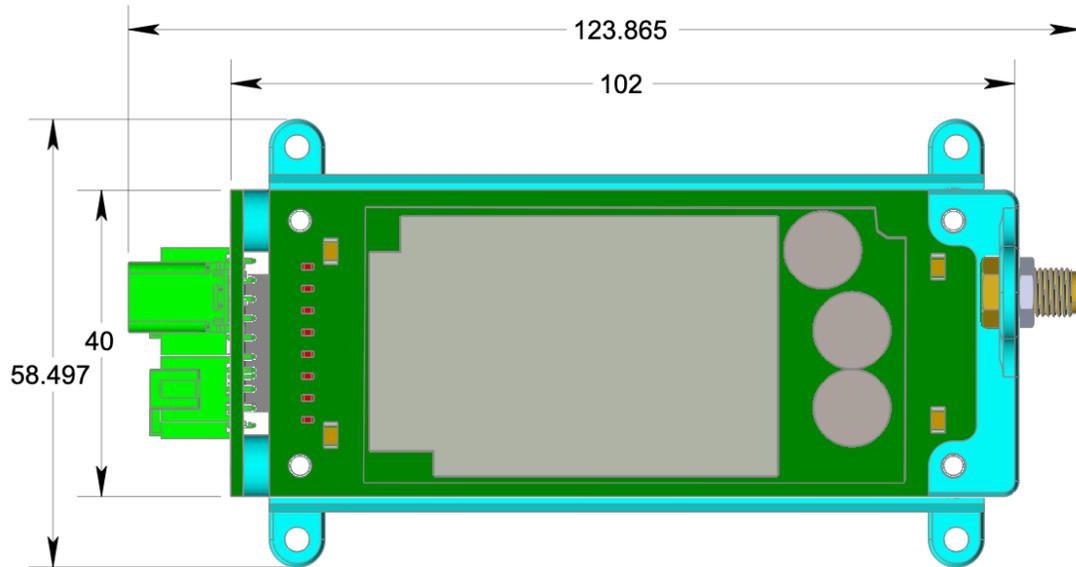
The following table provides the facilities requirements that must be met for the beySAT-NB.

Type	Requirements
Electrical	<ul style="list-style-type: none"> • DC input: 9-28 VDC • Maximal Power Consumption during Call: 5 Watt • Average Power Consumption during Call: 3 Watt
Thermal	<ul style="list-style-type: none"> • Ambient air temperature not exceeding -30 to +70 ° C while the beySAT-NB is operating
Installation	<ul style="list-style-type: none"> • Can be strapdown installed using 4x M3 screws. • Can be installed in vertical or horizontal position • Can be installed upside down

Connectors, Buttons and LEDs

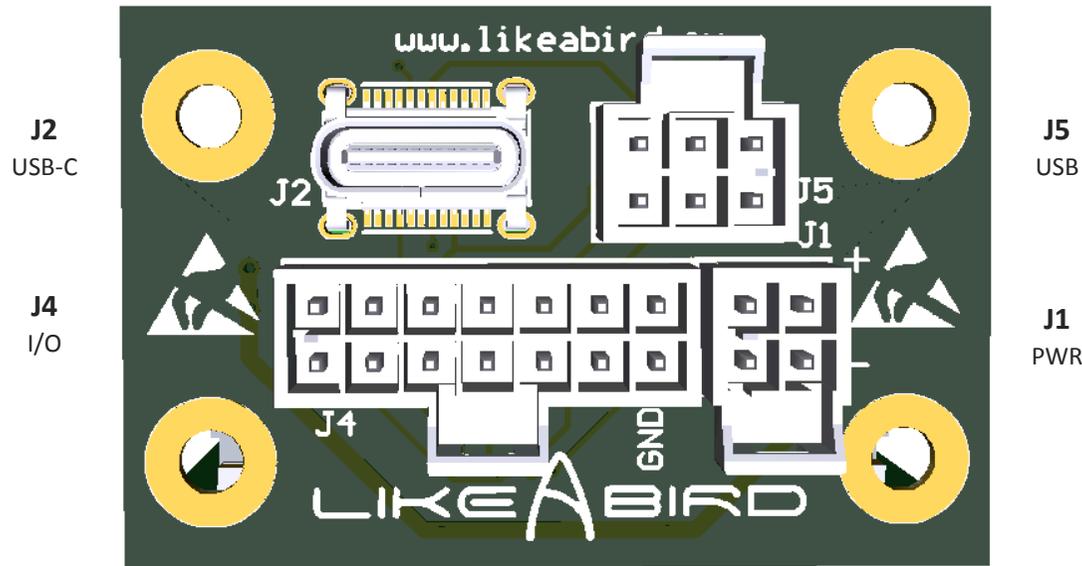
Type	Label
Power	J1: 9-28 VDC-In
USB	J2 & J5
I/O Signal Connector	J4 (TTL Level 3.3V)
SMA	RF Port for antenna
DIP Switch	DSW1
Activity LED	Power, DF, DPL, TX Active, Boost Enable
Solder Jumper	SB1, SB2, SB3

