Sub-track III –
IoT & Connectivity Presentation
ST60 video trailer

If only we could remove connectors from devices

https://youtu.be/NHRDrtExZgY
ST60
contactless connectivity

Liam Park
STMicroelectronics
1. ST60 positioning
2. ST60 Roadmap
3. ST60 A2 product presentation
4. ST60 A3 Product presentation
5. ST60 Turnkey solution
ST60 positioning
ST60: a new solution for contactless connectivity

High-speed, low-power, short range, point to point 60 GHz RF link

- Up to 6 Gbps
- Small footprint
- Ultra low power
- -40°C to 105°C

Replace cables for board-to-board connection
Enable connector-free solutions
- Immune to water / dust / vibration
- Rotation support
- Electrical isolation
- Improved Reliability
- Waterproof devices
- Sleeker design for devices
- ...

Solve product design challenges
60 GHz contactless connectivity

ST60 Benefits: Extreme Speed performance at very Low-Power, small Form Factor, integration easiness
Application examples

Electronic Appliance
- Low Data Rate transfer
- Consumer & Industrial
- Factory Automation, Debug and FW transfer
- Safe & reliable rotation

Factory Automation

Robotics
- Up to High Data Rate
- Consumer & Industrial
- GbE, Video, Camera
- Safe & reliable rotation

Accessories & modular devices (camera, etc)

Slipring
- Lidar Applications

Personal Electronics
- (docking, FW transfer)

Industrial Safety

Video Walls
ST60 roadmap
**ST60 portfolio – Applications**

**High Data Rate**
- Up to 6.25 Gbps
  - Contactless SLVS
  - DP, PCIe, VbyOne, CSI/DSI (*)

**Next Generation**
- Contactless Up to 10 Gbps

**Low Data Rate**
- Up to 100 Mbps
  - Contactless Single GPIO

**Contactless eUSB2**
- 100 Mbps
  - 480 Mbps
  - Contactless eUSB2, USB2

**Contactless Dual GPIO, UART, I2C & SPI**
- 6 Gbps

**Contactless UART, GPIO & I2C**
- 5 Gbps

(*) leveraging companion chips / serializer
ST60 portfolio – Features

**ST60A2 external antenna**
GPIO up to 100 Mbps, SLVS up to 6 Gbps

- Protocol agnostic tunneling in low power mode (44 mW max)
- Configuration by I²C or HW force mode (no MPU/MCU integrated)
- 60 GHz ASK modulation
- Small footprint VFBGA 2.2 x 2.2 x 0.8 mm
- Compliancy with existing 60 GHz regulation, with adequate antenna design

**ST60A3 antenna in package or on board**
eUSB2 480 Mbps, UART I²C GPIO up to 6 Mbps

- Multi-protocols tunneling in low power mode (130 mW max)
- Simple configuration by I²C and OTA (no MPU/MCU integrated)
- 60 GHz ASK modulation
- Small footprint package: VFBGA 2.9 x 4.1 x 0.8 mm AiP or VFBGA 2.2 x 2.6 x 0.8 mm with external antenna
- Compliancy with existing 60 GHz regulation
## ST60 portfolio – Features

