

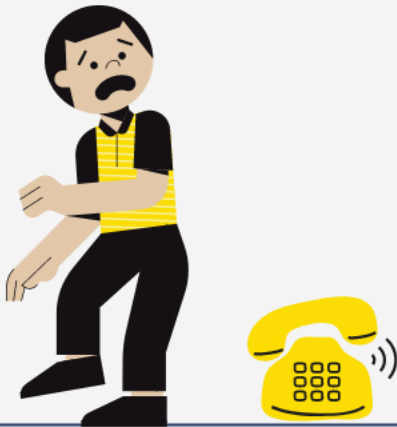
changing the way offices communicate



# Problem

“The cost of moving to a VoIP or centralized telephony system is prohibitive for small-businesses like us.”

Sumesh Kumar Garg  
CEO - APEX Thermocon Pvt. Ltd.



## Missing sales opportunities

Pandemic has caused all businesses to wfh accentuating the revenue loss from missed business enquiries on phone lines



## Risky to change phone system

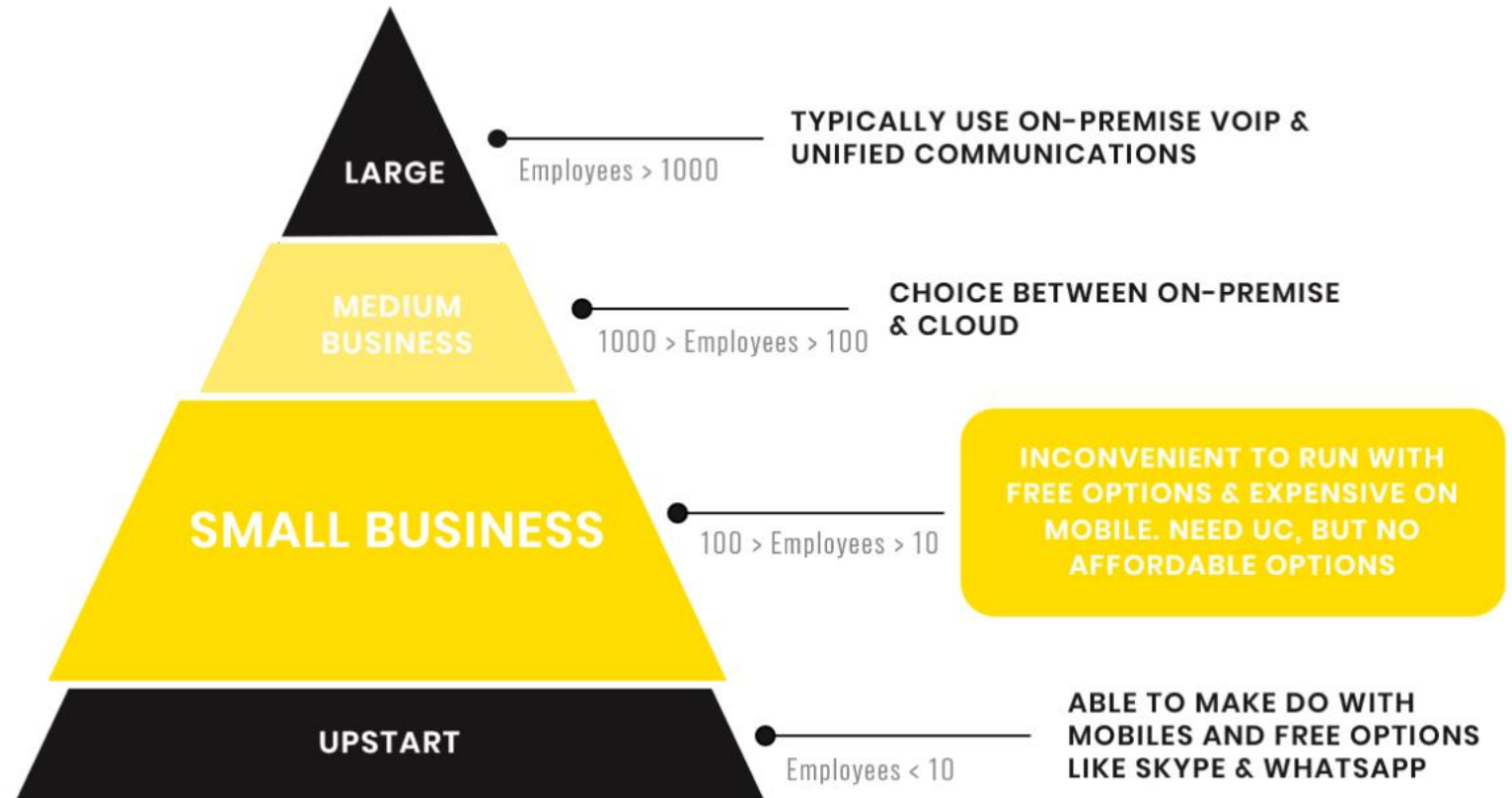
Can't afford phone system downtime or change in business phone numbers as they are contact points for customers



## Complex and costly solutions

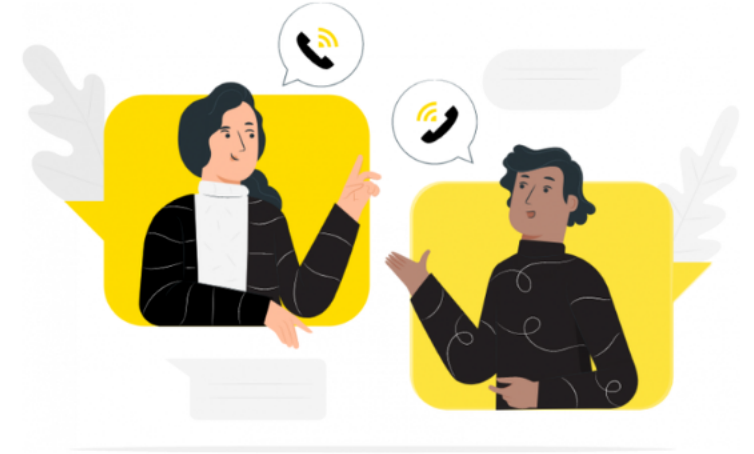
Available upgrade options are either expensive or so complex that creates an ongoing dependency on costly vendors

# Problem Size



# Solution

Crux is designed to address SME communication needs. It is affordable, zero downtime, no change in phone numbers, and seamlessly connects employees globally whether they are in office or working from home



## ✓ Zero downtime

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Businesses retain their present phone numbers and services, without any disruption

## ✓ Do-It-Yourself

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Crux is all-in-one, plug-n-play and pre-configured making it super easy to use and manage

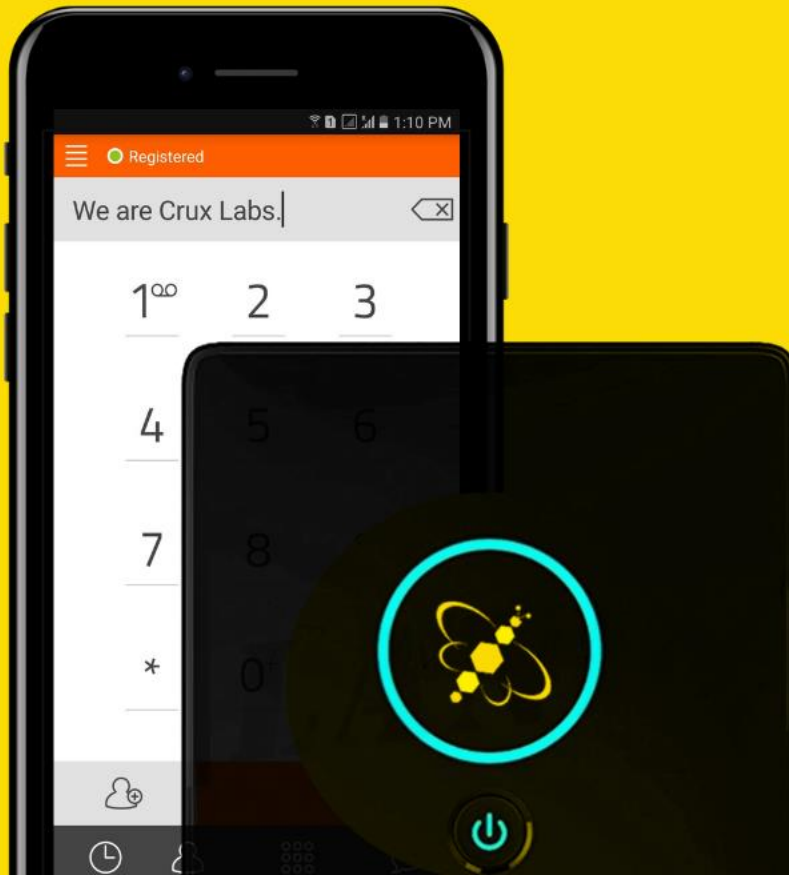
## ✓ Cost efficient

---

Not only is Crux affordable to buy, businesses can also reduce their monthly phone bill by up to 80%

# Introducing Crux LX & VX

Unified Communications platform for offices and Call Centres  
that is simple to use, affordable and deploys in under 60-minutes



# ALL IN ONE & SECURE UNIFIED COMMUNICATIONS



## SIP & WiFi Protection

Intrusion Detection

Brute-force Protection

IP Whitelist & Blacklist

WPA / WPA2 Security



Tested & Certified  
for use with  
Various SIP Trunks

REGISTERED WITH



# Users simply call using a Softphone app

# HOW CRUX WORKS

User experience is no different from a regular calling experience. Simply fire up your dialer and call an extension or a phone number directly.