beySAT-NB Dimensions & Weight



Weight including OEM Mounting Brackets and SMA Connector: 102g

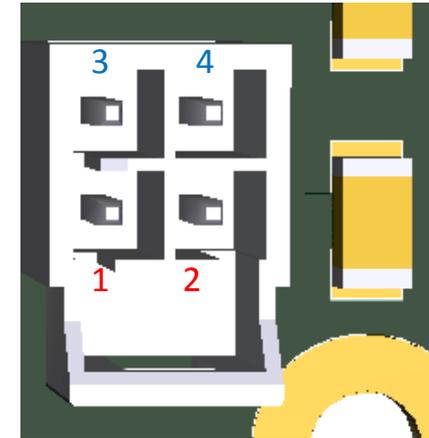
beySAT-NB Connectors



Back View

J1 Power Connector

Pin	Signal	Function
1	MAIN_POWER	9-28V Positive Input
2	MAIN_POWER	9-28V Positive Input
3	MAIN_GND	Main Power Ground
4	MAIN_GND	Main Power Ground



Main Power Input
Front View

Mating Connector

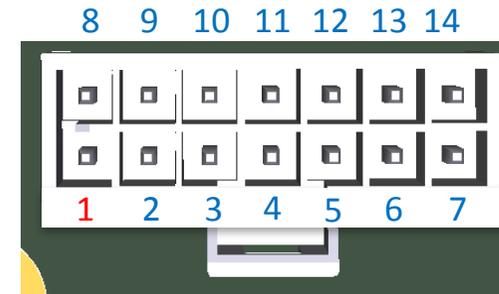
- **Manufacturer:** Molex
- **Part Name:** Nano-Fit Receptacle Housing, 2.50mm Pitch, Dual Row, 4 Circuits
- **Mfg. Part Number:** 105308-1204
- **Crimp Terminal:** 105300-1200 (24-26 AWG)



J4 I/O Connector

Pin	Signal	Function	Signal Direction	Signal Group
1	DF_TX_B	Data to Modem	In	Data Port
2	DF_RTS_B	Request to Send	In	Data Port
3	DPL_RXD_B	Data to Modem	In	DPL Port
4	EXT_ON_OFF	External Power On/Off	to GND*	GPIO
5	CODEC_PCMSYNC	Frame Sync	Out	PCM Audio P1
6	CODEC_PCMOUT	Data to Modem	In	PCM Audio P1
7	GND	Ground		
8	DF_RX_B	Data from Modem	Out	Data Port
9	DF_CTS_B	Clear to Send	Out	Data Port
10	DPL_TXD_B	Data from Modem	Out	DPL Port
11	DPL_HST_ACT	Handset/LBT Switch	to GND*	GPIO
12	CODEC_PCMLCK	Clock	Out	PCM Audio P1
13	CODEC_PCMIN	Data from Modem	Out	PCM Audio P1
14	GND			

* In order to use the EXT_ON_OFF and/or DPL_HST_ACT, the DIP switch DSW1 must be configured first. All digital signals are TTL Level 3.3V.



I/O Front View



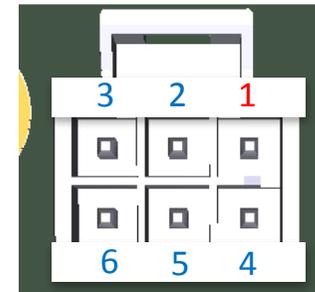
Receptacle Housing

Mating Connector

- **Manufacturer:** Molex
- **Part Name:** Nano-Fit Receptacle Housing, 2.50mm Pitch, Dual Row, 14 Circuits
- **Mfg. Part Number:** 105308-1214
- **Crimp Terminal:** 105300-1200 (24-26 AWG)

J5 USB Connector

Pin	Signal	Function
1	GND	Ground
2	GND	Ground
3	USB_VBUS	VBUS Voltage 5V
4	GND	Ground
5	USBDM	USB Data -
6	USBDP	USB Data +



USB Front View



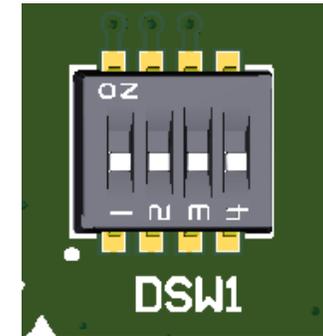
Receptacle Housing

Mating Connector

- **Manufacturer:** Molex
- **Part Name:** Nano-Fit Receptacle Housing, 2.50mm Pitch, Dual Row, 6 Circuits
- **Mfg. Part Number:** 105308-1206
- **Crimp Terminal:** 105300-1200 (24-26 AWG)

DSW1 DIP Switch: Board Configuration

DIP Switch	Function	DIP Switch Position	
1	MUX_SEL_DF	Select DF-Port between UART or USB Interface	ON = USB; OFF = UART
2	DPL_HST_ACT*	Select DPL-Port between UART or USB Interface	ON = USB; OFF = UART
3	EXT_ON_OFF**	External On/Off of 9523N Transceiver	ON = Permanent On; OFF = External On/Off
4	N/C		



DIP Top View

* If this signal needs to be controlled from external (DPL_HST_ACT on Backplane), it must be always be open-circuit (OFF). This is used if an external DPL handset with a PCM audio coder is used to use the beySAT-DP for voice calls. Don't connect any computer-CPU-MCU-SOC GPO to this pin. It must be controlled through a switch or remotely controlled relay/SSR. An external switch to GND can be used to control it remotely.

