# PicoScenes 许可证计划 (PSLP) v0.2.2

**摘要：**PSLP v0.2.2提供了免费和收费两档许可证。免费档覆盖了大部分常用功能，收费档额外提供高级功能特性+非常及时的技术支持。目前v0.2.2版收费档费率拟定为8688元年/台，并提供批量折扣。

**许可证类型：**PSLP v0.2.2设置了两档许可证：免费许可证Free License (FL) 和专业用户许可证Power User License (PUL)。FL授权对用户永久免费使用，但部分高级功能受限；**PUL授权用户在一台计算机上使用PicoScenes所有功能，但需按年订阅付费，**PUL可在不同计算机上切换。

**许可证内容**：PSLP涉及内容繁杂，大体归类为技术支持，平台特性和硬件支持(AX210，AX200，QCA9300，IWL5300以及USRP)三大方面。FL和PUL的功能区别具体见PicoScenes许可证细节列表 v0.2.2 。此表格列出了PicoScenes最详细的功能与特性。

**许可证时效**：从2022年2月20日0点起，正式启动v0.2.2版本许可证。此时间之后，PicoScenes默认切换到FL v0.2.2，用户通过授权密钥或文件切换至PUL v0.2.2。

**订阅费率：**v0.2.2版PUL费率拟定为**8688元/年/台。**批量购买方面：一次性批量购买$N, N \leq 7$，可享受$(N-1)*8\,\%$ 折扣，例如一次性批量购买3台，可享受16%折扣；一次性订阅2年/3年可在批量折扣的基础上额外享受9%/18%折扣。PicoScenes团队将每两个月优化license的结构及细节，并上浮PUL费率100美元左右。

**支付渠道：**中文地区用户可在PicoScenes官方淘宝店选购，该淘宝店**可提供电子发票**；海外用户支付渠道正在建立，敬请期待。

**深度定制化开发：**开放面向科研机构或商业的定制化开发，欢迎商务洽谈。

PicoScenes开发团队
2022年2月18日

# PicoScenes License Plan (PSLP) v0.2.2

**TL;DR**：PSLP v0.2.2 offers two license options, free and paid. The former covers the most common features, and the latter provides the advanced features plus timely technical support. The subscription fee of the paid license is 1360 USD/computer/year with an extra bulk purchase discount.

**License Types**: PSLP v0.2.2 has two license options: **Free License (FL) and Power User License (PUL)**. FL is permanently free of charge but with limited access to some advanced features. The PUL grants user to use all PicoScenes features on one computer, and users will pay the annual subscription fee. The PUL subscribers can switch their PULs to different computers.

**License Items**: We divide the PSLP into three large feature sets: the technical support, platform features, and support for CSI hardware (AX210, AX200, QCA9300, IWL5300, and USRP). The differences between FL and PUL are listed in PSLP License Details v0.2.2. This table is the most detailed list of the PicoScenes features.

**License Timing**: The PSLP v0.2.2 will be activated on Feb. 18, 2022. After that, PicoScenes program will automatically switch to the FL v0.2.2 by default. The PUL subscriber can activate their PUL v0.2.2 using a license key or file.

**PUL Subscription Fee**: The subscription fee of PLSP v0.2.2 PUL is 1360 USD/computer/year. Bulk purchase discount: purchasing $N, N \leq 7$ subscriptions in one-time bulk will have a discount of $(N-1)*8\%$, *e.g.*, 16% discount for 3 subscriptions in a one-time purchase. In addition, subscribing 2/3 years can have an extra 9%/18% discount. PicoScenes team will optimize the PLSP every two months and raise the subscription fee about 100 USD。

**Payment**: Chinese users can purchase PUL subscription on PicoScenes Taobao Shop.  The overseas payment channel is being established. Please stay tuned.

**Customized Development**: we will accept business negotiation on research or commercial purposed customized development.

