



INNOVATIONS AT SAANKHYA LABS

FIRST INDIAN SDR CHIPSET PROVIDER!

Company Snapshot



Saankhya Labs

EE Times Silicon 60: Hot Startups to Watch



HQ in Bangalore, India
Fully-owned subsidiary in USA



Featured in
leading media:

THE TIMES OF INDIA



BW BUSINESSWORLD

EE Times



**India's first semiconductor
Product company** Founded in 2007

Awards including:

- Innovation Excellence Award for MSMEs by FKCCI (2015)
- **EE Time Silicon 60: Hot Start-ups to Watch**
- Finalist ACE Award – EE Times EDN (2012)
- TV Innovation Award – IMS Research, USA (2011)
- Frost & Sullivan Excellence Award (2010)
- Silicon India – Start up city (2010)
- India Semiconductor Association Award (2010)
- **27 international patents**

45+ full time employees



Backed by Tier 1 investors:



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Saankhya Labs S

Technology

■ Technology

- Industry's first production SDR
- SDR is a highly flexible way to implement a communication system
- Best Power Performance Area (PPA) next generation communication ASSP platform
- Patented variable bit-width data-path designs => **Lowest Power DSP** in the industry
- Re-useable hardware accelerators

■ Current IC products

- SL100x (Demodulator) and SL900x (Modulator)



- Supports a wide range of applications (terrestrial and satellite receivers, TVWS modems, cable head-ends)
- Ability to design custom waveforms
- Shipping initial production volumes
- Roadmap for single chip modem solution

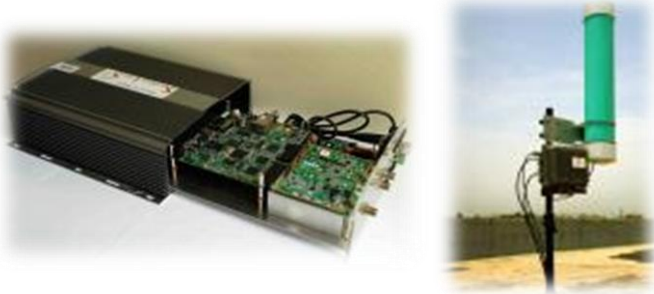


Benefits of Saankhya SDR

- Completely indigenous chipsets: **All DSP's** architected and **patented** by **Saankhya**
- Field proven hardware and software: OFDM, Single Carrier, also supports custom waveform generation and reception
- Wide data rate & channel bandwidth support: <1Kbps up to 50Mbps; 5Khz up to 15Mhz
- Single platform solution for multiple diverse applications
 - Terrestrial, cable, satellite & IP communication
 - Ideally suited for low-power, cost-effective, hand-held applications
 - Makes development and deployment much easier
- Additional layer of PHY level security through specific proprietary waveforms

Saankhya SDR Products: TVWS Modem

■ Base-station



- Long range from 10 to 20 Km*
- Bandwidth and frequency agility
- Max link rate: 30Mbps for 8Mhz
- Up-to 60 concurrent users
- Targeted for **Digital India** and defense applications
- Can act as a IoT hotspot

■ CPE



- Long range from 10 to 20 Km*
- Max link rate: 30Mbps for 8Mhz
- Single CPE acts as a Wi-fi/IoT hotspot for a few villages
- Deliver triple play services
- Low power consumption => Powered by Off grid **solar panels**

TVWS Market Opportunity

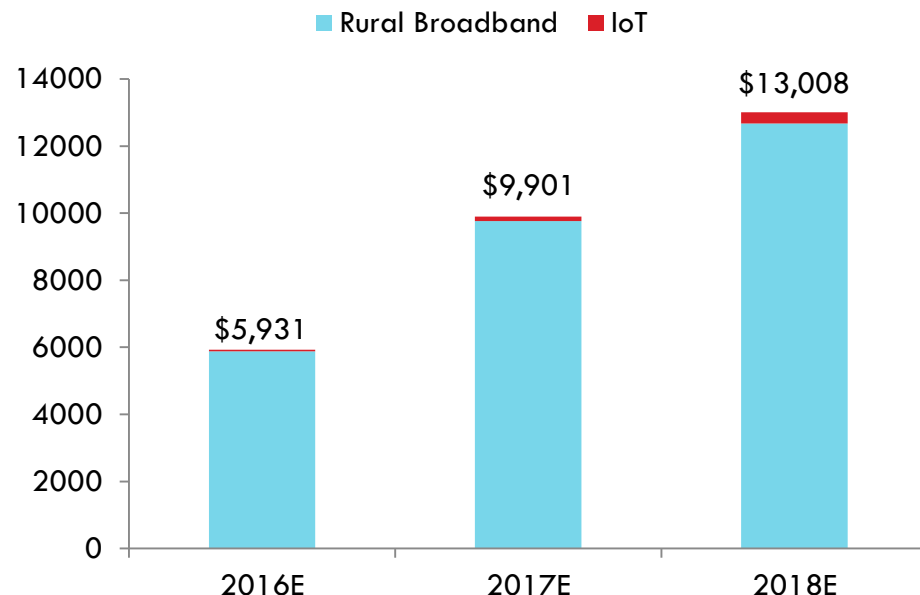
(\$ in millions)