** If this signal needs to be controlled from external (EXT_ON_OFF on Backplane), it must always be open-circuit (OFF). Don't connect any computer-CPU-MCU-SOC GPO to this pin. It must be controlled through a switch or remotely controlled relay/SSR. An external switch to GND can be used to control it remotely.

Qualified Add-Ons

Manufacturer	Mfr Part Number	Description
Helix Geospace	HXDC1610-SAA	Overmoulded Iridium Antenna - SMA Conector. IP67. 50x19mm @ 26g
Mauritz	1010260	RG174 RF Cables. Required with SMA Male to SMA Female Connectors
Mauritz	1010640	RG316 PTFE RF Cables. Required with SMA Male to SMA Female Connectors
Mauritz	1010645	RG188 PTFE RF Cables. Required with SMA Male to SMA Female Connectors
LikeAbird	LAB-beySAT-NB-WHK	Wire Harness Kit for Power, USB and I/O
LikeAbird	LAB-beySAT-NB-ENC	Enclosure Kit



Antenna



RF Cables



I/O Harness



Enclosure Kit

IRIDIUM CORE 9523N CERTIFICATIONS

The Iridium Core 9523N is tested to the regulatory and technical certifications shown below:

Regulatory Approvals	Radio Tests	EMC Tests	Electrical / Mechanical / Operational Safety Tests
CE	ETSI EH 301 441 V1.1.1 (2000-05)	ETSI EH 301 489-1 V1.9.2 (2011-09) ETSI EH 301 489-20 V1.2.1 (2002-11)	EI1 60950-1:2006 + A11:2009 + A1:2010 + A12:2011 + AC:2011 + A2:2013 AS/HSZ 60950-1:2011 + A1:2012
FCC	FCC CFR47 parts 2 (2014), 15B (2014), and 25 (2014)	EI161000-4-2:2009 EI161000-4-3:2006 + A1:2008 + A2:2010 EI161000-4-4:2004 + A1:2010 EI161000-4-6:2009 EI155022:2006 + A1:2007	
Industry Canada	RSS170 Issue 3, Jul 2015 RSS-GEN Issue 4, Nov 2014 ICES-003 Issue 5, Aug 2012		

NOTE: ANATEL is also available

IRIDIUM CORE 9523N CERTIFICATIONS

Labeling Requirement for Enclosed Devices:

The enclosed device shall be properly labelled to identify the modules within the enclosed device. The certification label of the module shall be clearly visible at all times when installed in the enclosed device, otherwise the enclosed device must be labelled to display the FCC ID and IC of the module, preceded by the words "Contains transmitter module", or the word "Contains", or similar wording expressing the same meaning, as follows:

Contains FCC ID: Q639523N or Contains transmitter module FCC ID: Q639523N

Contains IC: 4629A-9523N or Contains transmitter module IC: 4629A-9523N

RF INTERFACE

Radio Interference:

This device complies with Part 15 of the FCC Rules and Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (EIRP) is not more than that necessary for successful communication.

Iridium Core 9523N RF Interface Specifications:

Parameter	Value
Frequency Range	1616 MHz to 1626.5 MHz
Duplexing Method	TDD (Time Domain Duplex)
Input/Output Impedance	50Ω
Multiplexing Method	TDMA/FDMA

Parameter	Value
Average Power during a transmit slot (max)	7 W
Average Power during a frame (typical)	0.6 W
Receiver sensitivity (Typical level at connector)	-118 dBm
Max Cable loss permitted (Note 1)	3 dB
Link Margin - Downlink (Note 2)	12 dB
Link Margin - Uplink (Note 2)	12 dB