PicoScenes Team
Feb. 18, 2021

## FL与PUL的主要区别（摘要版）

根据过去半年的试用反馈，FL与PUL的最主要区别不是技术层面，而是**技术支持**。PUL用户可以通过微信或其它IM联系我们，得到最及时甚至实时的技术支持。在几乎所有用户的评价中，技术支持都被认为最有价值。

在技术层面，FL保留了大多数Wi-Fi感知所需要的内容；而PUL可以访问很多PicoScenes的最新和最亮点的功能，例如多网卡支持、160MHz带宽的注入、QCA9300网卡的载波与带宽调节、基于USRP的多天线MIMO、Precoding等。

下表是二者详细的特性对比。

PicoScenes开发团队
2022年2月18日

## The main differences between the FL and PUL (TL; DR version)

According to the trail feedbacks over the past six months, the main difference between FL and PUL is not the technical level, but technical support. PUL subscribers can reach us via WeChat or other IM, and we provide timely and even real-time support.

Technically, FL contains the most commonly used features for Wi-Fi sensing; while PUL retains the latest and the most highlighted features of PicoScenes, such as the multi-NIC support, 160-MHz bandwidth packet injection, arbitrary tuning for carrier frequency and sampling rate on the QCA9300 NIC, USRP-based MIMO Tx and Rx, Precoding, *etc*.

The following table is a detailed functional comparison between FL and PUL.

PicoScenes Team
Feb. 18, 2022

## v0.1.11与v0.2.2的主要区别（摘要版）

根据过去3个月的用户反馈与使用统计，在v0.2.2版本中，我们优化了FL与PUL的特性差异，将PUL中SDR前端的若干关键特性下放给FL，包括2x2 MIMO，时钟同步，基带信号录制与重放以及完整基带信号的获取。详细的更新请参见下表中蓝色标亮的特性。

PicoScenes开发团队
2022年2月19日

## The main differences between v0.1.11 and v0.2.2 (TL; DR version)

Based on user feedback and usage statistics over the past 3 months, in v0.2.2 we have optimized the features between FL and PUL by relaxing several key features of the SDR frontend in PUL to FL, including 2x2 MIMO, clock synchronization, Tx/Rx signal recording/playback, and access to full baseband signal. Please refer to the blue-colored features for more details.

PicoScenes Team
Feb. 19, 2022

## PSLP版本修订日志/ PSLP Revision Update Log

| 修改日期/Revision Date | 受影响版本号/Affected PSLP Version | 修改/Modifications |
|---|---|---|
| **Nov. 18, 2021** | v0.1.10 —> v0.1.11 | Add AX210 section |
| **Feb. 18, 2021** | v0.1.11 -> v0.2.2 | Several key features relaxed for FL users |
| **Feb. 19, 2021** | v0.2.2 -> v0.2.2 | Minor tweaks; highlight the relax features (the blue-colored features in the following table) |

## PicoScenes许可证功能列表 v0.2.2 (PSLP License Details v0.2.2)

| 特性集/ Feature Set | 特性 Feature | 特性描述 Feature Description | FL | PUL | 特性版本 Feature version |
|---|---|---|---|---|---|
| **技术支持 Technical Support** | 完善的平台文档<br>Good documentation | https://ps.zpj.io | ✓ | ✓ | **v0.2** |
| | 基于Issue Tracker的技术支持<br>Issue tracker-based technical support | 最长36小时内回复<br>Reply in at most 36 hours | ✓ | ✓ | **v0.2** |
| | 基于IM的非常及时、针对性的技术支持<br>Very timely and targeted technical support via IM | 在微信或其它IM上成立专门的PicoScenes技术支持小组，空闲时可提供实时技术支持，最长12小时回复<br>Establish special technical support group on WeChat or other IM, providing real-time technical support if possible. Reply in 12 hours at most. | | ✓ | **v0.2** |
| **平台特性 Platform Features** | 基于Debian apt的安装、更新、卸载<br>Debian apt-based installation, upgrade and uninstallation | 新装系统的安装过程仅10分钟<br>Fresh new installation can be as short as 10 minutes. | ✓ | ✓ | **v0.2** |
| | PicoScenes MATLAB Toolbox | 用于在MATLAB中解析PicoScenes生成的.csi文件；可自动升级<br>Parsing the .csi file in MATLAB; auto-upgradable | ✓ | ✓ | **v0.2** |
| | PicoScenes Python Toolbox | 用于在Python中解析生成的.csi文件<br>Parsing the .csi file in Python | ✓ | ✓ | **v0.2** |
| | CSI live plot | Rx端实时显示CSI幅度和相位<br>Rx end plots CSI magnitude and phase in real time | ✓ | ✓ | **v0.2** |
| | 具有前向兼容的PicoScenes数据帧格式<br>PicoScenes Data format with forward compatibility | 不用担心PicoScenes升级造成的已有数据无法解析问题<br>Forward compatibility guarantees the correct parsing of the old .csi data format during the future upgrade | ✓ | ✓ | **v0.2** |
| | 丰富的网卡阵列控制脚本<br>Rich NIC control scripts | 基于PCIE层次的网卡命名、批量配置等<br>PCIE hierarchy-based NIC naming, batch configuration, *etc*. | ✓ | ✓ | **v0.2** |