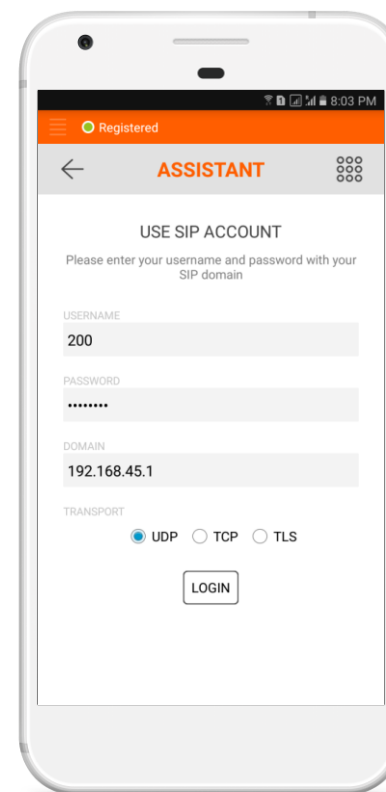
1

Connect Crux LX



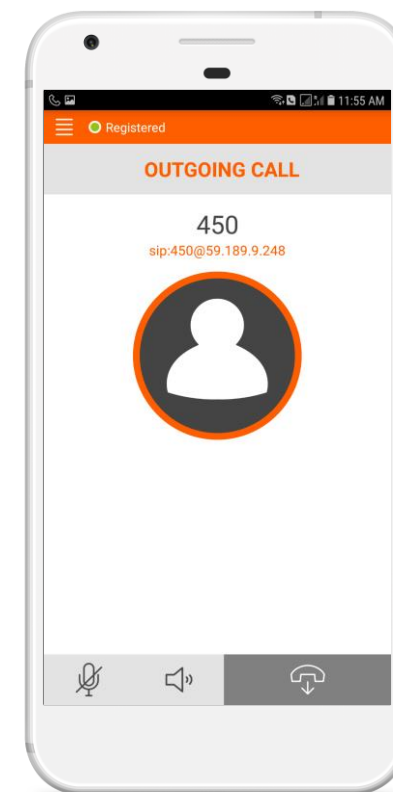
2

Install an App



3

Dial to Talk





# Who Crux is for

These are our target users



## Small to Medium businesses

Businesses with up to 250 employees globally that rely on a phone system for sales and support



## Call Centres

Call Centres with up to 30 agents globally and handling call volume of up to 5,000 calls per day





# Market Size

**45 B**

TOTAL AVAILABLE MARKET

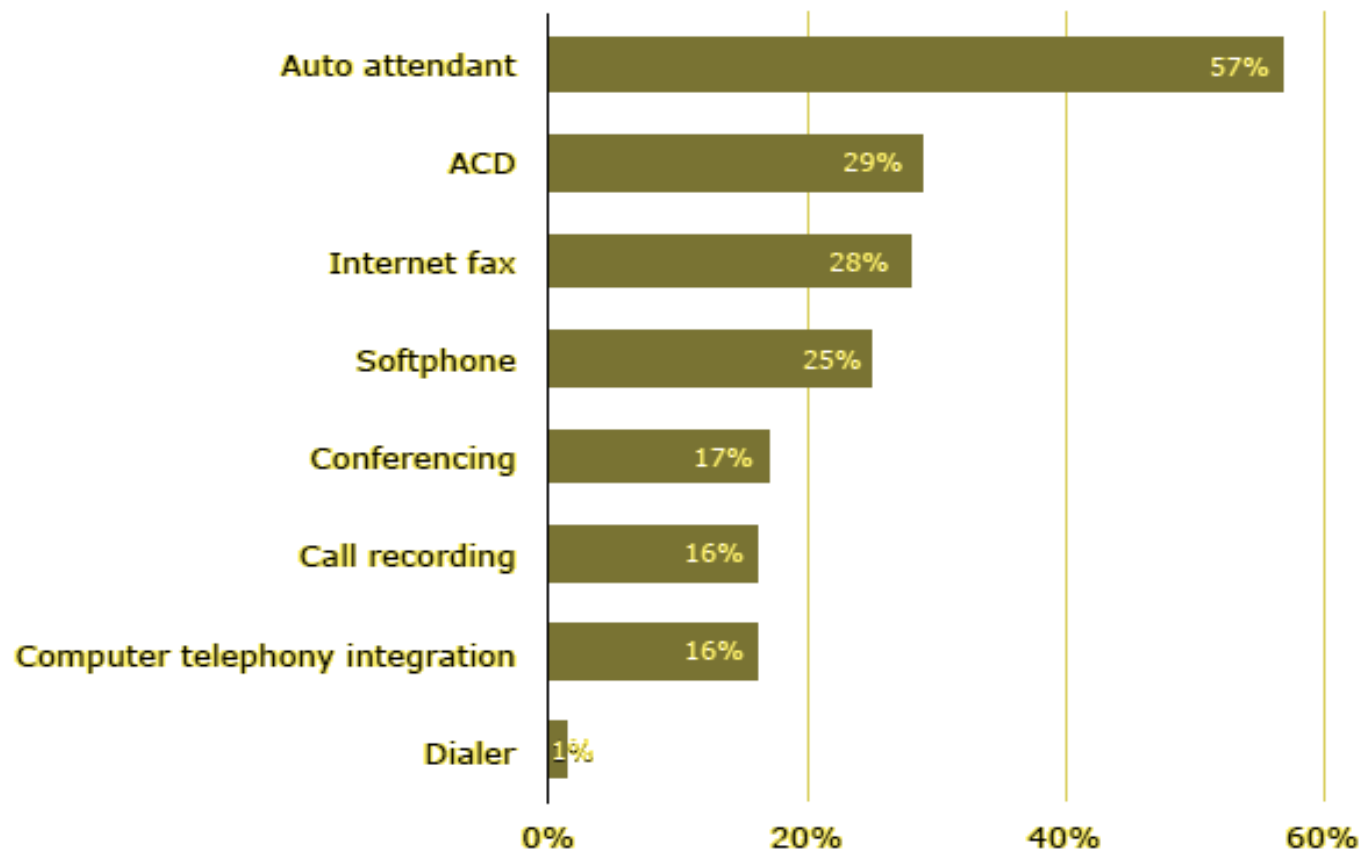
**100 M**

SERVICEABLE AVAILABLE MARKET

**10 M**

SERVICEABLE OBTAINABLE MARKET

# SME BUYER MARKET TRENDS



Features  
supported by  
Crux LX

Call Forwarding 29% | Mobile Compatibility 21% | Voicemail 25%

# How Crux started

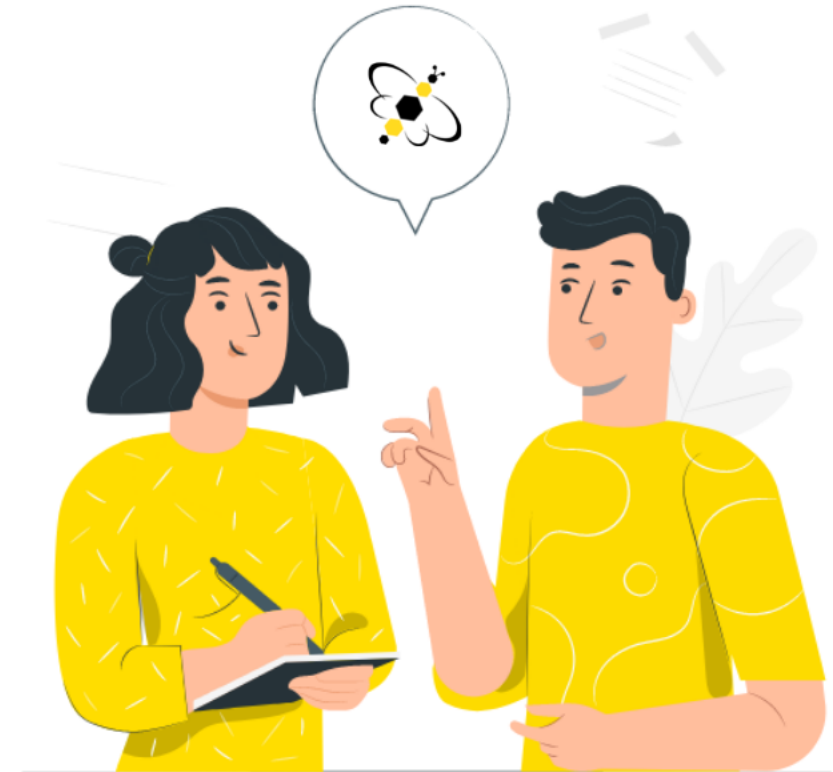
Crux was conceptualized in 2016 with a focus to build a cost-effective and a fully-functional telephony product for small and medium businesses

In 2017, Crux LX beta runs were concluded with 60% units sold out

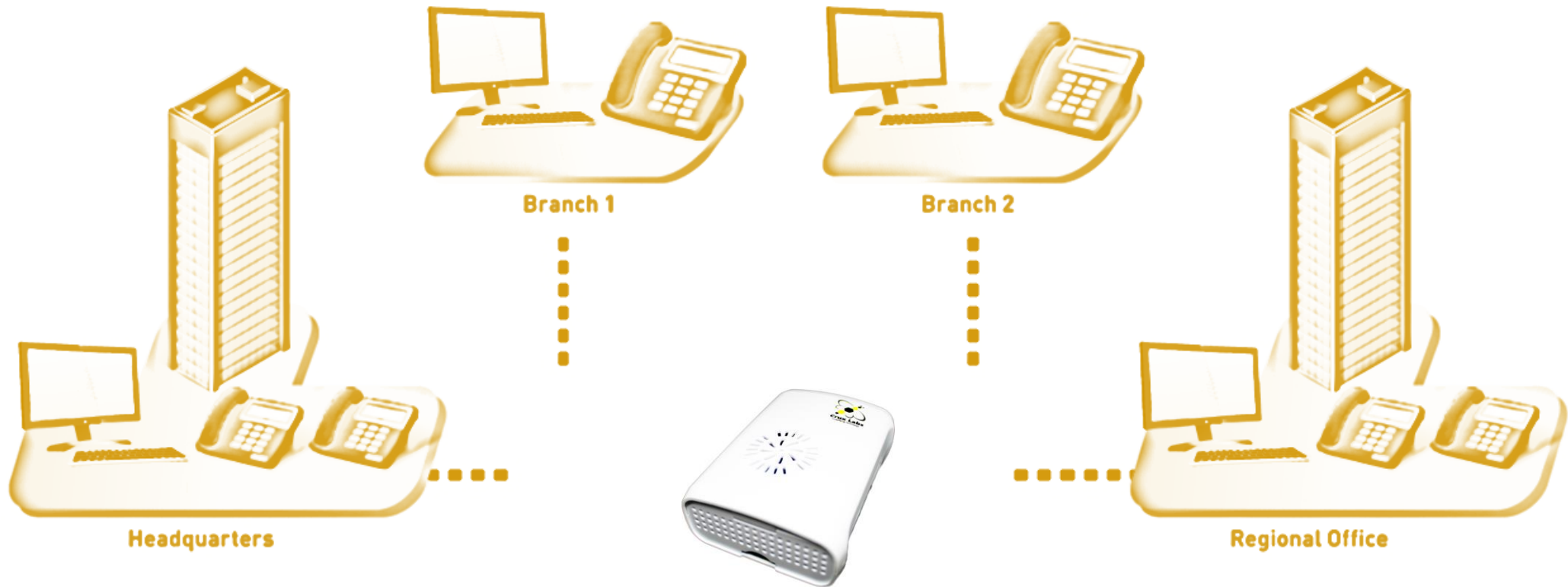


# Why Crux will grow

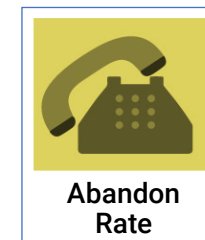
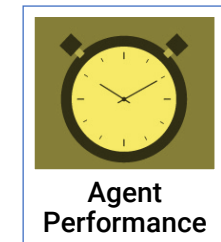
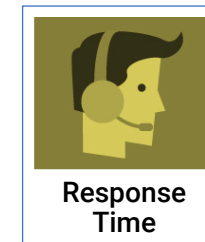
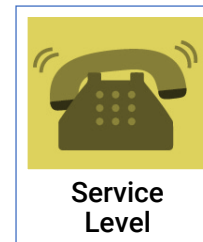
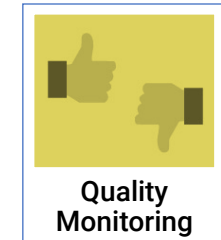
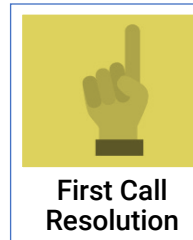
- 01 Need for always-on teams**  
Acceptance towards remote work readiness has dramatically gone up during pandemic
- 02 Need for instant results**  
Customers and businesses want a better connect for instant results
- 03 Need for adaptability**  
Users want solutions that can be used on various devices and in different places