Note 1 & 2: See „Antenna & Cable Specs“

GNSS Constellations Frequencies

Constellations	Bands	Frequency in MHz				Wavelength (cm)	Minimum Received Power (5° Elev) dBW*	Signals / Comments
		Centre	Bandwidth	Lower	Upper			
GPS	L1	1575.42	±2	1573.42	1577.42	19.0	-163.0(D) / -158.25(P)	L1C GPS III
			±1.023	1574.397	1576.443		-157	L1C/A
			±10.23	1565.19	1585.65		-161.5	L1P(Y)
	L2	1227.60	±15	1560	1590	24.4	-158.0	M Code
			±10.23	1217.37	1237.83		-160.0 (Block II F)	L2P(Y)
			±1.023	1226.577	1228.623		-161.5 (Block II F)	L2C
L5	1176.45	±10.23	1166.22	1186.68	25.5	-157.9 (Block II F)	M Code	
QZSS	L1	1575.42	±2	1573.42	1577.42	19.0	-163.0(D) / -158.25(P)	L1C D/P
	L6	1278.75	±21.0	1257.75	1299.75	23.4	-158.82	Block II
	L2	1227.60	±1.023	1226.577	1228.623	24.4	-158.5	L2C
	L5	1176.45	±10.23	1166.22	1186.68	25.5	-157	I/Q
	E1	1575.42	±12.276	1563.144	1587.696	19.0	-157.25	D/P
GALILEO	E5a	1176.45	±10.23	1166.22	1186.68	25.5	-155.25	D/P
	E5(altBOC)	1191.795	±25.575	1166.22	1217.37	25.2	-155.25	AltBOC
	E5b	1207.14	±10.23	1196.91	1217.37	24.8	-155.25	D/P
	E6	1278.75	±20.46	1258.29	1299.21	23.4	-155.25	D/P
GLONASS	G1	N/A	±0.5	1598.0625	1605.37	~18.7	-161.0	FDMA
	G1a CDMA	1600.995	±5.0			18.7	-158.5	CA
			±1	1599.995	1601.995			P
			±2	1598.995	1602.995			L1SC
				1242.9375	1248.625			L1OC-D
	G2	N/A	±0.5			~24.0	-167	L1OC-P
			±5.0					FDMA
	G2a CDMA	1248.06	±7.0	1241.06	1255.06	24.0	-158.5	CA
			±1	1247.06	1249.06			P
			±2	1246.06	1250.06			L2SC
G3 CDMA	1202.025	±10.23	1191.795	1212.255	24.9	-158.5	L2OC-D	
BEIDOU	B1I	1561.098	±2.046	1559.052	1563.144	19.2	-163	L2OC-P
	B1	1575.42	±16.368	1559.052	1591.788	19.0	-159(MEO) / -161(IGSO)	BeiDou (II) OS
	B2a	1176.45	±10.23	1166.22	1186.68	25.5	-163	BeiDou (III) I/Q
	B2/B2b	1207.14	±10.0	1197	1217	24.8	-163	BeiDou (III) Not Published
	B3I	1268.52	±10.23	1258.29	1278.75	23.6	-163	B3C-D / B3C-P
IRNSS/NAVIC	L5	1176.45	±12.0	1164.45	1188.45	25.5	-159.0	SPS
	S	2492.028	±16.0	2476.03	2508.3	12.0	-162.3	SPS
WAAS/EGNOS	L1	1575.42	±1.023	1574.397	1576.443	19.0	-158.5 / -152.5 (Future)	C/A
	L5	1176.45	±10.23	1166.22	1186.68	25.5		L5 I/Q
L-BAND CORRECTIONS	L			1539	1559			
IRIDIUM				1616	1626.5			RHCP
				1621.35	1626.5			Up Load
GLOBALSTAR	L-Band			1610	1618.75			LHCP
	C-Band			6875	7055			
INMARSAT	L-Band			1525	1559			Downlink
				1626.5	1660.5			Uplink
	Extended			1518	1559			Alphasat
				1668	1675			
LIGHTSQUARED/LIGADO			1526	1536			Limits power to 10 W	
LTE JAPAN	Band 11			1475.9	1500.9			Down Link
	Band 21			1495.9	1510.9			Down Link
LTE EUROPE	Band 32			1452	1496			Down Link

The Iridium satellite communication system broadcasts in the 1610 to 1626.5 MHz band. The L1 frequencies broadcast by GPS, Galileo and GLONASS satellites are 1575.42 MHz, 1575.42 MHz and 1602 MHz + n 0.5625 MHz, respectively (each GLONASS satellite uses a unique frequency).

The proximity of the Iridium frequency band with the L1 frequencies of the GPS, Galileo and GLONASS systems leaves GNSS receivers susceptible to interference from Iridium data transmissions. Interference from Iridium transmissions can cause cycle slips and loss of lock on the carrier and code phases, thereby degrading the quality of GNSS observations.

GNSS receivers and/or antennas with notch filters could be used to reduce interferences.

Iridium and Inmarsat SATCOM Frequencies

RF INTERFACE

RF Exposure:

This equipment complies with FCC and IC radiation exposure limits set forth for an uncontrolled environment. The antenna should be installed and operated with minimum distance of 20 cm between the radiator and your body. Antenna gain must be below: 3.0 dBi. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

FCC Class B Digital Device Notice:

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

ANTENNA & CABLE SPECS

The beySAT-NB should be connected to a certified Iridium-band antenna with the following antenna connector characteristics as described below:

Parameter	Value
Impedance	50 Ohms nominal
Gain (maximum)	3 dBi
Polarization	RHCP
VSWR (maximum operational)	1.5 : 1

Note 1: Cable losses should be minimized. The total implementation loss for an antenna, connectors, cable, lightning arrestor and any other RF component between the beySAT-NB and the antenna should not exceed 3 dB. Implementation loss higher than this will affect the Iridium link performance and quality of service. Solutions with a loss higher than 3 dB will not meet the requirements of Iridium Solution Certification.

Note 2: Link Margins are given assuming a free-space propagation model.