| 特性集/ Feature Set | 特性 Feature | 特性描述 Feature Description | FL | PUL | 特性版本 Feature version |
|---|---|---|---|---|---|
| | 使用、开发 PicoScenes 插件<br>Using and Developing PicoScenes Plugins | PicoScenes Plugin Development Kit 开源<br>PicoScenes Plugin Development Kit is open sourced | ✓ | ✓ | **v0.2** |
| | 并行多PicoScenes进程<br>Concurrent Multi-process of PicoScenes | 多进程或用于某些复杂控制<br>Multi-Process may be easier for certain complex control | | ✓ | **v0.2** |
| | 多前端硬件支持(>=2块COTS NIC或USRP)<br>Multi-NIC or FrontEnd (>=2 COTS NICs or USRP | 可支持异构多网卡/USRP混合前端阵列<br>Support Multi-NIC/USRP hybrid frontend array | ✓(受限，最多2台前端)<br>✓(limited，2 frontends max) | ✓ | **v0.2** |
| **AX210** | 6-GHz频段访问<br>6-GHz Band Access | 访问完整的6GHz频段[5955,7115] MHz<br>Accessing the full 6-GHz band [5955, 7115] MHz | ✓(2022年4月之后，将根据国家地区管制受限)<br>✓(Will be limited after Apr. 2022 according to regulation domain) | ✓ | **v0.2** |
| | AX210的其它特性继承AX200<br>AX210 inherits other features of AX200. | | | | |
| **AX200** | 连接AP测量CSI<br>CSI measurement via AP connection | 支持连接全协议(11a/g/n/ac/ax)、全带宽(20/40/80/160 MHz)、全频段(2.4/5 GHz)的AP，并对所有接收帧(除11b格式)测量CSI<br>CSI measurement by connecting to Wi-Fi AP, supporting all protocol (11a/g/n/ac/ax), all bandwidths (20/40/80/160 MHz) and all bands (2.4/5 GHz) | ✓ | ✓ | **v0.2** |
| | 监听模式测量CSI<br>CSI measurement by “Monitor mode + Packet Injection” | 支持在监听模式下对所收到的全协议(11a/g/n/ac/ax)、全带宽(20/40/80/160 MHz)、全频段(2.4/5 GHz)的帧(除11b格式)测量CSI<br>CSI measurement for the overheard frames in monitor mode, supporting all protocols (11a/g/n/ac/ax), all bandwidths (20/40/80/160 MHz) and all bands (2.4/5 GHz) | ✓ | ✓ | **v0.2** |
| | 注入(Packet Injection) 信道带宽(CBW) 为20/40 MHz的11a/g/n/ac/ax格式帧<br>Packet Injection in 11a/g/n/ac/ax format with 20/40 MHz Channel bandwidth (CBW) | 用于触发稳定频率的CSI测量；可指定20/40MHz带宽、MCS、MIMO、400/800/1600/3200 ns GI、BCC/LDPC编码；数据包内容为定制PicoScenesTxFrame格式；内容深度定制可借助PicoScenes-PDK插件<br>Packet injection can trigger CSI measurement in a constant rate. Capable of specifying 20/40 MHz CBW, MCS, MIMO, 400/800/1600/3200 ns Guard Interval (GI), BCC/LDPC coding. Packet content is with PicoScenesTxFrame format, can be further customized via PicoScenes-PDK plugins. | ✓ | ✓ | **v0.2** |
| | 注入让IWL5300网卡触发CSI测量的包<br>Inject packets that can trigger CSI measurement on IWL5300 | 有专用的“—5300”选项，可实现AX200(注入)→IWL5300(接收)的CSI测量<br>Dedicated “—5300” option for AX200(Injection) -> IWL5300 (Rx in monitor mode) CSI measurement | ✓ | ✓ | **v0.2** |
| | 运行切换信道及信道宽带(CBW)<br>Change channel and bandwidth in real-time | 无需暂定测量，通过命令或API直接控制控制信道、中心频率以及工作宽带<br>Direct channel/CBW changing via API or command options | ✓ | ✓ | **v0.2** |
| | 注入(Packet Injection) 信道带宽(CBW) 为80/160 MHz的11ac/ax格式帧<br>Packet Injection in 11ac/ax format with 80/160 MHz Channel bandwidth (CBW) | 用于触发稳定频率的CSI测量；可指定80/160 MHz带宽、MCS、MIMO、400/800/1600/3200 ns GI、BCC/LDPC编码；数据包内容为定制PicoScenesTxFrame格式；内容深度定制可借助PicoScenes-PDK插件<br>Packet injection can trigger CSI measurement in a constant rate. Capable of specifying 80/160 MHz CBW, MCS, MIMO, 400/800/1600/3200 ns Guard Interval (GI), BCC/LDPC coding. Packet content is with PicoScenesTxFrame format, can be further customized via PicoScenes-PDK plugins. | | ✓ | **v0.2** |