# JUMP START YOUR OFFICE ANYTIME, ANYWHERE!









# NEED A GLOBAL CALL CENTRE? READY IN 60-MINUTES!



# A MISSED CALL IS A MISSED BUSINESS OPPORTUNITY

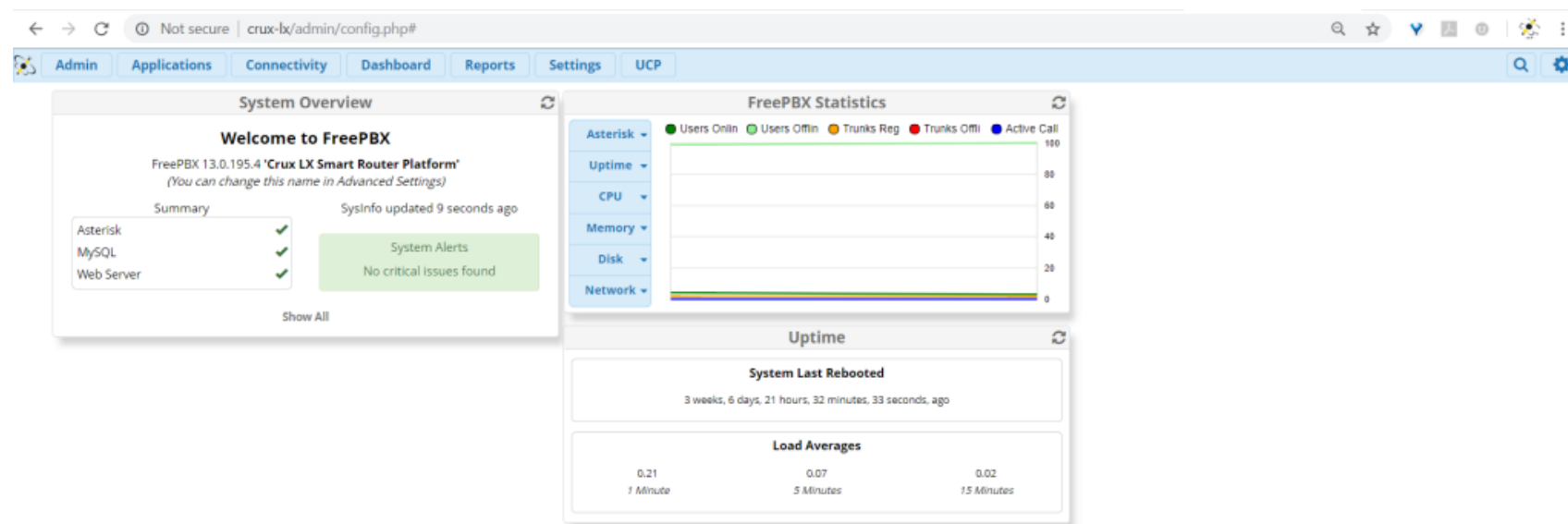
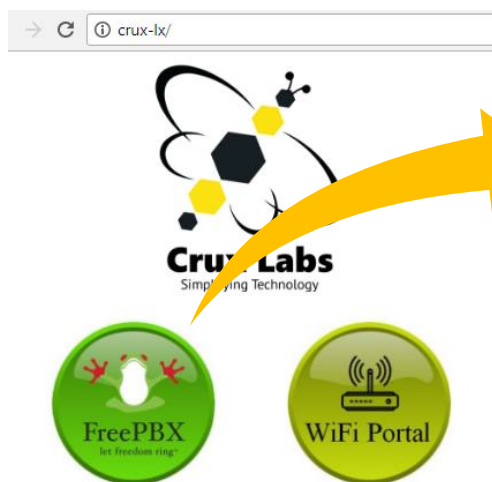


**NEVER MISS A BUSINESS CALL WITH CRUX!**

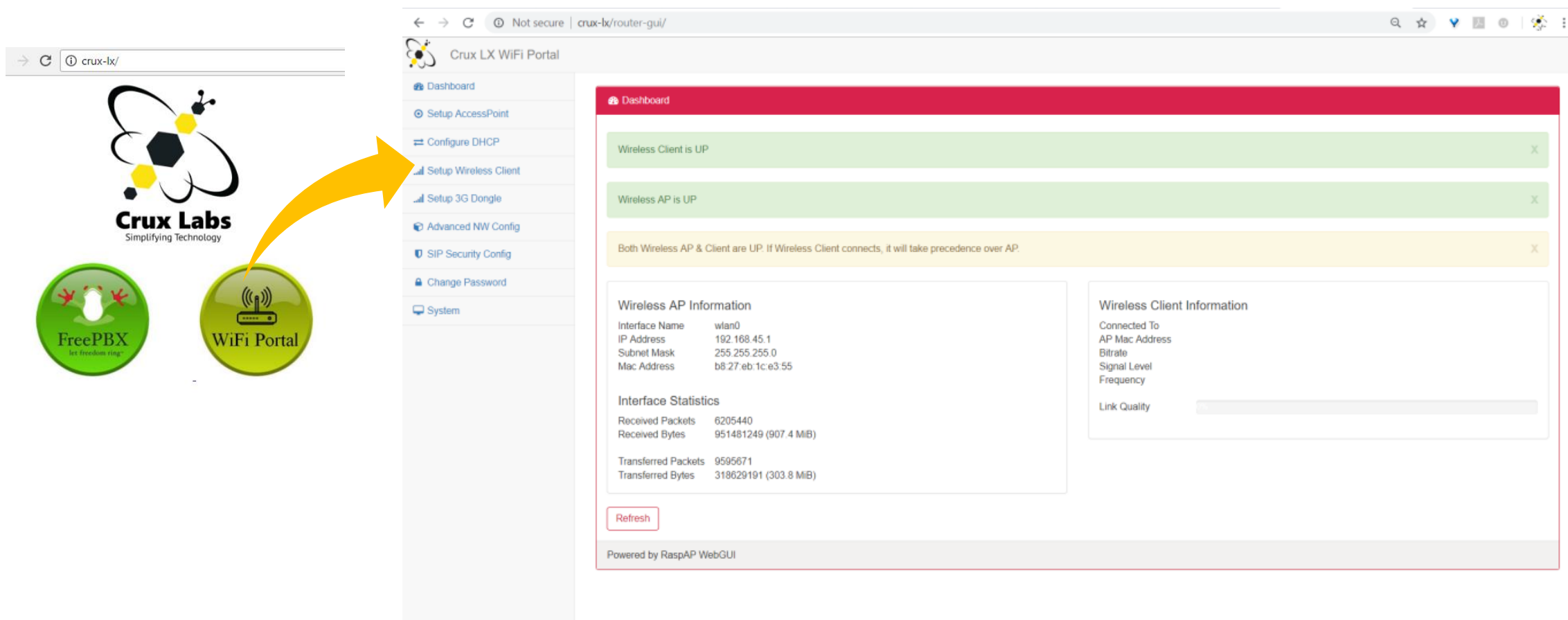
|   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|
|    |    |    |    |    |    |    |    |
| Music On Hold (MP3 Music)   | Call Transfer (Attend/Blind)  | Call Forward (All/Busy/No Answer)   | Call Park   | Busy Lamp Field (BLF)   | Parallel Ring   | 3 Way Conference  | Ring Group (Dept Hotline)   |
|    |    |    |    |    |    |    |    |
| Prefix and Caller ID Display  | Call Pickup (Group / Direct)  | Voice Recording   | Call Detail Report  | Voicemail (To Tel Set / To Email)   | Personal Auto Attendance  | Day Night Mode  | IVR (Auto attendance)   |
|    |    |    |    |    |    |    |    |
| Call Queues (ACD)   | Voice Conference Bridge   | Video Call (coming soon)  | Fax to Email (PDF)  | Paging (All / By Group / Direct)  | SIP Door phone with Camera  | Dial Plan (for outbound call)   | DISA (Control by Password or Caller ID)   |
|  |  |  |  |  |  |  |  |
| Remote SIP Device (IOS/Android)   | SIP Trunk connection (Via Internet)   | Instant Message (coming soon)   | Phone Book (LDAP / XML) (coming soon)   | Web 2.0 Admin Page  | Backup and Restore  | High Availability (coming soon)   | Firewall (Iptable)  |



# CRUX LX & VX VOICE PORTAL



# CRUX LX & VX WiFi PORTAL



The diagram illustrates the connection between a physical device and the Crux LX WiFi Portal web interface. On the left, a physical device is shown with the Crux Labs logo and two circular buttons: "FreePBX" and "WiFi Portal". A yellow arrow points from the "WiFi Portal" button to the web interface on the right.