RF Exposure:

This equipment complies with FCC and IC radiation exposure limits set forth for an uncontrolled environment. The antenna should be installed and operated with minimum distance of 20 cm between the radiator and your body. Antenna gain must be below: 3.0 dBi. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

ANTENNA & CABLE SPECS

The beySAT-NB Signal Strength vs Upload Speed:

Consider that the Iridium has 5 bars of signal strength, roughly speaking your effective download speeds vary with signal strength:

- 5 bars Iridium signal => Full speed
- 4 bars Iridium signal => 50% speed
- 3 bars Iridium signal => 10% speed
- 2 bars and below usually either fail to connect or will transfer data only very slowly

AT INTERFACE

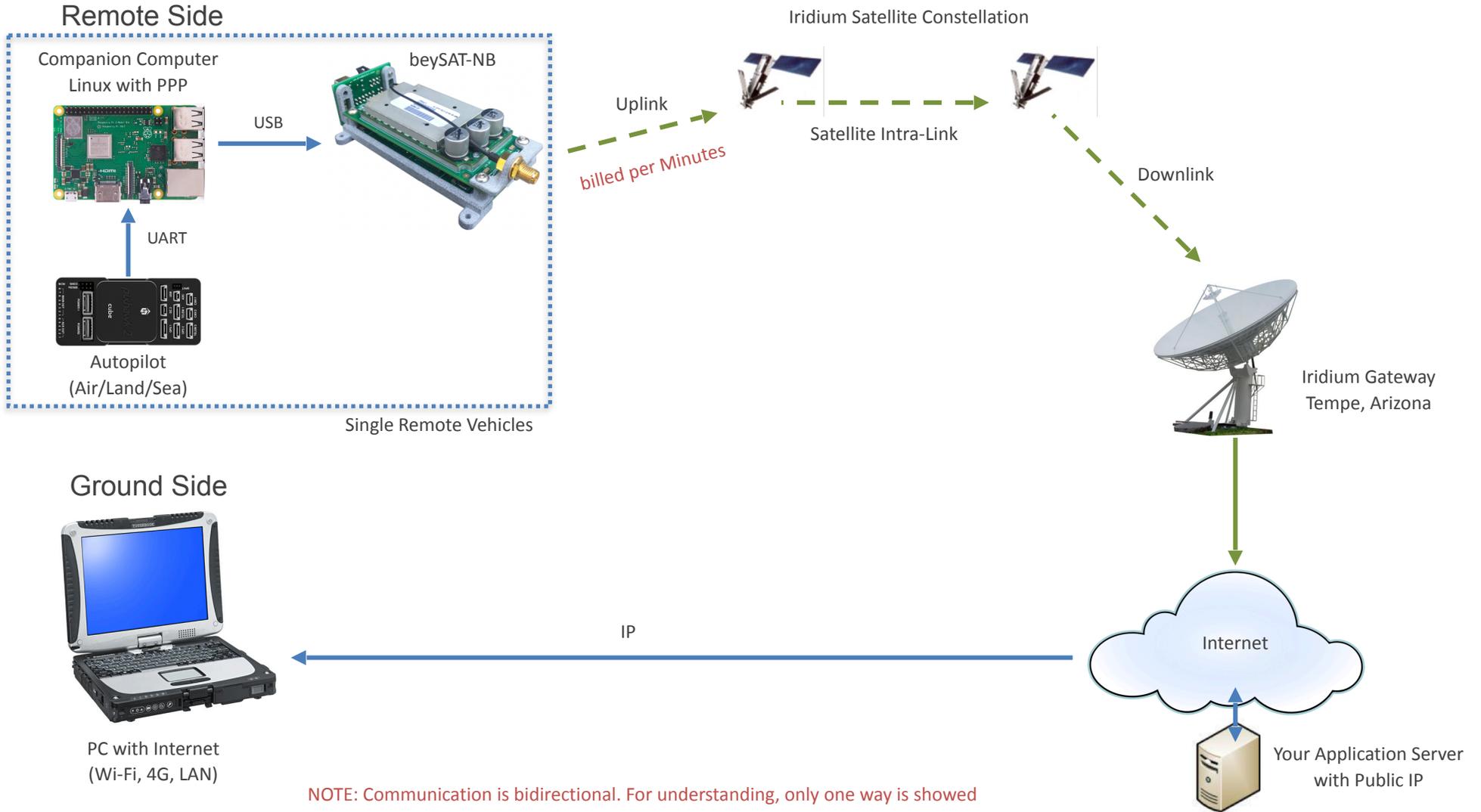
The beySAT-NB is configured and operated through the use of AT commands. See the „*ISU AT Command Reference V5*“ for the full set of AT commands and responses. For differences in AT command support between Iridium Core 9523N software releases, see the relevant software release notes, which are made available to authorized Iridium VARs and VAMs. It is the responsibility of Product Developers to check compatibility of applications software with the AT Commands on all Iridium Core 9523N software versions used for both development and commercial deployments.

The basic AT commands required to trigger a call are:

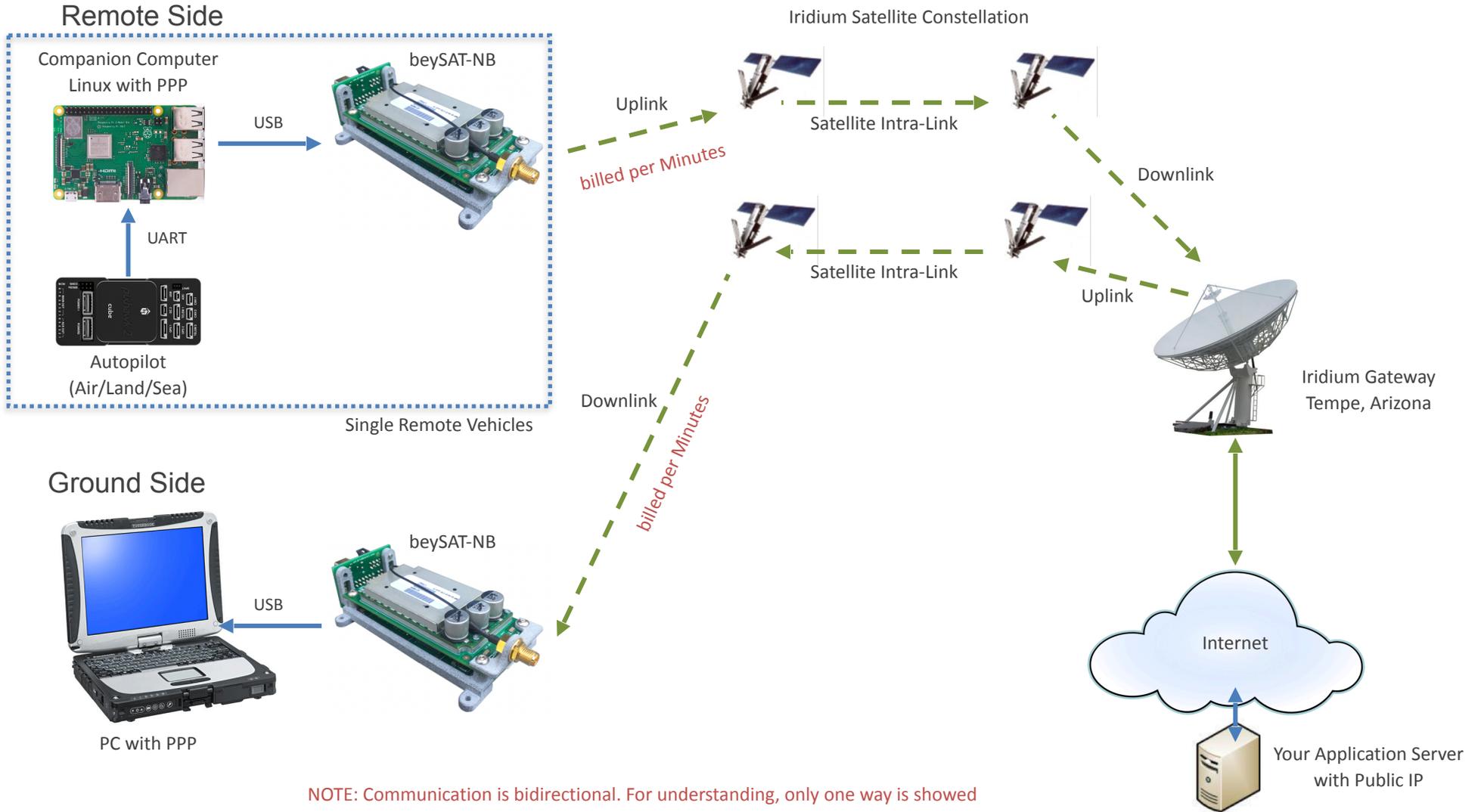
- ATZ
- AT+CBST=71,0,1
- ATDT 008816000025 (standard number for PPP Direct Internet)

Topologies

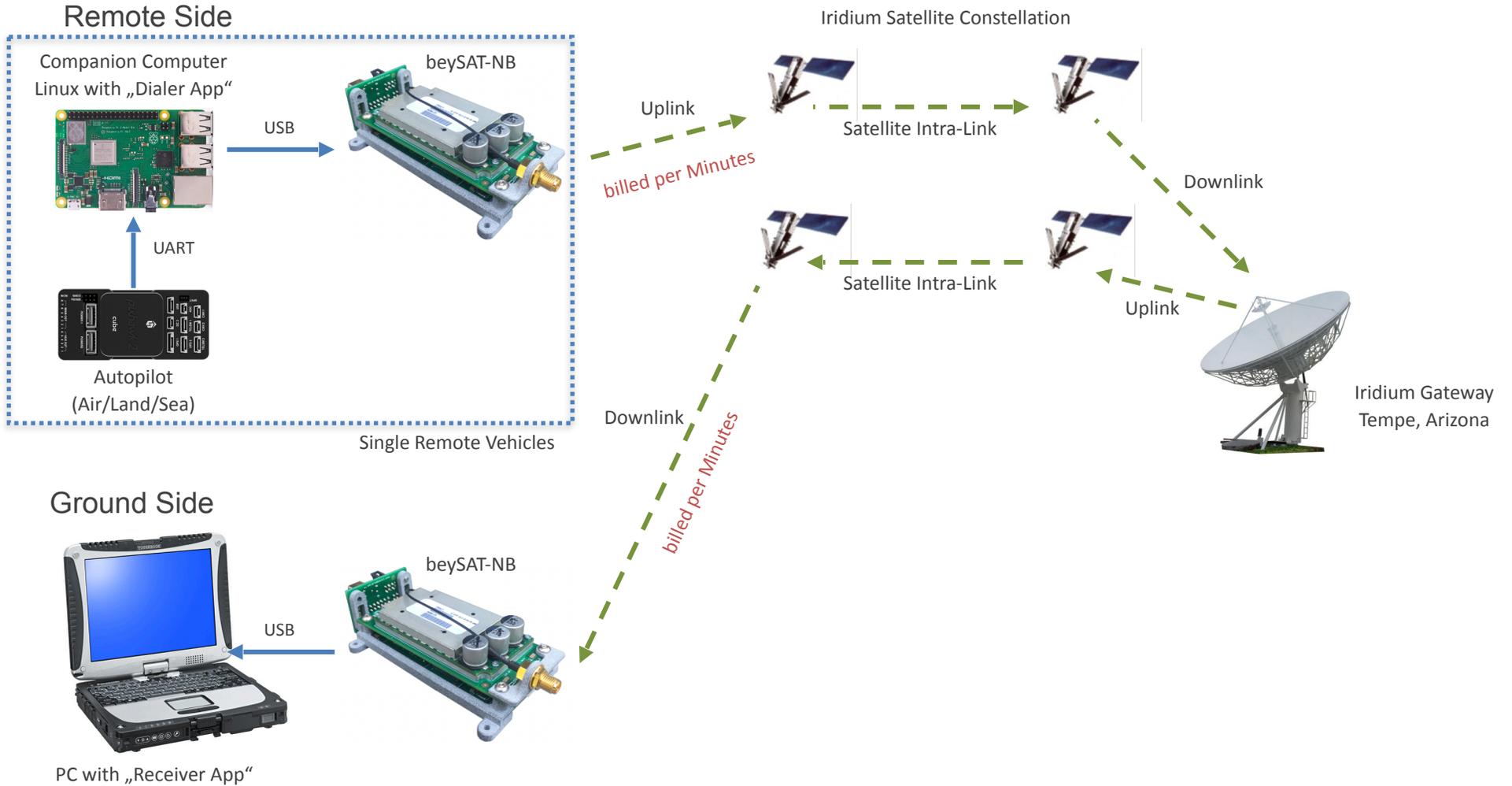
Topology: Iridium Direct Internet Server