| 特性集/ Feature Set | 特性 Feature | 特性描述 Feature Description | FL | PUL | 特性版本 Feature version |
|---|---|---|---|---|---|
| QCA9300 | 对任意来源包测量CSI<br>CSI measurement for all source MAC address | 对任意源地址(Source Address)的帧测量CSI<br>CSI measurement for all the overheard frames which are with different source MAC address | ✓(受限，仅对最初收到6个地址测量)<br>✓(limited，just for the first 6 received MAC addresses) | ✓ | v0.2 |
| | 获得FTM时钟计数<br>Obtain Fine-Timing Measurement (FTM) clock count | 硬件底层使用的320MHz时钟原始计数，每4秒一周，可用于精确同步<br>The raw clock count from the 320 MHz baseband clock. About 4s a round. Useful for precise synchronization | | ✓ | v0.2 |
| | 测量指定Frame Type帧的CSI<br>CSI measurement for the specified frame types | 指定基于Frame Type的过滤，例如指定仅对Beacon Frame类型测量CSI<br>CSI measurement for the specified frame types, e.g., measuring CSI only for Beacon Frames | | ✓ | v0.2 |
| | 监听模式测量CSI<br>CSI measurement by “Monitor mode + Packet Injection” | QCA9300网卡仅支持对“指定其MAC地址且not_sounding=OFF的11n协议帧”测量CSI<br>QCA9300 NIC hardware reports CSI only for 11n frames with HT-rate flag not_sounding=off | ✓ | ✓ | v0.2 |
| | 注入(Packet Injection) 信道带宽(CBW) 为20/40 MHz的11a/g/n格式帧<br>Packet Injection in 11a/g/n/ac/ax format with 20/40 MHz Channel bandwidth (CBW) | 用于触发稳定频率的CSI测量；可指定20/40MHz带宽、MCS、MIMO、400/800 ns GI、BCC/LDPC编码以及not_sounding标记；数据包内容为定制PicoScenesTxFrame格式；内容深度定制可借助PicoScenes-PDK插件<br>Packet injection can trigger CSI measurement in a constant rate. Capable of specifying 20/40 MHz CBW, MCS, MIMO, 400/800 ns Guard Interval (GI), BCC/LDPC coding and not_sounding flag. Packet content is with PicoScenesTxFrame format, can be further customized via PicoScenes-PDK plugins. | ✓ | ✓ | v0.2 |