The web interface is titled "Crux LX WiFi Portal" and is accessed via the URL "crux-lx/router-gui/". The interface displays the following information:

- Dashboard:**
  - Wireless Client is UP
  - Wireless AP is UP
  - Both Wireless AP & Client are UP. If Wireless Client connects, it will take precedence over AP.
- Wireless AP Information:**

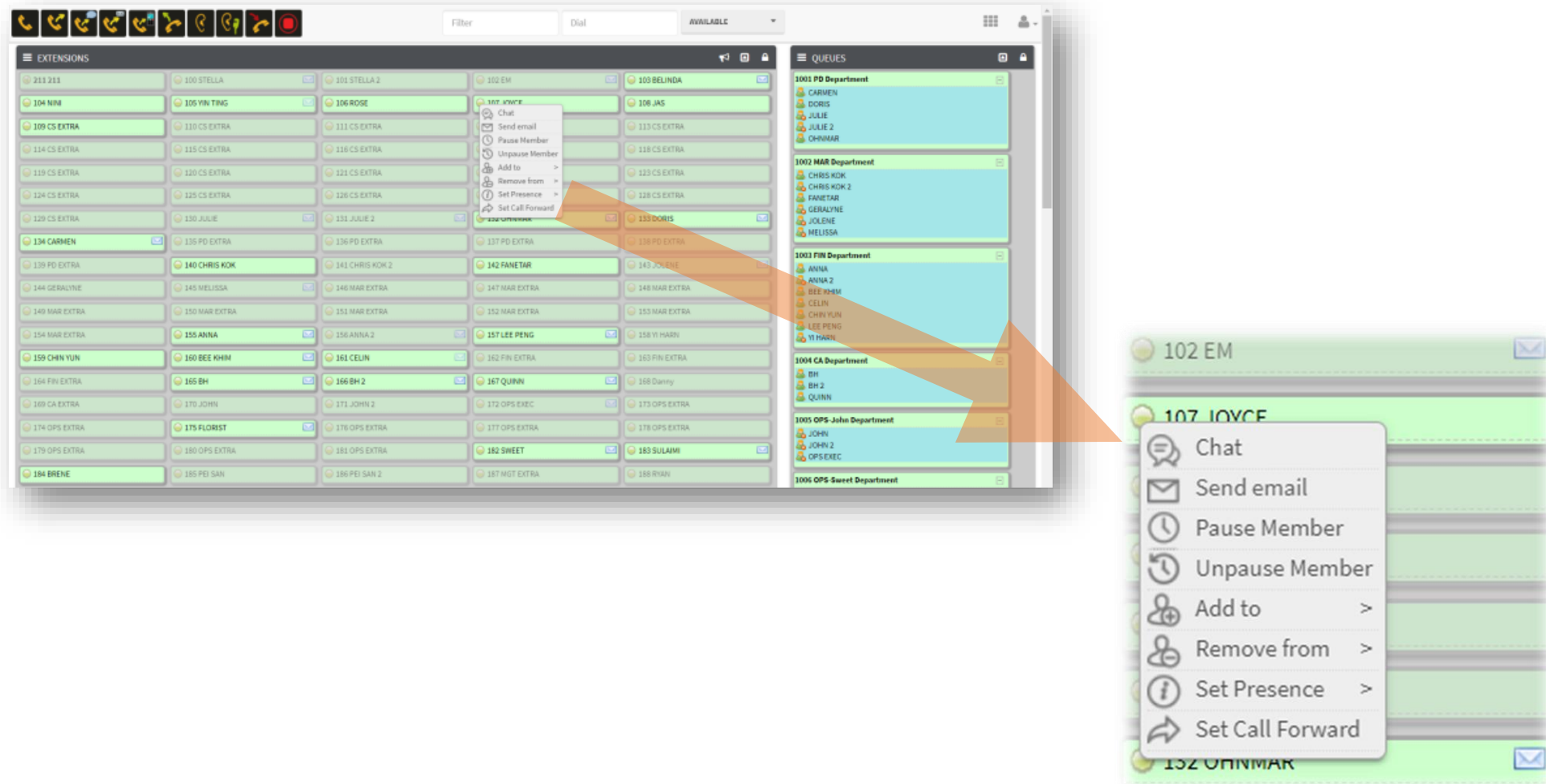
|                |                   |
|----------------|-------------------|
| Interface Name | wlan0             |
| IP Address     | 192.168.45.1      |
| Subnet Mask    | 255.255.255.0     |
| Mac Address    | b8:27:eb:1c:e3:55 |
- Interface Statistics:**

|                     |                       |
|---------------------|-----------------------|
| Received Packets    | 6205440               |
| Received Bytes      | 951481249 (907.4 MiB) |
| Transferred Packets | 9595671               |
| Transferred Bytes   | 318629191 (303.8 MiB) |
- Wireless Client Information:**

|                |  |
|----------------|--|
| Connected To   |  |
| AP Mac Address |  |
| Bitrate        |  |
| Signal Level   |  |
| Frequency      |  |
| Link Quality   |  |

A "Refresh" button is located at the bottom of the dashboard section. The footer of the interface states "Powered by RaspAP WebGUI".

# CRUX VX REALTIME DASHBOARD



The dashboard displays a grid of extensions and a list of queues. A context menu is shown for extension 107 JOYCE, listing various actions.

**EXTENSIONS**

| Extension     | Extension     | Extension       | Extension     | Extension     |
|---------------|---------------|-----------------|---------------|---------------|
| 211 211       | 100 STELLA    | 101 STELLA 2    | 102 EM        | 103 BELINDA   |
| 104 NINI      | 105 YIN TING  | 106 ROSE        | 107 JOYCE     | 108 JAS       |
| 109 CS EXTRA  | 110 CS EXTRA  | 111 CS EXTRA    | 112 CS EXTRA  | 113 CS EXTRA  |
| 114 CS EXTRA  | 115 CS EXTRA  | 116 CS EXTRA    | 117 CS EXTRA  | 118 CS EXTRA  |
| 119 CS EXTRA  | 120 CS EXTRA  | 121 CS EXTRA    | 122 CS EXTRA  | 123 CS EXTRA  |
| 124 CS EXTRA  | 125 CS EXTRA  | 126 CS EXTRA    | 127 CS EXTRA  | 128 CS EXTRA  |
| 129 CS EXTRA  | 130 JULIE     | 131 JULIE 2     | 132 DORIS     | 133 PD EXTRA  |
| 134 CARMEN    | 135 PD EXTRA  | 136 PD EXTRA    | 137 PD EXTRA  | 138 PD EXTRA  |
| 139 PD EXTRA  | 140 CHRIS KOK | 141 CHRIS KOK 2 | 142 FANETAR   | 143 JOLENE    |
| 144 GERALYNE  | 145 MELISSA   | 146 MAR EXTRA   | 147 MAR EXTRA | 148 MAR EXTRA |
| 149 MAR EXTRA | 150 MAR EXTRA | 151 MAR EXTRA   | 152 MAR EXTRA | 153 MAR EXTRA |
| 154 MAR EXTRA | 155 ANNA      | 156 ANNA 2      | 157 LEE PENG  | 158 YI HARN   |
| 159 CHIN YUN  | 160 BEE KHIM  | 161 CELIN       | 162 FIN EXTRA | 163 FIN EXTRA |
| 164 FIN EXTRA | 165 BH        | 166 BH 2        | 167 QUINN     | 168 DANNY     |
| 169 CA EXTRA  | 170 JOHN      | 171 JOHN 2      | 172 OPS EXEC  | 173 OPS EXTRA |
| 174 OPS EXTRA | 175 FLORIST   | 176 OPS EXTRA   | 177 OPS EXTRA | 178 OPS EXTRA |
| 179 OPS EXTRA | 180 OPS EXTRA | 181 OPS EXTRA   | 182 SWEET     | 183 SULAMI    |
| 184 BRENE     | 185 PEI SAN   | 186 PEI SAN 2   | 187 MGT EXTRA | 188 RYAN      |

**QUEUES**

- 1001 PD Department
  - CARMEN
  - DORIS
  - JULIE
  - JULIE 2
  - OHNMAR
- 1002 MAR Department
  - CHRIS KOK
  - CHRIS KOK 2
  - FANETAR
  - GERALYNE
  - JOLENE
  - MELISSA
- 1003 FIN Department
  - ANNA
  - ANNA 2
  - BEE KHIM
  - CELIN
  - CHIN YUN
  - LEE PENG
  - YI HARN
- 1004 CA Department
  - BH
  - BH 2
  - QUINN
- 1005 OPS John Department
  - JOHN
  - JOHN 2
  - OPS EXEC
- 1006 OPS Sweet Department

**Context Menu for 107 JOYCE:**

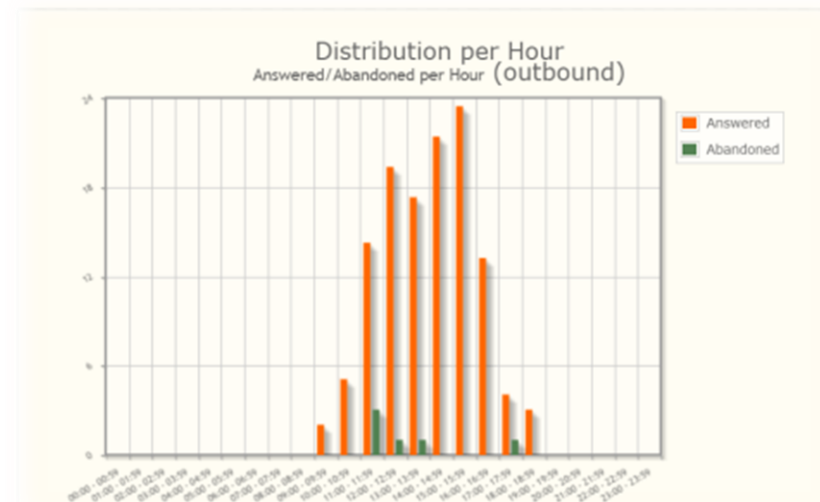
- Chat
- Send email
- Pause Member
- Unpause Member
- Add to >
- Remove from >
- Set Presence >
- Set Call Forward

# CRUX VX PERFORMANCE REPORTS

| Total Calls                  |            |
|------------------------------|------------|
| Number of Received Calls:    | 1166 calls |
| Number of Answered Calls:    | 868 calls  |
| Number of Unanswered Calls:  | 0 calls    |
| Number of Abandoned Calls:   | 298 calls  |
| Number of Transferred Calls: | 0 calls    |
| Unanswered Rate:             | 0.00 %     |
| Abandon Rate:                | 25.56 %    |

Search:

| by Queue |          |             |         |          |         |
|----------|----------|-------------|---------|----------|---------|
| Avg Wait | Avg Talk | Max Callers | % Answ  | % Unansw | SLA     |
| 00:00:27 | 00:01:10 | 2           | 56.67 % | 43.33 %  | 55 %    |
| 00:00:04 | 00:01:02 | 1           | 95.45 % | 4.55 %   | 95.45 % |
| 00:00:06 | 00:01:47 | 1           | 93.55 % | 6.45 %   | 93.55 % |
| 00:00:22 | 00:04:04 | 1           | 61.36 % | 38.64 %  | 61.36 % |
| 00:00:36 | 00:01:34 | 1           | 20.83 % | 79.17 %  | 20.83 % |
| 00:00:17 | 00:00:50 | 3           | 77.02 % | 22.98 %  | 75.07 % |
| 00:00:17 | 00:02:16 | 1           | 63.64 % | 36.36 %  | 63.64 % |