<table>
<thead>
<tr>
<th>Features</th>
<th>ST60A2G0</th>
<th>ST60A3H0</th>
<th>ST60A3H1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Antenna</strong></td>
<td>• External Antenna</td>
<td>• External antenna</td>
<td>• Antenna In Package (AIP)</td>
</tr>
<tr>
<td></td>
<td>• PCB patch antennas or directive SMT horn antennas supporting both end-fire and broadside radiation patterns</td>
<td>• Multiple solutions available (vertical, horizontal radiation)</td>
<td>• Broadside radiation, Up to 5 cm FSPL</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Compatible with H1 internal antenna</td>
<td>• Smallest footprint, Ease of integration</td>
</tr>
<tr>
<td><strong>Low Data Rate</strong></td>
<td>• GPIO: Single GPIO, Up to 100Mbps</td>
<td>• GPIO: up to 6 Mbps, Dual CMOS IO, LP and ULP modes, single and bi-directional tunneling, UART: up to 6 Mbps, Dual CMOS IOs, LP &amp; ULP modes</td>
<td>• GPIO: up to 6 Mbps, Dual CMOS IO, LP and ULP modes, single and bi-directional tunneling, UART: up to 6 Mbps, Dual CMOS IOs, LP &amp; ULP modes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• PC: up to 1 Mbps, Standard, Fast-and Fast-mode Plus modes, Dual CMOS IOs</td>
<td>• PC: up to 1 Mbps, Standard, Fast-and Fast-mode Plus modes, Dual CMOS IOs</td>
</tr>
<tr>
<td><strong>USB</strong></td>
<td></td>
<td>• eUSB2</td>
<td>• eUSB2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Hybrid repeater</td>
<td>• Hybrid repeater</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• LS, FS &amp; HS modes, up to 480 Mbps</td>
<td>• LS, FS &amp; HS modes, up to 480 Mbps</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Several eUSB2 configurations supported</td>
<td>• Several eUSB2 configurations supported</td>
</tr>
<tr>
<td><strong>HDR/FDR</strong></td>
<td>• SLVS Half Duplex @ 6.25 Gbps max</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>(SLVS)</strong></td>
<td>• SGMII @ 1.25 Gbps</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Package</strong></td>
<td>• BGA 2.2x2.2x0.8 mm, 0.4mm pitch</td>
<td>• BGA 2.2x2.6x0.8 mm, 0.4mm pitch</td>
<td>• BGA 2.9x4.1x0.8 mm, 0.4mm pitch</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Antenna in Package,</td>
</tr>
<tr>
<td>Power</td>
<td>• VCC 1.8V - 1.45V</td>
<td>• eUSB2 HS Rx/Tx tunneling – 110/130 mW</td>
<td>• VCC: 1.8V</td>
</tr>
<tr>
<td></td>
<td>• SLVS @ 5 Gbps:</td>
<td>• UART Rx/Tx tunneling – 90 mW / 15 mW (ULP)</td>
<td>• eUSB2 HS Rx/Tx tunneling – 110/130 mW</td>
</tr>
<tr>
<td></td>
<td>• Rx: 27 mW, Tx: 44 mW</td>
<td>• I²C tunneling – 90 mW</td>
<td>• UART Rx/Tx tunneling – 90 mW / 15 mW (ULP)</td>
</tr>
<tr>
<td></td>
<td>• GPIO @ 100 Mbps:</td>
<td>• GPIO tunneling – 90 mW</td>
<td>• I²C tunneling – 90 mW</td>
</tr>
<tr>
<td></td>
<td>• Rx: 16 mW, Tx: 40 mW</td>
<td>• Low power mode – 120 µW</td>
<td>• GPIO tunneling – 90 mW</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Standby mode – 13 µW</td>
<td>• Low power mode – 120 µW</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Standby mode – 13 µW</td>
</tr>
<tr>
<td><strong>Temp range</strong></td>
<td>• Consumer: -20,+85 °C</td>
<td>• Consumer: -20,+85 °C</td>
<td>• Consumer: -20,+85 °C</td>
</tr>
<tr>
<td></td>
<td>• Industrial: -40,+105 °C</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Schedule</strong></td>
<td>• Mass production: now</td>
<td>• Samples: Now</td>
<td>• Samples: Now</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Mass Production: now</td>
<td>• Mass Production: now</td>
</tr>
</tbody>
</table>
ST60A2 product overview
ST60A2 overview

Compact solution integrating full 60 GHz RF transceiver

- Up to 6.25 Gbps
- Small Footprint
- Ultra low power
- -40°C to 105°C

Point to Point
Short range
Half Duplex
Full / High Data Rate modes: FDR/HDR
- SLVS differential input-output port (TX/RX)
- Need DC balanced data 8b/10b coded
- FDR mode: from 1 Mbps to 5 Gbps
- HDR mode: from 500 Mbps to 6.25 Gbps
- Typical interfaces:
  - LVDS (need level adaptation)
  - Ethernet SGMII