| | 注入让IWL5300网卡触发CSI测量的包<br>Inject packets that can trigger CSI measurement on IWL5300 | 有专用的“—5300”选项，可实现QCA9300(注入)→IWL5300(接收)的CSI测量<br>Dedicated “—5300” option for QCA9300(Injection) -> IWL5300 (Rx in monitor mode) CSI measurement | ✓ | ✓ | v0.2 |
| | Tx通道指定<br>Tx chain specification | 指定某个Tx通道是否参与发送<br>Specify which Tx chains are used for Tx | ✓ | ✓ | v0.2 |
| | Rx通道指定<br>Rx chain specification | 指定某个Rx通道是否参与接收<br>Specify which Rx chains are used for Rx | ✓ | ✓ | v0.2 |
| | 接收启动了11n ESS特性的包<br>CSI measurement for 11n frames with ESS feature on | Extra Spatial Sounding (ESS)是11n引入的机制，通过发送额外的HT-LTF段，可以实现对于单空间流帧有两个间隔为4*us*的连续CSI测量<br>Extra Spatial Sounding (ESS) is an 11n-introduced feature, which transmits extra HT-LTF segment, achieving 4-us spaced dual CSI measurement for 1-stream frame | ✓ | ✓ | v0.2 |
| | 访问非标准频段<br>Access non-standard carrier frequency range | QCA9300网卡硬件可在[2.2-2.9] GHz和[4.4-6.1] GHz范围内细粒度调节中心频率<br>QCA9300 NIC hardware can operate in [2.2-2.9] and [4.4-6.1] GHz carrier frequency range with fine granularity | ✓(受限，仅提供[2.3-2.6] GHz)<br>✓Limited, [2.3-2.6] GHz only) | ✓ | v0.2 |
| | 访问非标准带宽<br>Access non-standard baseband sampling rate | QCA9300网卡硬件可在[2.5,80] MHz以每2.5 MHz为步长调节基带工作频率<br>QCA9300 NIC baseband can operate in [2.5-80] MHz baseband sampling rate with 2.5 MHz step | ✓(受限，仅提供10/30 MHz)<br>✓(Limited, 10/30 MHz only) | ✓ | v0.2 |
| | 手动指定Rx增益<br>Manual Rx gain control | 关闭硬件AGC功能，实现幅度稳定的CSI测量，Rx增益手动调节范围[0-66] dBm<br>Turning off the hardware AGC and obtaining stable CSI measurement. Manual Rx control within [0, 66] dBm. | ✓(受限，仅提供[0-22] dBm)<br>✓(Limited, [0-22] dBm only) | ✓ | v0.2 |
| | 注入启动了11n ESS特性的帧<br>Inject ESS-enabled 11n frames | 可以实现面向IWL5300/QCA9300/USRP的单空间流双CSI测量，AX200/AX210不支持对ESS的测量<br>Achieving dual-CSI measurement from 1-stream packet on IWL5300/QCA9300/USRP receiver. AX200/AX210 doesn’t support ESS measurement. | | ✓ | v0.2 |