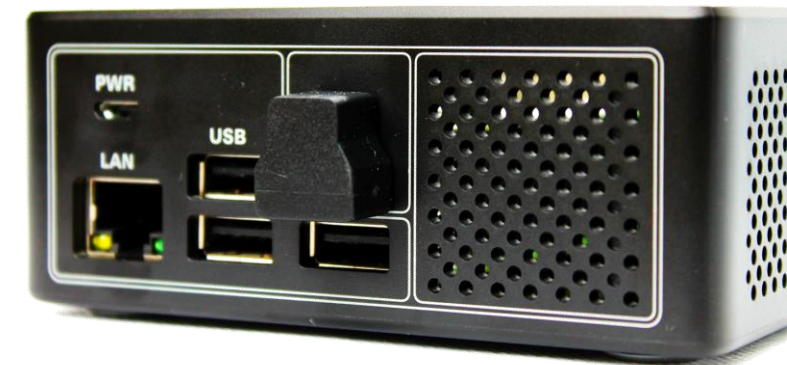


[download](#)



[download](#)

# EVERYTHING THAT A CALL CENTRE NEEDS



# CRUX DEPLOYMENT MULTI-LOCATION



## SALIENT FEATURES OF CRUX IN A CROSS-COUNTRY SETUP

- Call Centre agents and office staff share same phone lines, hence optimized usage – lower phone bill (**cost-**)
- Agents and office users can be located in office or remotely at home (**sales++**)
- Supervisor can access live dashboard and run reports from office or remotely
- Either Crux can be monitored and managed from anywhere (**cost-**)
- When any employees call a Malaysia or Singapore number, the call is routed via Crux in Malaysia or Singapore office respectively – hence, always a local call (**cost-**)
- External callers in the two countries can call local number to reach staff in either of the countries (**cost-, sales++**)
- All calls are recorded and recordings can be accessed from anywhere – useful for coaching and training agents and staff to improve client experience (**sales++**)
- Crux automatically routes calls based on a time schedule and a calendar (**sales++**)



# CLIENT TESTIMONIES



**Aik Boon Chua**

Director – DewTouch Innovations

“Crux provided us flexibility to route support calls between our centres globally, that helped us optimize customer support effort and lower our spends on cross-border phone calls”



**Ryan P. Chioh**

Managing Director – FarEastFlora.com

“Crux has been one of the wisest technology decisions made by my business. It has helped us increase our sales, significantly reduced our telecom costs and improved staff productivity”



**Jason Ong**

Director – Maranatha Accounting

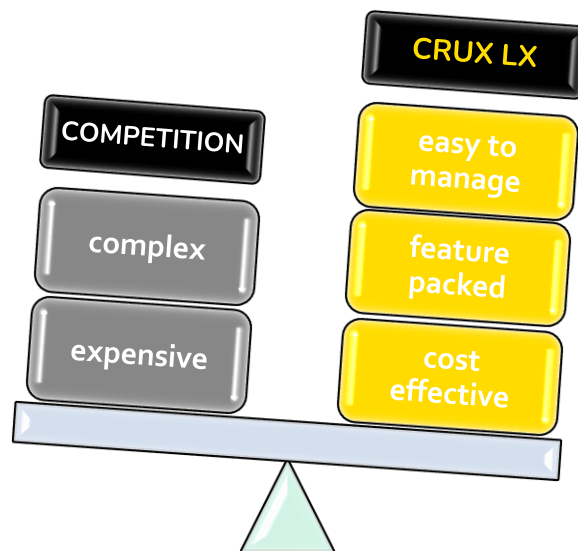
“Our Crux unit supports three of our affiliated start-ups due to its flexibility. We have setup new locations and new hires with ease. Rohit has been most professional, helpful & patient”



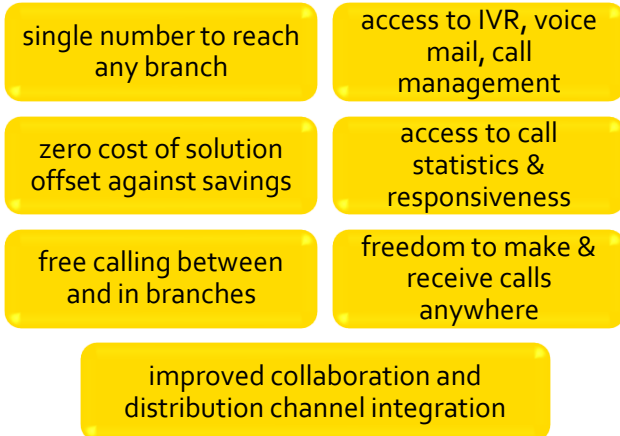


# CASE STUDY DIABETES SINGAPORE

## BEFORE



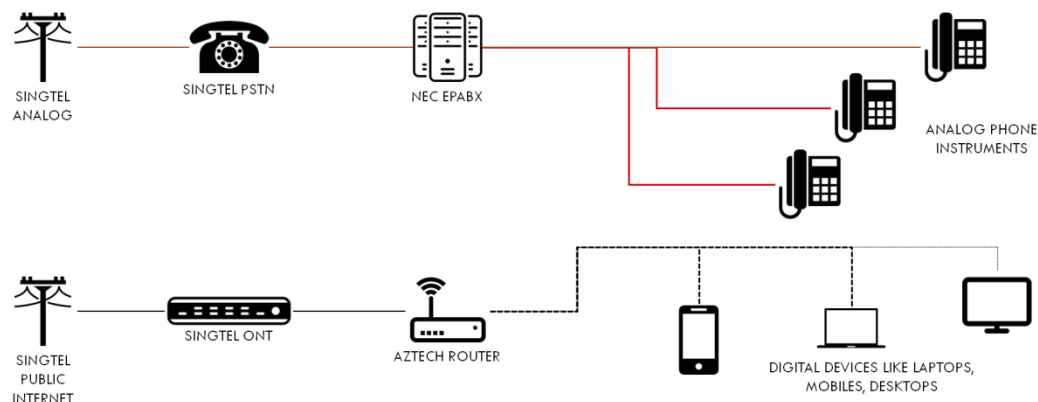
## AFTER



"I had a very specific need for a telephony system for my organization. The only available solution was Crux LX. It turned out to be the most cost-effective solution as well as easy to install and configure. Its functionality is far outstanding and **there is no comparable product in the market.** It has significantly enabled my business to increase its distribution reach."