Low Data Rate mode: LDR
- Single-ended CMOS IO: from 9.6 kbps to 100 Mbps
- Typical interfaces: UART, GPIO
ST60A2 LDR Demo
ST60A3 product overview
60 GHz V-Band transceiver for contactless connectivity
up to 480 Mbps

Short range, point to point, low power, self mate detection RF link
eUSB2, GPIO, UART, I2C or SPI RF tunneling

Antenna in Package (AiP) suited for footprint-constrained applications
- Broadside radiation, 42 dB typical link budget, up to 5 cm Free Space Propagation Loss

Optimized BoM

Low power consumption
- eUSB2 HS Rx/Tx – 110 / 130 mW typ.
- UART/I2C/GPIO – 90 mW typ.
- Low power mode – 120 µW
- Standby mode – 13 µW typ.
ST60A3 eUSB Tunneling
ST60A2 evaluation kit overview
ST60A2 RF evaluation kit

- Versatile evaluation kit supporting:
  - Low and high data rates modes
  - HW forced and I²C/SW controlled modes
- Compatible with ST60 RF modules featuring integrated, patch & horn antennas variants
- Designed for RF validation & measurements
  - Eye diagram, BER, Jitter

XNucleo adapter boards:
- Single ST60A2 printed patch antenna half duplex
- Dual ST60A2 H&V horn antenna full duplex
- Single ST60A2 circular antenna half duplex
Daughter board used with Evaluation Kits

Far-Field radiated feature:
EIRP max = 4.8 dBm

Measurement on B2266 Board (CW signal)

Far-field radiation properties (3D and 2D views)

B2266 – RF daughter board

ST60A2G0 side's view

Opposite view

~8mm

Daughter board used with Evaluation Kits
Far-Field radiated feature: 
EIRP max = 7.5 dBm

Measurement on B2275 Board (CW signal)

Far-field radiation properties (3D and 2D views)
Far-Field radiated feature: EIRP max = 3 dBm

Measurement on B2312 Board (CW signal)

B2279 – RF daughter board

Far-field radiation properties (3D and 2D views)

Note: B2279 to be used in combination with B2266

Daughter board used in both Discovery and Evaluation Kits
Broadside Horn – RF daughter board

Far-Field radiated feature:
EIRP max = 7.8 dBm

Broadside direction

HPBW 40°–58°
HPBW 57°–61°

Daughter board used with Evaluation Kits
Solderable Antenna Module (SAM) – RF board

Far-Field radiated feature: EIRP max = 5.5 dBm

HPBW 40°~58°
HPBW 57°~61°

Daughter board used with Evaluation Kits
ST60A3
Discovery & evaluation kits
ST60A3G1 discovery kit – USB2 type A B2309/B2310 & B2309/B2310

ST60A3G1 Discovery Kit is a hardware and software package to demonstrate USB2, eUSB2, UART, GPIO and I2C communications of a ST60A3G1 RF link
ST60A3G1 discovery kit – USB type C B2309/B2310 & B2313/B2310
B2310A02 RF daughter board

Far-Field radiated feature:
EIRP max=5.5dBm

Measurement on B2310 Board (CW signal)

Far-field radiation properties (3D and 2D views)

Daughter board used in both Discovery and Evaluation Kits
ST60
Turnkey solutions
# Ethernet module

<table>
<thead>
<tr>
<th>Type</th>
<th>Figure</th>
<th>Frequency [GHz]</th>
<th>Peak gain [dBi]</th>
<th>Feature</th>
<th>Module Size (mm)</th>
<th>Max data rate (Gbps)</th>
<th>Max. Distance (mm)</th>
<th>ST Partner</th>
</tr>
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<tbody>
<tr>
<td>S2S</td>
<td><img src="image_url" alt="Image" /></td>
<td>55 ~ 66</td>
<td>6.5</td>
<td>RF to Ethernet conversion/ Full-duplexing</td>
<td>50 X 60</td>
<td>1.25</td>
<td>30</td>
<td>SensorView</td>
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## Table