| 特性集/ Feature Set | 特性 Feature | 特性描述 Feature Description | FL | PUL | 特性版本 Feature version |
|---|---|---|---|---|---|
| IWL5300 | 连接AP测量CSI<br>CSI measurement via AP connection | IWL5300需连接11n协议的开放AP（无加密）<br>IWL5300 must be connected to 11n format Open System AP | ✓ | ✓ | v0.2 |
| | 监听模式测量CSI<br>CSI measurement by “Monitor mode + Packet Injection” | IWL5300仅支持对发送给魔术MAC地址(magic MAC address)的11n帧测量CSI<br>IWL5300 reports CSI only for the 11n frames sent to a magic MAC address | ✓ | ✓ | v0.2 |
| | 注入(Packet Injection) 11a/g/n协议帧<br>Packet Injection with 11a/g/n format | 可指定20/40MHz带宽、MCS、MIMO、400/800 ns GI<br>Capable of specifying 20/40 MHz bandwidth, MCS, MIMO, 400/800 ns GI | ✓ | ✓ | v0.2 |
| | 运行时切换信道及信道宽带（CBW）<br>Channel changing and bandwidth in real-time | 无需暂定测量，通过命令或API直接控制控制信道、中心频率以及工作宽带<br>Direct channel/CBW changing via API or command options | ✓ | ✓ | v0.2 |
| | 不重启一键切换固件<br>Switch IWL5300 firmware without reboot | 切换CSI测量固件或一般上网用固件<br>Switch between the special CSI measurement and ordinary firmware | ✓ | ✓ | v0.2 |
| | Tx通道指定<br>Tx chain specification | 指定每个Tx通道是否参与发送<br>Specify which Tx chains are used for Tx | ✓ | ✓ | v0.2 |
| | Rx通道指定<br>Rx chain specification | 指定每个Rx通道是否参与发送<br>Specify which Rx chains are used for Rx | ✓ | ✓ | v0.2 |
| | 接收启动了11n ESS特性的包<br>CSI measurement for 11n frames with ESS | Extra Spatial Sounding (ESS)是11n引入的机制，通过发送额外的HT-LTF段，可以实现对于单空间流帧有两个间隔为4*us*的连续CSI测量<br>Extra Spatial Sounding (ESS) is an 11n-introduced feature, which transmits extra HT-LTF segment, achieving 4-us spaced dual CSI measurement for 1-stream frame | ✓ | ✓ | v0.2 |
| | 支持所有USRP型号<br>Support all USRP models | B210/N210/X310/N310经过测量，E3x0/X4x0没有测试过<br>Tests pass on B210/N210/X310/N310; E3x0/X4x0 not tested | ✓ | ✓ | v0.2 |
| | 支持多USRP合并<br>Multi-USRP combination | 多个N2x0或X3x0系列可合并为一个大的MIMO USRP<br>Multiple N2x0 or X3x0 USRPs can be merged into one MIMO USRP | | ✓ | v0.2 |
| | 在非标准频段工作<br>Access non-standard carrier frequency range | 需在USRP子板支持范围内<br>Should be within the range of USRP daughterboard | ✓(受限，仅提供[2.3-2.6] GHz)<br>✓(Limited, [2.3-2.6] GHz only) | ✓ | v0.2 |
| | 在非标准带宽工作<br>Access non-standard sampling rate range | 需在USRP主板支持范围内<br>Should be within the range of USRP motherboard | ✓(受限，仅提供10/30 MHz)<br>✓(Limited, 10/30 MHz only) | ✓ | v0.2 |
| | 手动指定Rx增益<br>Manual Rx gain control | PicoScenes基带没有实现AGC，需要手动指定Rx Gain<br>PicoScenes on SDR does not implement AGC, therefore manual RX gain control | ✓ | ✓ | v0.2 |
| | Tx通道指定<br>Tx chain specification | 指定某个Tx通道是否参与发送<br>Specify which Tx chains are used for Tx | ✓(受限，最多2通道)<br>✓(Limited, up to 2 channels) | ✓ | v0.2 |
| | Rx通道指定<br>Tx chain specification | 指定某个Rx通道是否参与接收<br>Specify which Rx chains are used for Rx | ✓(受限，最多2通道)<br>✓(Limited, up to 2 channels) | ✓ | v0.2 |
| | Tx基带信号录制<br>Record Tx baseband signal | 录制在一次会话中生成的所有基带信号<br>Record Tx baseband signal to file | ✓ | ✓ | v0.2 |