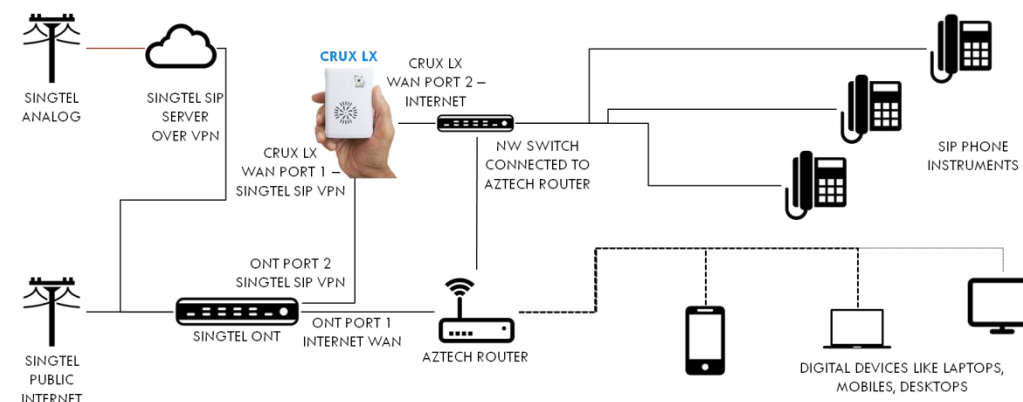


**Venkatesh Narasiah**  
Executive Director  
Diabetes Singapore



**Jurong Centre Branch Setup (Before)**  
Isolation between Digital (WiFi/Internet) and Analog (PSTN) technologies

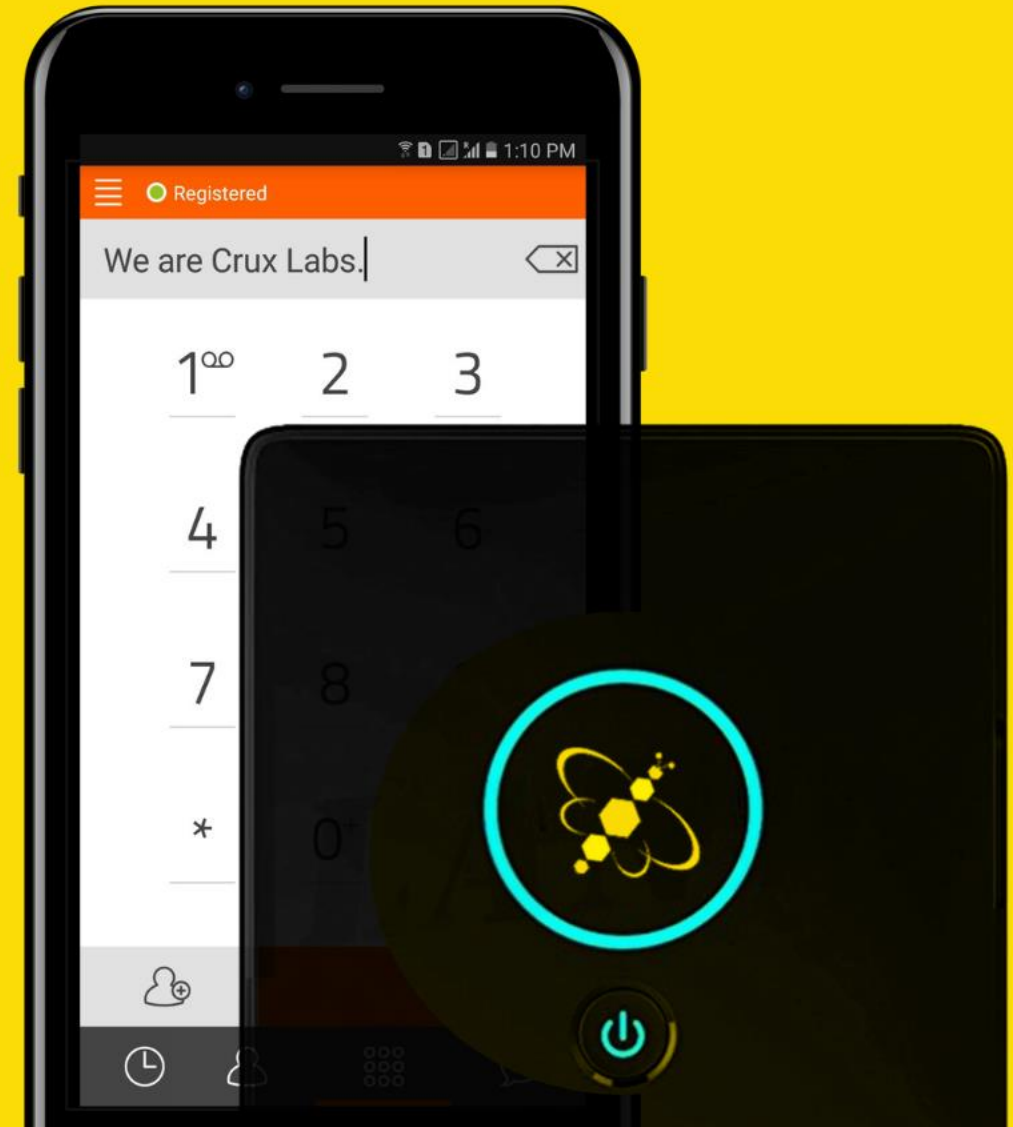
**LEGEND**  
— ANALOG  
— DIGITAL



**Jurong Centre Branch Setup (with Crux LX)**  
Fully Digital (WiFi/Internet/Telephony) technologies

**LEGEND**  
— ANALOG  
— DIGITAL

# Competitive Advantages

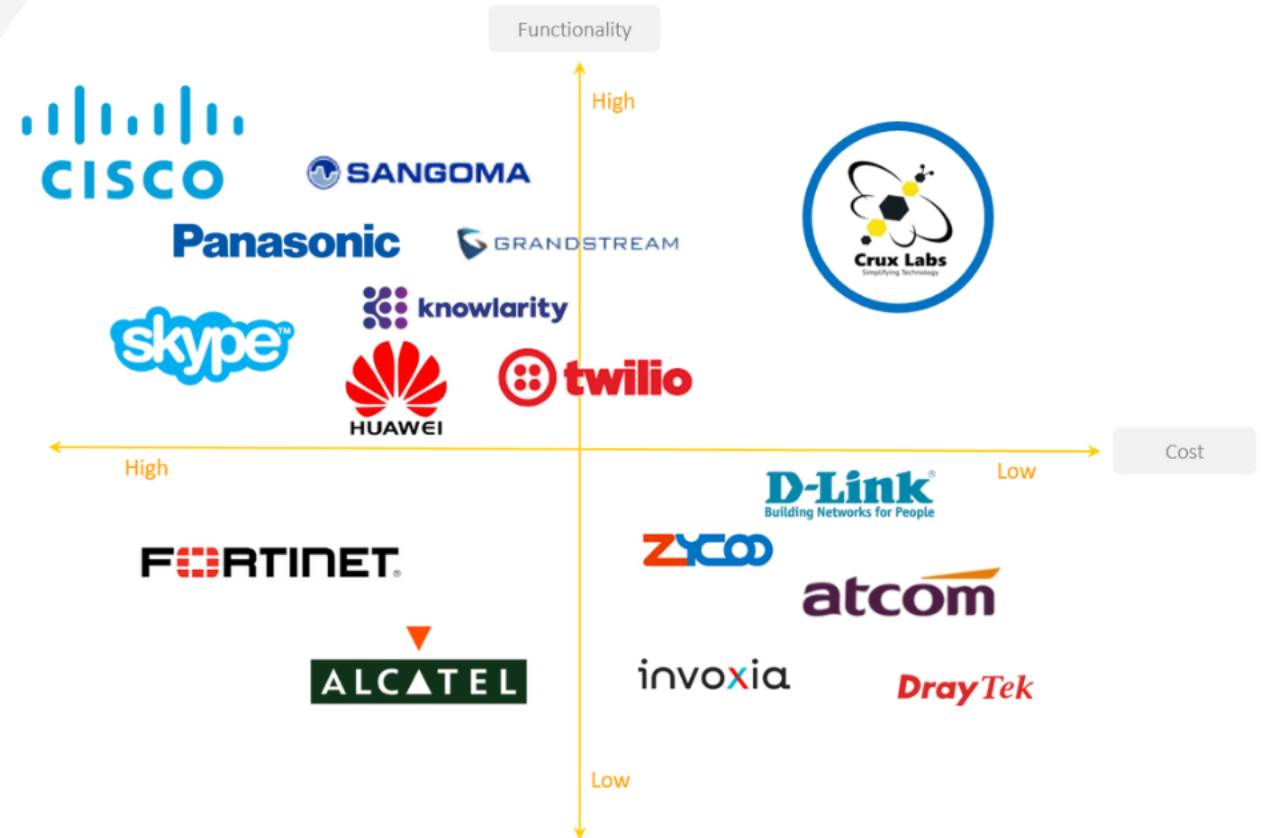


# Indirect Competitors

- Freshworks, Zendesk, ZohoCRM
- WhatsApp, Skype
- Telecom ISPs with UCaaS

# Direct Competitors

- Panasonic, Grandstream
- 3CX, RingCentral, 8x8
- Avaya, Genesys, Sangoma





## Easy to use

Crux has an intuitive user-friendly interface designed to make the process simple and easy to understand, use and manage



## Secure and protected

Crux merges the benefits of on-premise security with conveniences of cloud, keeping phones and call data secure and protected from hacking



## Smart savings

Crux breaks free from the expensive SaaS notion of per user monthly pricing and in turn lowers the monthly phone bill by up to 80%










## Accessible

Crux can be used across multiple devices such as smartphones, tabs and laptop computers and connects users agnostic of their location

# TECHNOLOGY COMPARISON

|   | TDM PBX      | IP PBX       | PBX on Cloud            | Crux LX                 | Crux VX                 |
|---|--------------|--------------|-------------------------|-------------------------|-------------------------|
| Auto Attendant (Working / Non-working Hours)      | x            | ✓\$          | ✓\$                     | ✓                       | ✓                       |
| Call Forwarding, Transfers & Conferences          | x            | ✓\$          | ✓\$                     | ✓                       | ✓                       |
| Call Detail Records & Call Recordings             | x            | ✓\$\$        | ✓\$                     | ✓                       | ✓                       |
| Unified Communication, Voicemail, Fax2Email       | x            | ✓\$          | ✓\$                     | ✓                       | ✓                       |
| Add Extensions or Users                           | x            | x            | ✓\$                     | ✓                       | ✓                       |
| Built-in Storage (up to 16,000 hrs) & IP Security | x            | x            | ✓\$\$                   | ✓ microSD               | ✓ SSD                   |
| Third Party Integrations (CRM, RoboCaller, etc.)  | x            | x            | ✓\$                     | ✓                       | ✓                       |
| Auto Call Distribution & Call Queues              | x            | x            | ✓\$\$                   | ✓                       | ✓                       |
| Work from Home (Remote Users)                     | x            | x            | ✓\$                     | ✓                       | ✓                       |
| Individual User Customization, Personalized IVR   | x            | x            | x                       | ✓                       | ✓                       |
| Built-in Broadband & Mobile WiFi Router           | x            | x            | x                       | ✓                       | ✓                       |
| Linkup Multi-Location Phone Lines and Users       | x            | x            | x                       | ✓                       | ✓                       |
| Realtime Dashboard & Call Analytics               | x            | x            | x                       | x                       | ✓                       |
| Skills for Maintenance                            | Required     | Required     | Required                | Do-it-yourself          | Do-it-yourself          |
| Time to Deploy                                    | Days – Weeks | Days – Weeks | Hours                   | 30-mins                 | 60-mins                 |
| Total Cost of Acquisition (US\$)                  | > S\$2500    | > S\$5000    | > S\$20 /user /month    | > S\$1,499 (one-time)   | > S\$9,999 (one-time)   |
| Communication Device                              | Instrument   | Instrument   | Instrument or Softphone | Instrument or Softphone | Instrument or Softphone |

# CRUX OFFERS BEST PRICE PERFORMANCE

| SOLUTIONS                         |  <b>Crux Labs</b><br>Simplifying Technology |  |  |  |  |  |  |
|-----------------------------------|--|--|---|---|---|---|---|
| FEATURES                          | CRUX VX  | PRO  | STANDARD  | 8X8 X2  | OC BUSINESS   | INFLUENCER  | PREMIUM   |
| 100 Extensions, 30-Ch Licenses    | \$7,200  | \$123  | \$3,499   | \$2,500   | \$2,495   | \$100++   | \$750   |
| SIP30 Line, DID Rental, Call Mins | \$200  | \$1,200  | \$150   | \$150   | \$350   | \$150++   | \$150   |
| Hosting or Hardware Cost          | \$7,699  | \$70   | \$0   | \$0   | \$0   | \$0   | \$0   |
| Softphone Apps (iOS, Android)     | ✓  | ✓  | ✓   | ✓   | ✓   | ✓   | ✓   |
| Auto Attendant (Multi-Level IVR)  | ✓  | ✓  | ✓   | ✓   | ✓\$   | ✓   | ✓   |
| Auto Call Distribution (Queues)   | ✓  | ✓  | ✓   | ✓   | ✓\$   | ✓   | ✓\$   |
| Realtime Dashboard                | ✓  | ✓  | ✓\$   | ✓\$   | ✓\$   | x   | ✓\$   |
| Call Analytics & Visual Reports   | ✓  | ✓  | ✓\$   | ✓\$   | ✓\$   | x   | ✓\$   |
| Listen & Whisper Modes            | ✓  | ✓\$  | ✓\$   | ✓\$   | ✓\$   | x   | x   |
| Day & Time based Call Flows       | ✓  | ✓\$  | ✓\$   | ✓\$   | ✓\$   | x   | ✓\$   |
| One-time Setup Cost               | \$0  | N/A  | N/A   | N/A   | N/A   | N/A   | N/A   |
| Annual Support (excluded)         | 20% of ONE TIME  | 27.5% of ANNUAL  | N/A   | N/A   | N/A   | N/A   | N/A   |
| Choice of SIP & DID Vendor        | ✓  | ✓  | x   | x   | x   | x   | x   |
| Administration Portal with RBAC   | ✓  | x  | x   | x   | x   | x   | x   |
| Per MONTH Per USER Cost           | \$0  | \$13.93+   | \$36.49++   | \$26.50++   | \$28.45++   | \$2.50++  | \$9.00++  |
| Total ANNUAL Cost wo support      | \$2,400  | \$16,717+  | \$43,788++  | \$31,800++  | \$34,140++  | \$3,000++   | \$10,800++  |
| Total ONE TIME Cost               | \$14,899   | N/A  | N/A   | N/A   | N/A   | N/A   | N/A   |
| 3-yr Total Cost of Ownership      | USD 22,099   | USD 50,151+  | USD 131,364+  | USD 95,400+   | USD 102,420+  | N/A   | N/A   |