Topology: Iridium Direct Internet Server - PtP or PtMP

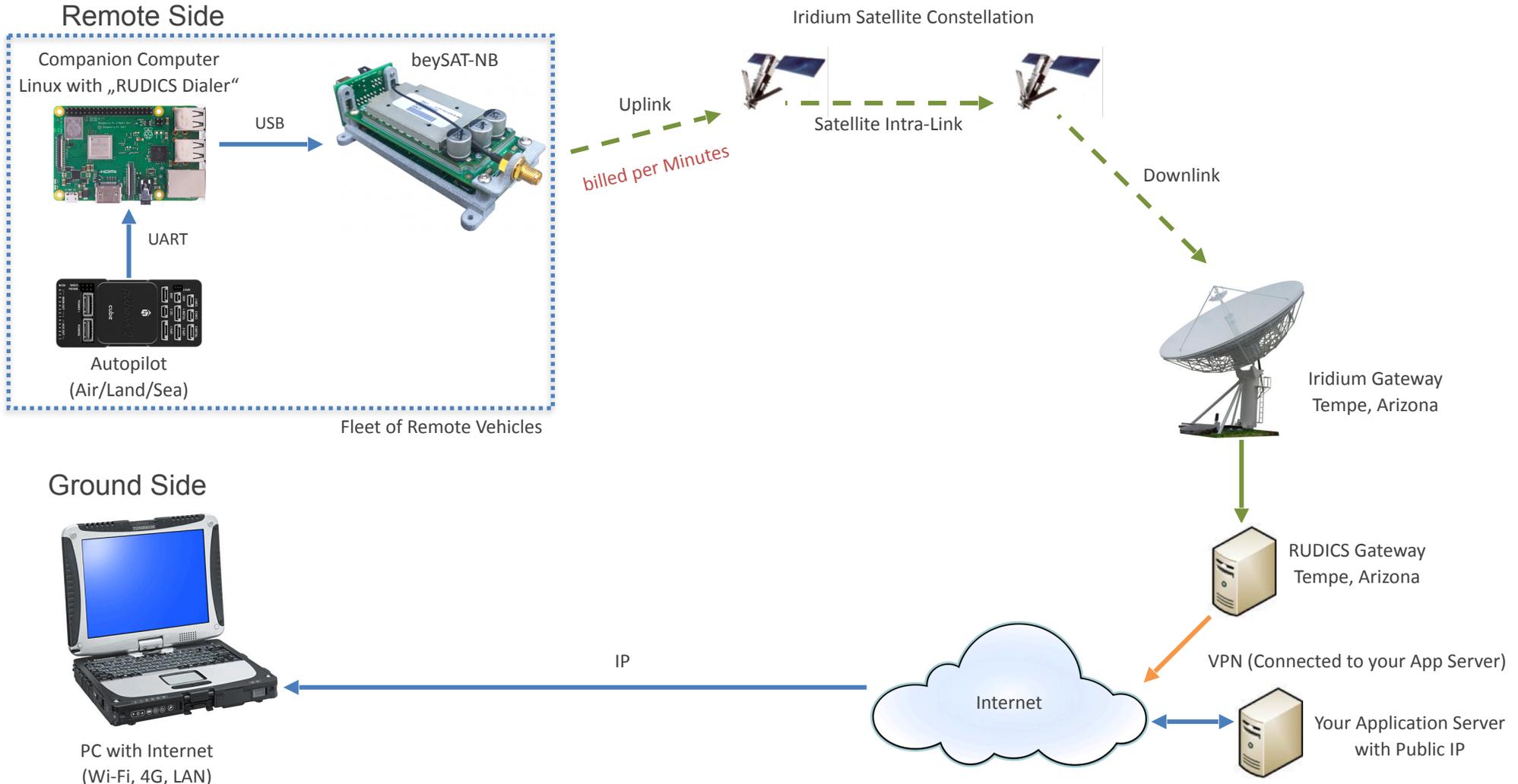


Topology: Point to Point w/o PPP



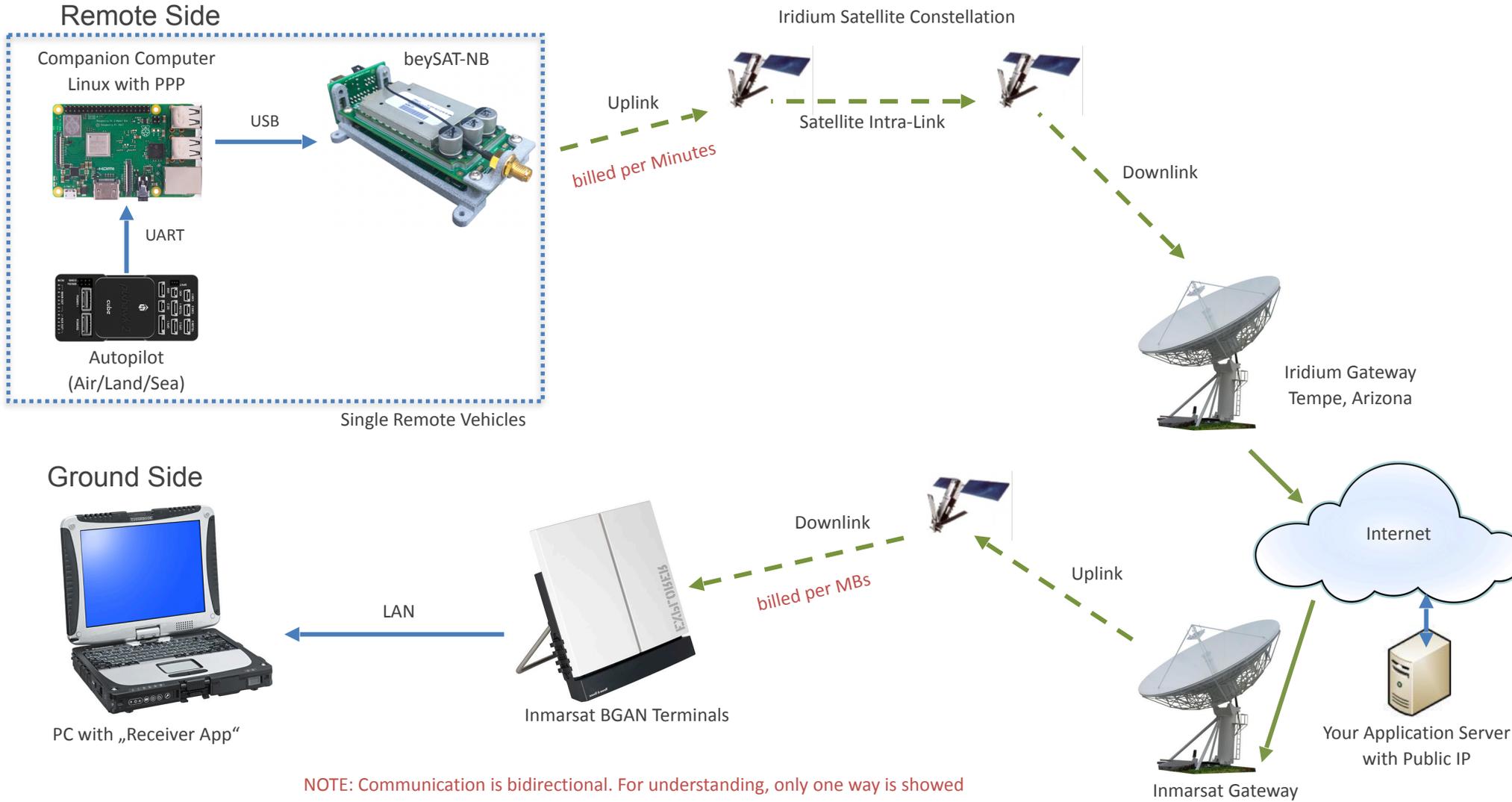
NOTE: Communication is bidirectional. For understanding, only one way is showed

Topology: Iridium RUDICS - PtP or PtMP



NOTE: Communication is bidirectional. For understanding, only one way is showed

Topology: Iridium Direct Internet Server to Inmarsat GCS



3D View of Iridium NEXT Constellation

Global Selection of Satellites:

<https://celestrak.org/NORAD/elements/>

Iridium NEXT:

<https://celestrak.org/cesium/orbit-viz.php?tle=/NORAD/elements/gp.php?GROUP=iridium-NEXT&satcat=/pub/satcat.txt&orbits=0&referenceFrame=1>

Iridium NEXT Visual Project:

<https://nootropicdesign.com/projectlab/2019/12/27/iridium-signal-monitoring/>

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