| 特性集/ Feature Set | 特性 Feature | 特性描述 Feature Description | FL | PUL | 特性版本 Feature version |
|---|---|---|---|---|---|
| USRP | Tx基带信号回放<br>Replay Tx baseband signal | 将预生成的(或录制)的基带信号发射出去<br>Transmit the pre-generated or recorded Tx baseband signal | ✓ | ✓ | **v0.2** |
| | Rx基带信号录制<br>Record Rx baseband signal | 录制在一次会话中的Rx接收到的基带信号，既原始I/Q<br>Record Rx baseband signals to file, i.e., the raw I/Q signals | ✓ | ✓ | **v0.2** |
| | Rx基带信号回放<br>Replay Rx baseband signal | 将预生成的(或录制)的基带覆盖实时Rx流，用于离线基带信号解析<br>Override the Rx stream with the pre-generated or recorded Rx signals, suitable for off-line Rx signal decoding | ✓ | ✓ | **v0.2** |
| | TX CFO | 重采样Tx信号，施加指定的Carrier Frequency Offset (CFO)<br>Resample the Tx baseband signal and exert extra Carrier Frequency Offset (CFO) | | ✓ | **v0.2** |
| | TX SFO | 重采样Tx信号，施加指定的Sampling Frequency Offset (SFO)<br>Resample the Tx baseband signal and exert extra Sampling Frequency Offset (SFO) | | ✓ | **v0.2** |
| | RX CFO | 重采样Rx信号，施加指定的Carrier Frequency Offset (CFO)<br>Resample the Rx baseband signal and exert extra Carrier Frequency Offset (CFO) | | ✓ | **v0.2** |
| | RX SFO | 重采样Rx信号，施加指定的Sampling Frequency Offset (SFO)<br>Resample the Rx baseband signal and exert extra Sampling Frequency Offset (SFO) | | ✓ | **v0.2** |
| | Tx Resampling | 通过基带重采样绕过USRP整数倍带宽数量有限的问题<br>Up-sampling the Tx baseband signal to W/A USRP integer factor problem | ✓(受限，仅支持1.0和1.25)<br>✓(Limited, only 1.0 and 1.25) | ✓ | **v0.2** |
| | Rx Resampling | 通过基带重采样绕过USRP整数倍带宽数量有限的问题<br>Down-sampling the Rx baseband signal to W/A USRP integer factor problem | ✓(受限，仅支持0.8和1.0)<br>✓(Limited, only 0.8 and 1.0) | ✓ | **v0.2** |
| | Tx I/Q Imbalance | 指定Tx I/Q不平衡数值(幅度与相位)<br>Add Tx I/Q imbalance factor (mag and phase) | | ✓ | **v0.2** |
| | Rx I/Q Imbalance | 指定Rx I/Q不平衡数值(幅度与相位)<br>Add Rx I/Q imbalance factor (mag and phase) | | ✓ | **v0.2** |
| | 20 MHz信道带宽(CBW)对全协议 、全来源帧测量CSI<br>CSI measurement for frames with 20 MHz bandwidth | 注：SDR软基带基于CPU软解，丢包不可避免，MIMO/大带宽/LDPC/MU-MIMO/ OFDMA都会提升丢包率<br>Note: packet loss is inevitable for software-based SDR baseband. MIMO/ large bandwidth/LDPC/MU-MIMO/OFDMA will cause more packet loss. | ✓(受限，最大2x2 MIMO)<br>✓(Limited, up to 2x2 MIMO) | ✓ | **v0.2** |
| | 注入让IWL5300网卡触发CSI测量的包<br>Inject packets that can trigger CSI measurement on IWL5300 | 有专用的“—5300”选项，可实现USRP(注入)→IWL5300(接收)的CSI测量<br>Dedicated “—5300” option for USRP (Injection) -> IWL5300 (Rx in monitor mode) CSI measurement | ✓ | ✓ | **v0.2** |
| | 注入让QCA9300网卡触发CSI测量的包<br>Inject packets that can trigger CSI measurement on QCA9300 | 默认开启HT rate sounding标记<br>Setting HT-rate flag not_sounding=Off by default | ✓ | ✓ | **v0.2** |
| | 40/80/160 MHz信道带宽(CBW)对全协议 、全来源帧测量CSI<br>CSI measurement for frames with 40/80/160 MHz bandwidth | 注：SDR软基带基于CPU软解，丢包不可避免，MIMO/大带宽/LDPC/MU-MIMO/ OFDMA都会提升丢包率<br>Note: packet loss is inevitable for software-based SDR baseband. MIMO/ large bandwidth/LDPC/MU-MIMO/OFDMA will cause more packet loss. | | ✓ | **v0.2** |