# ASSUMPTIONS FOR PRICE COMPARISON

- This comparison assumes a deployment with following parameters
  - 100 users (or extensions)
  - 30-channel concurrency (sum of simultaneous internal and external calls)
  - 30 licenses for call center capabilities like Realtime Dashboard & Call Analytics with Visual Reports
  - 30-channel SIP trunk with 30 DIDs rental and call charges assuming minimum of 2,000 call minutes
- Note on Annual Support
  - Support cost is indicated where available. Since it was not conclusive for most operators, it has not been included in comparison
- Legend
  - ✓ means the feature is standard and its cost is included in the comparison
  - ✓ \$ means the feature is not standard, and its cost is unknown, hence excluded in the comparison
  - x means the feature is not available and its cost, if any, is excluded in the comparison
- Note about Crux Labs
  - Crux VX is a one-time purchase product with perpetual licenses – that means, once bought, it is free to use for life for the said number of users
  - Crux VX has no per user or per month or per annum costs to it, but for the comparison, the SIP, DID & Call Costs are used as ANNUAL Cost
  - Crux VX support costs \$2,979 (20%) per annum or \$7,449 (50%) if pre-paid for 3 years
- Note about Exotel and Knowlarity
  - Both seem to have a lot of variation in costs as published on their website and actual costs paid by their customers for the scenario being compared
  - For this comparison, we have used the published prices on their websites as minimum amounts, though customer reports indicate they are higher
  - Both of these operators are required to make two calls and use a bridging mechanism to enable a single call, incurring higher call costs

---

\*This was a complex comparison as all operators bundle different set of users, concurrency, feature sets and some include calling minutes as well. However, they do not publish breakups, nor do they publish prices for optional add-ons. Hence, in order to make this comparison fair and easy for clients, we are sharing our approach and underlying assumptions that were made to make it homogenous.



# CHOOSING BETWEEN CRUX LX & VX



| SME SIZE                      | CALL CENTRE: UP TO 10 AGENTS<br>OFFICE: UP TO 100 STAFF  | CALL CENTRE: UP TO 20 AGENTS<br>OFFICE: 50 - 250 STAFF  | CALL CENTRE: UP TO 30 AGENTS  |
|-------------------------------|--|---|---|
| TECHNOLOGY USED               | 1-10 PSTN LINES / ISDN2 / ISDN10 / EPABX   | ISDN30 / ISDN60 / EPABX   | ON-PREMISE / SAAS PBX / UC / ISDN   |
| PROBLEMS                      | <ul style="list-style-type: none"> <li>Make and receive calls only when in office</li> <li>No collaboration features</li> </ul>  | <ul style="list-style-type: none"> <li>Make and receive calls only when in office</li> <li>Few or nil collaboration features</li> <li>Grossly underutilized resources</li> </ul>  | <ul style="list-style-type: none"> <li>Typically agents and supervisor are co-located</li> <li>High cost of acquisition and ownership (on-prem)</li> <li>High 2-year / 3-year total cost of ownership (SaaS)</li> <li>Incremental cost per feature and limited options</li> </ul>   |
| BUSINESS IMPACT               | <ul style="list-style-type: none"> <li>Missed business due to missed customer calls</li> <li>Low productivity due to lack of collaboration</li> <li>Missed opportunity to improve staff effectiveness</li> </ul>   | <ul style="list-style-type: none"> <li>Missed business due to missed customer calls</li> <li>Low productivity due to lack of collaboration</li> <li>Missed opportunity to improve staff effectiveness</li> <li>Paying high rental for old ISDN lines</li> </ul>                                     | <ul style="list-style-type: none"> <li>High cost of sales and support</li> <li>Heavy investment in equipment and infrastructure</li> <li>Ineffective utilization due to per feature and per user costs</li> </ul>   |
| CRUX IMPACT                   | <ul style="list-style-type: none"> <li>Business does not miss any calls anymore</li> <li>Remote working capability with same phone lines</li> <li>Best of both worlds – low cost and highly efficient</li> <li>Efficiencies due to migrating from ISDN to SIP</li> <li>*30-50% Cost savings in monthly telecom bill</li> </ul> | <ul style="list-style-type: none"> <li>Agents and supervisor can work remotely</li> <li>Cost savings by migrating from ISDN to SIP</li> <li>Remote working capability</li> <li>Best of both worlds – low cost and highly efficient</li> <li>*30-80% Cost savings in monthly telecom bill</li> </ul> | <ul style="list-style-type: none"> <li>Agents and supervisor can work remotely</li> <li>One time cost of acquisition, No recurring user fee</li> <li>Choice of operators and costs savings on call rates</li> <li>Convenience of SaaS &amp; no infra despite on-prem</li> <li>*30-80% Cost savings in monthly telecom bill</li> </ul> |
| * Savings are usage dependent |  |   |   |
| COST OF SOLUTION              | <ul style="list-style-type: none"> <li>Crux LX starts at S\$1,499 + service charges</li> <li>(Optional) Up to 20-channel ATA or Gateway</li> <li>(Optional) IP Phones and networking equipment</li> </ul>  | <ul style="list-style-type: none"> <li>Crux LX starts at S\$4,999 + service charges</li> <li>(Optional) Up to 20-channel ATA or Gateway</li> <li>(Optional) IP Phones and networking equipment</li> </ul>   | <ul style="list-style-type: none"> <li>Crux VX starts at S\$9,999 + service charges</li> <li>(Optional) Up to 30-channel ATA or Gateway</li> <li>(Optional) IP Phones, headsets, nw equipment</li> </ul>  |
| PAYBACK                       | Typically between 6-18 months  | Typically between 6-12 months   | Typically between 3-12 months   |

# AWARDS & RECOGNITION

## BIZ SCHOOL



### BEST IDEA AWARD

2018

NTU-NBS

## TECH SCHOOL



### TOP25

2018

IIT Delhi - BeCON

## TELCO

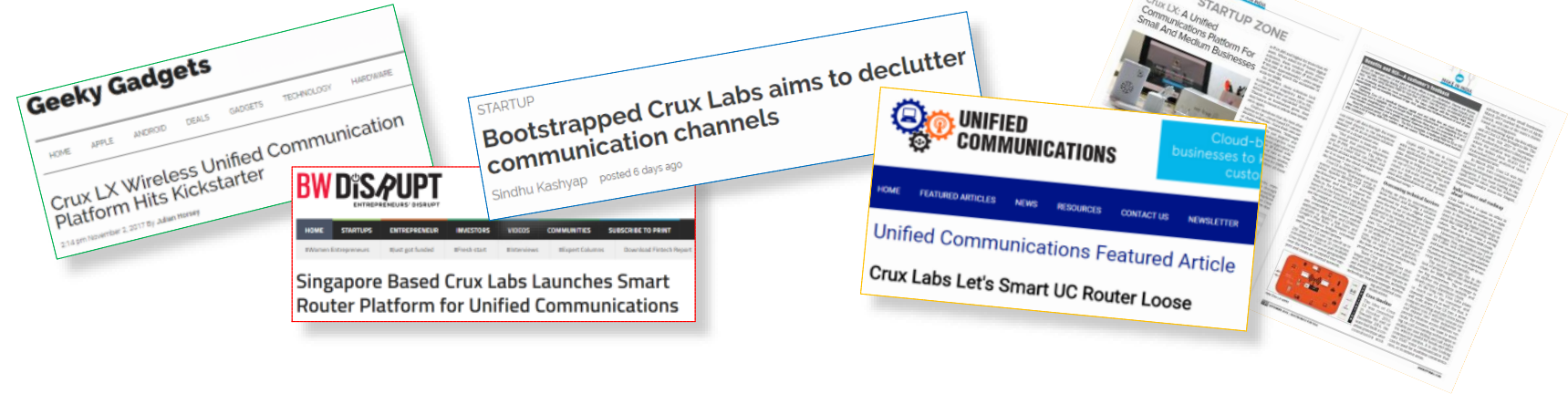


### TOP100

2018

RELIANCE JIO GENNEXT

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INNOVATE  
IGNITE

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**e27**

**BW Disrupt**  
ENTREPRENEURS' DISRUPT

**telecomasia**

**UNIFIED COMMUNICATIONS**

**TRENDHUNTER**

**Telecom Drive**  
Telecoms. Communications. Innovations

**GadgetFlow**

**10 K TEN**

**SmartWorld**  
Making Your Business Smarter

**Gismo Review**

**StartUp terminal**

**KICKSTARTER**

**RESTORATIVE INNOVATION**

**Geeky Gadgets**



# How a Pocket-sized Device Solved Telephony Issues for Diabetes Singapore

Why did Diabetes Singapore deploy an open source powered Crux LX to tackle its telephony challenge, and what can we learn from this experience?



The team at Diabetes Singapore

**D**iabetes Singapore (DS) is a Singapore-based non-profit organisation. Its mission is to raise awareness and to provide education, counselling and support to people with diabetes, and to their families and the community, in order to empower them to lead a healthy and productive life. It is headed by Venkatesh Narasiah, executive director, whose vision is to run this organisation on commercial principles while keeping the non-profit motto alive.

## The symptoms

Like most health organisations, the telephony setup of Diabetes Singapore (DS) included a mix of PSTN lines (eight phone numbers), one mobile number across three branches and one mobile van. As individually numbered phone lines were difficult to advertise and remember, managing this telephony infrastructure was a challenge at times. Customers would often get confused between multiple lines and locations.

For Internet access, Narasiah's team was using isolated digital public Internet lines, which were distributed by a router to the team members' different devices in their branch offices. There was no voicemail or auto attendant/IVR (Interactive Voice Response) system for support. Calls between branches required placing external calls.

## The diagnosis

Session Initiation Protocol (SIP) phone lines was an option DS was looking at to unify the telephony across locations (for a single call-in number, internal dial-in across branches, and DID or Direct Inward Dialling for key external-facing staff members).

Diabetes Singapore approached the large SIP line providers in the country but none of them were willing to take up an end-to-end solution based approach. They were willing to only supply the SIP, while the implementation needed to be done by any vendor of DS's choice. But there weren't many implementation providers to choose from and the cost implications were also very high. Besides, these vendors too were not willing to provide a one-stop solution but wanted to implement the solution in phases, starting with the headquarters and going on to explore how the branches could be linked to the headquarters' telephony system.