<table>
<thead>
<tr>
<th>Items</th>
<th>2023</th>
<th>2024</th>
<th>Remark</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Oct</td>
<td>Nov</td>
<td>Dec</td>
</tr>
<tr>
<td>Ethernet Module (Full duplex)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethernet Module (Full duplex+Rotation)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethernet Module (Full duplex+Rotation+Power Transfer)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# Solderable Antenna Module (SAM)

<table>
<thead>
<tr>
<th>Type</th>
<th>Frequency [GHz]</th>
<th>Peak gain [dBi]</th>
<th>Substrate (FR4) (Layer/Thickness mm)</th>
<th>Feature</th>
<th>Module Size (mm)</th>
<th>Product</th>
<th>Max data rate (Gbps)</th>
<th>Max. Distance (mm)</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAM1</td>
<td>55 – 65</td>
<td>6dBi</td>
<td>6L 1.2T</td>
<td>Single No R/C No shield can</td>
<td>6.4 x 7.4</td>
<td>S60PVS3A</td>
<td>2.83 – 5.66</td>
<td>20 – 12</td>
<td>Verified</td>
</tr>
<tr>
<td>SAM2</td>
<td>55 – 65</td>
<td>6dBi</td>
<td>6L 1.2T</td>
<td>Loopback + R/C</td>
<td>6.4 x 10</td>
<td>S60PVS4A</td>
<td>2.83 – 5.66</td>
<td>20 – 12</td>
<td>On-going</td>
</tr>
<tr>
<td>SAM3</td>
<td>55 – 65</td>
<td>6dBi</td>
<td>6L 1.2T</td>
<td>SAM2 + R/C + Shield can</td>
<td>8 x 14</td>
<td>S60PVS4B</td>
<td>2.83 – 5.66</td>
<td>16 – 8</td>
<td>On-going</td>
</tr>
<tr>
<td>SAM4</td>
<td>56 – 66</td>
<td>8dBi</td>
<td>4L 1.2T (v1) 6L 1.2T (v2)</td>
<td>Horn + R/C</td>
<td>8 x 14</td>
<td>S60HVS1A</td>
<td>2.83 – 5.66</td>
<td>22 – 14</td>
<td>to be update</td>
</tr>
<tr>
<td>SAM5</td>
<td>56 – 66</td>
<td>8dBi</td>
<td>6L 1.2T</td>
<td>Horn + R/C + Shield can</td>
<td>8 x 14</td>
<td>S60HVS1B</td>
<td>2.83 – 5.66</td>
<td>22 – 14</td>
<td>to be update</td>
</tr>
<tr>
<td>S2S</td>
<td>SAM1</td>
<td>55 – 65</td>
<td>6dBi</td>
<td>Single + R/C</td>
<td>8 x 12</td>
<td>S60PHS3A</td>
<td>2.83 – 5.66</td>
<td>20 – 12</td>
<td>On-going</td>
</tr>
<tr>
<td>SAM2</td>
<td>55 – 65</td>
<td>6dBi</td>
<td>6L 1.2T</td>
<td>Single + R/C + Shield can</td>
<td>8 x 12</td>
<td>S60PHS3B</td>
<td>2.83 – 5.66</td>
<td>20 – 12</td>
<td>On-going</td>
</tr>
</tbody>
</table>
Various serialize modules

<table>
<thead>
<tr>
<th>Type</th>
<th>Figure</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPIO</td>
<td>multiple GPIOs transfer GPIO, UART, I2C, I2S and so on</td>
<td>ES</td>
</tr>
<tr>
<td>LVDS</td>
<td>multiple LVDS transfer</td>
<td>ES</td>
</tr>
<tr>
<td>MIPI</td>
<td>Multiple MIPI CSI-2</td>
<td>Under developing</td>
</tr>
</tbody>
</table>
Our technology starts with You

Find out more at www.st.com