| 特性集/ Feature Set | 特性 Feature | 特性描述 Feature Description | FL | PUL | 特性版本 Feature version |
|---|---|---|---|---|---|
| | 注入(Packet Injection) 信道带宽(CBW) 为20 MHz的11a/g/n/ac/ax格式帧<br>Packet Injection in 11a/g/n/ac/ax format with 20 MHz Channel bandwidth (CBW) | 用于触发稳定频率的CSI测量；可指定20/40MHz带宽、MCS、MIMO、400/800/1600/3200 ns GI、BCC/LDPC编码；数据包内容为定制PicoScenesTxFrame格式；内容深度定制可借助PicoScenes-PDK插件<br>Packet injection can trigger CSI measurement in a constant rate. Capable of specifying 20/40 MHz CBW, MCS, MIMO, 400/800/1600/3200 ns Guard Interval (GI), BCC/LDPC coding. Packet content is with PicoScenesTxFrame format, can be further customized via PicoScenes-PDK plugins. | ✓(受限，最大2x2 MIMO)<br>✓(Limited, up to 2x2 MIMO) | ✓ | **v0.2** |
| | 注入启动了11n ESS特性的帧<br>Inject ESS-enabled 11n frames | 可以实现面向IWL5300/QCA9300/USRP的单空间流双CSI测量，AX200不支持对ESS的测量<br>Extra Spatial Sounding (ESS) is an 11n-introduced feature, which transmits extra HT-LTF segment, achieving 4-us spaced dual CSI measurement for 1-stream frame | | ✓ | **v0.2** |
| | 注入(Packet Injection) 信道带宽(CBW) 为80/160 MHz的11ac/ax格式帧<br>Packet Injection in 11a/g/n/ac/ax format with 40/80/160 MHz Channel bandwidth (CBW) | 用于触发稳定频率的CSI测量；可指定80/160 MHz带宽、MCS、MIMO、400/800/1600/3200 ns GI、BCC/LDPC编码；数据包内容为定制PicoScenesTxFrame格式；内容深度定制可借助PicoScenes-PDK插件<br>Packet injection can trigger CSI measurement in a constant rate. Capable of specifying 80/160 MHz CBW, MCS, MIMO, 400/800/1600/3200 ns Guard Interval (GI), BCC/LDPC coding. Packet content is with PicoScenesTxFrame format, can be further customized via PicoScenes-PDK plugins. | | ✓ | **v0.2** |
| | 批量帧生成+批量注入<br>Batch Frame generation + Batch Packet Injection | 可生成并注入帧间隔为严格确定值的连续帧流；批量生成所有格式的帧，指定连续帧之间的间隔，并批量连续发出<br>Pre-generate frame signals with precise inter-frame spacing | | ✓ | **v0.2** |
| | 11n/ac/ax发送信号预编码<br>Tx Signal Precoding for 11n/ac/ax | 可指定信号预编码矩阵，实现beamforming、phased array或任意自定义信号均衡<br>Tx signal precoding can be used to realize beamforming, phased array and arbitrary signal equalization | | ✓ | **v0.2** |
| | 对任意来源包测量CSI<br>CSI measurement for any source MAC address | 对任意源地址(Source Address)的帧测量CSI<br>CSI measurement for all the overheard frames which are with different source MAC address | ✓(受限，仅对最初收到6个地址测量)<br>✓(limited, just for the first 6 received MAC addresses) | ✓ | **v0.2** |
| | 支持外部时钟<br>Support external clock source | MIMO Cable/External Clock/GPS clock | ✓ | ✓ | **v0.2** |
| | Tx MIMO Beamforming | 指定Tx Steering矩阵，可用于Beamforming或Phased Array<br>Specifying Tx steering matrix, used for beamforming and phased array | | ✓ | **v0.2** |
| | 获得L-LTF段 CSI<br>Obtain the L-LTF CSI | L-LTF段的CSI<br>Return the L-LTF based CSI estimation | | ✓ | **v0.2** |
| | 获得Pilot SubcarriersCSI<br>Obtain Pilot-subcarrier based CSI | OFDM Symbols里的Pilot subcarriers组成的CSI<br>Return the CSI composed of per-OFDM symbol pilot subcarriers | | ✓ | **v0.2** |
| | 获取完整Rx基带信号<br>Obtain complete Rx baseband signal | 返回每个包的完整多通道基带信道，严格从L-STF开始<br>Return the complete multi-channel baseband signals, starting from L-STF part | ✓ | ✓ | **v0.2** |