Rural Broadband Market

Rural Broadband	2016E	2017E	2018E	2019E	2020E
USA	\$ 2,370	\$ 1,490	\$ 1,030	\$ 916	\$ 803
UK	356	224	155	138	121
India	-	4,951	3,578	3,628	3,081
SE Asia	2,492	1,334	3,748	3,258	2,767
S. America	231	619	2,087	2,138	1,816
Africa	429	1,147	2,072	2,401	2,039
TAM	\$ 5,878	\$ 9,765	\$ 12,669	\$ 12,478	\$ 10,627

Internet of Things Market

Internet of Things	2015E	2016E	2017E	2018E
Smart Cities	10	50	100	200
# Base Station	100	500	1,000	2,000
# Clients	100,000	750,000	2,250,000	6,750,000
TAM	\$ 13	\$ 53	\$ 136	\$ 340



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Key Assumptions:

(1) Fiber optic backbone will be available in rural areas between 2015-18 (2) Internet Penetration to reach 70% by 2018 (3) Market Share to increase from 2% in 2015 to 20% in 2018

Satellite Broadcast Receiver/ VSAT



■ Satellite Broadcast receiver



■ Supports:

- Emergency / disaster warning signal
- Multi-channel multimedia capabilities
- Satellite receiver for in-accessible areas
- Working on a upgrade for VSAT

■ Features

- Frequency band: S-band (2.55-2.6GHz)
- S-band DVB-S receiver with integrated LNA stages and patch antenna
- Symbol rates from 144 kbps to 5.5 Mbps
- Receiver sensitivity: -99 dBm @ 5.5 MSPS
- USB powered; consumption: ~500 mW
- Size & Weight: 105mm x 74mm; 95gms

Saankhya SDR based system products

- Multi Standard SDR Defense Receiver modules



- Single and Multi-channel transmitters



- Multi Standard L/S Band receivers



- Satellite Receiver for tele-education and tele-medicine





5G: Dynamic RAN Platform

- ❖ Marries Big data, Cognitive radio and Machine learning to make the network dynamic
 - ❖ Network learns constantly
 - ❖ Designs the modulation standard (2G/4G..) dynamically based on cost functions decided by operator
 - ❖ Negotiates with receivers on the network to figure out their capabilities
 - ❖ Capability description is now a 'Java' like virtual machine
 - ❖ Standardize on the Virtual Machine, not the modulation scheme !
- ❖ Elements of the Solution
 - ❖ Flexible PHY Baseband and RF
 - ❖ Configurable Wideband RF
 - ❖ Variable BW, Centre frequency
 - ❖ Big Data Cloud Compute Server
 - ❖ Collect data perform/coordinate sense, design
 - ❖ Virtual machine model for PHY/MAC
 - ❖ Flexible ASSP and Accelerators to support PHY primitives for modem operations
 - ❖ Allows code download and execution

Expectation from Policy Makers



- Financial Support for hardware support
 - Private financial Investors do not invest (and don't understand) in R&D heavy Hardware/Semiconductors; Busy with online 'kirana' stores
 - Be ready to expect a few failures ! Critical mass of companies before 1 becomes a unicorn
- More importantly help create an ecosystem and provide business
 - Tale of two companies ! : Huawei vs Midas
 - Chinese (substandard technology) semi businesses thrive because of the eco-system
 - BSNL ear-marks about 5% of its purchases from Indian telecom hardware
 - Create a policy of "Make" as is being done in MoD through DIPP
 - Identify a pool of tech companies and nurture them => No L1 !!

Expectation from Policy Makers



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- Policies to help local companies
 - Eg: Regulate a policy for TVWS as last mile access for Digital India
 - Almost all of the technology for TVWS is available in India; chipsets to systems to software
 - Last chance to build a thriving telecom hardware industry in India !

12

Thank you



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