## The medication

Around this time, Narasiah happened to meet Rohit Gupta, who was heading Crux Labs. Gupta was seeking customers

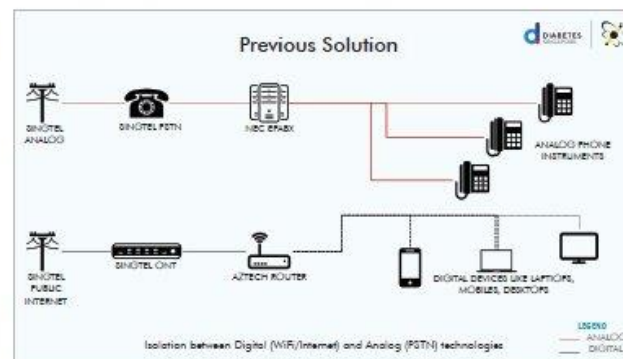


Figure 1: Initial setup

|                                 | TDM PBX  | IP PBX       | PBX on Cloud |
|---------------------------------|----------|--------------|--------------|
| IVR (Auto Attendant)            | X        | ✓S           | ✓            |
| Conference Call                 | X        | ✓S           | ✓            |
| Call Detail Records             | X        | ✓S           | ✓S           |
| Voice Mail                      | X        | ✓S           | ✓S           |
| Call Recording                  | X        | ✓S           | ✓S           |
| Skills for Maintenance          | Needed   | Needed       | Self Service |
| Time to Deploy                  | Few days | Days - Weeks | Ready to use |
| Smart Device Features           | X        | X            | ✓            |
| Individual Customization        | X        | X            | ✓            |
| Total Cost of Acquisition (TCA) | > \$2000 | > \$5000     | \$999        |
| Cost of Cabling & Installation  | > \$1000 | > \$2000     | X            |
| Extensions                      | Fixed    | Fixed        | Flexible     |

Table 1: A comparison of Crux LX with other telephony solutions  
(This chart and data is provided by Crux LX.)

who would try out his innovation – Crux LX, a device smaller than 7.6cm (3 inches) and powered by Raspberry Pi! Gupta's pitch to Narasiah was that Crux LX would cost less than half of what other vendors had quoted, and more importantly, he would ensure an end-to-end integrated solution with minimal disturbance to the team. Gupta offered that in case the setup did not deliver, Crux LX would be decommissioned and taken back, and the telephony instruments would be redeployed.

To seal the deal, Gupta shared a chart (Table 1) comparing his solution with others in the market.

For voice communication, Crux LX acts like a SIP server. To connect with this server and start speaking, you can download any SIP client application

or softphone application that allows you to input three key data points—extension numbers, passwords and the IP address of Crux LX. The people at DS preferred to use desk phones at their centres; hence, they installed additional switches to connect wired IP phones. These three data points allowed a SIP client to register with Crux LX, and employees could then call one another.

Crux LX uses open source software and hardware components for its product development. It is capable of forming a closed loop communication amongst a group of trusted devices over the Internet. DS used this to connect its centres at different locations across Singapore—Boon Keng, Jurong and Bedok. Multi-location interconnections involving a large number of users at

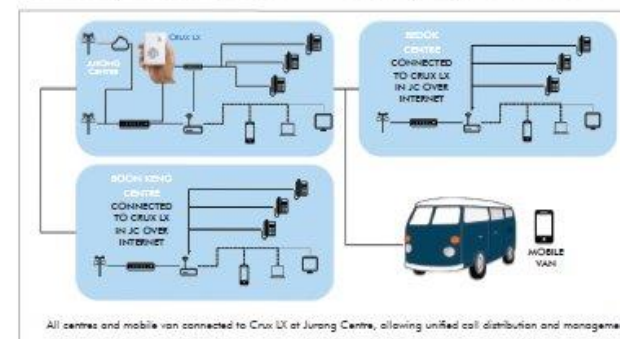


Figure 2: Overall DS setup with Crux LX

each location were done via an Inter-Asterisk Exchange setup that was supported by this system. When deployed in this configuration, a company's New York office can call its London office as though making a call within the office, though it will be routed over the Internet. This can be made secure by using VPN software.

DS employees can now connect to the Crux LX device in their office even when they are not in the office but are connected to the Internet. They can make and receive calls even from outside the office, as though they are in the office. With this device, the staff at DS can now enter three-digit numbers to call colleagues across locations and mobile vans without incurring call costs.

## The side effects

The deployment at Diabetes Singapore was the first end-to-end implementation by Crux Labs in Singapore. Hence there were some specific issues since the network setup was new. All of these were debugged—the setup was complete in two days and went live across all locations. New installations with the chosen SIP provider now take just 15 minutes!

Challenges also emerged when the setup went live. DS's Internet subscription didn't provide the company with a static IP address; hence, whenever the router got restarted, the IP address would change—and require a reconfiguration of the setup. Narasiah is now getting a static IP address to eliminate this issue. Plus, whenever the Internet bandwidth at the branches fluctuates, it causes a temporary dip in the quality of the calls.

## Hale and hearty

Currently, Narasiah's team is processing about 400 to 500 calls a week, and delays resulting from calls having to be routed through an operator are gone. Narasiah expects the investment in Crux LX to pay back in 12 to 18 months, depending on the usage! **END**

By: Nimeesh Kumar

The author is a technology journalist at OSFY.



## STARTUP ZONE

## Crux LX: A Unified Communications Platform For Small And Medium Businesses



Crux LX

PAROMIK CHAKRABORTY

Communication is an integral part of business operations. At present, not only large businesses and enterprises but, small and medium-scale businesses (SMBs) serve from geographically-distributed regions, requiring investments in digital communication methods. To bring to them a cost-effective, user-friendly and easy-to-maintain connectivity solution, startup Crux Labs offers Crux LX.

## Problems that Crux LX addresses

Rohit Gupta, founder of Singapore-based Crux Labs, noticed the lack of a scalable and cost-effective on-premise connectivity solution for SMBs. Solutions that exist were majorly analogue-based, requiring hardwiring. These were difficult to install and cumbersome

to maintain. Wiring and installation required high charges for cables and service. A bigger problem came when users had to shift base, which required them to follow the whole Herculean process all over again. Digital solutions, on the other hand, are expensive.

Gupta says, "Big enterprises have perks like work-from-home or geographically-distributed and connected workforces. They have made investments in communication technologies accordingly. But, that level of investment is difficult for SMBs."

While connecting with some businesses who belonged to their target customer category—companies with fewer than 100 employees—Gupta realised that the existing challenges were multifold. He also found that private branch exchange (PBX) vendors offer analogue-based solutions from big brands, starting at about ₹ 60,000

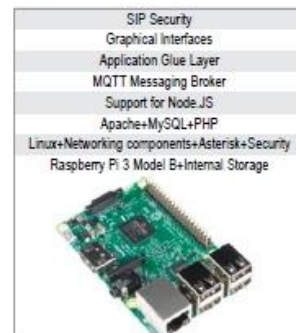
to ₹ 65,000 and higher for more than 50 users. When asked for IP-based digital solutions, these vendors quote about SG\$ 8000 to SG\$ 10,000 (₹ 403,000 to ₹ 503,000 approximately)—price range that does not match the economies of scale for SMBs.

In addition, these solutions lack scalability and simplicity. Most cater to a limited number of users (30 to 50), which cannot be expanded further. Therefore as businesses grow, they may have to invest in whole new setups once again.

Gupta mentions that the best alternatives so far—cloud-based IP communication solutions—have their own set of challenges. He explains, "Although these solutions do not require any upfront capital, subscription rates draw an expense almost equivalent to expensive on-premise IP-based solutions. Within a span of two to three years, the cost point becomes similar, failing to serve the purpose for SMBs." Crux Labs wanted to address all these issues at once.

## Crux LX architecture

Most of today's connectivity, especially in tier 1 cities, runs through fibre cables, eventually channelling voice-based signals over the telephone and network data over the router. Crux team wanted to create a platform that



Crux LX stacks and components

## Benefits and ROI—A customer's feedback

ELICO Ltd deployed Crux LX last year in all three offices in India—Hyderabad, Chennai and Mysore. Ramesh Datla, managing director, ELICO Ltd and ex-chairman, Confederation of Indian Industry (CII), says, "We were using Siemens PABX for more than 15 years. Over the years, we expanded and there is an increasing demand for more connections. The major challenge with the existing PABX was expandability and serviceability because of age. And, upgrade was hindered because of cost of other new solutions."

"Deploying Crux LX is beneficial because capital cost and setup time are much lower and maintenance cost is negligible. We use Google Mesh wireless infrastructure, and integrating Crux LX to it was quite straightforward. Since everyone uses cellphones these days, it is accessible to all, and cross-location communication cost is greatly reduced. Expansion of the solution is also easy."

About the payback period, Datla mentions, "The ROI is immediate. A traditional PABX for 50 or 100 lines costs a lot of money. With Crux solution, both can coexist. There are no additional costs involved after installation."

can route call data through the router and land directly to the smartphone instead—all as an on-premise solution instead of a cloud-based one.

"Our product is basically a wireless router that performs telephony and IP-PBX operations. The idea is to have a router that can utilise and analyse all data without having to wait for it to reach the cloud or depend on the Internet," says Gupta.

Crux LX is designed based on open source resources. Software setup is Linux Apache MySQL PHP (LAMP) architecture with MQTT messaging broker and built-in support for Node.js. For hardware, it uses Raspberry Pi as the base board and Broadcom processor. Avnet and Element14 are the supply partners for Crux Labs.

The platform can be operated using any compatible open source mobile application (like Zoiper and CSWave) available in Apple's App Store and Google's Play Store. It features voice calls, conference bridges, voicemail and many other useful options.

One Crux LX unit can enroll up to 250 users and support 20 concurrent conversations. Users can pair multiple Crux devices, even across geographies over the Internet, to expand user support and create an internal network.



How Crux LX works

Gupta adds, "We are in contact with some of our partners who have their applications on a cloud service (like Amazon Web Services) and are exploring to bring those applications on top of Crux LX platform. This will create a full-scale on-premise appliance for them without any dependence and expenditure on cloud, or any additional setup."

## Overcoming technical barriers

Picking up pace in telecommunications science and finding a solution unaffected by today's digital clutter were the first set of challenges Gupta had to face. Initially, the solution was planned to be manufactured in India, with the team following up some factories and gathering estimates. He says, "Cost points quoted by factories were prohibitory, costing almost ₹ 20 to 30 million for the production process, which had to be paid upfront." Taking an open systems approach, the team was able to manufacture the product at a much lower cost.

Team Crux overcame most challenges with the help of Board of Advisors, which comprised family members and friends who were also experts in different fields of operation, including technology, business strategy, marketing and external communications.

## Crux timeline

The idea of Crux LX was conceived in October 2016. Towards the end of December 2016, the team had built a coverless prototype after consultation with

advisors and some small businesses. March 2017 marked the start of Alpha launch, with one of the team's clients based out of Singapore.

The following April, the first official unit of Crux LX was brought to life. The period from July 2017 to September 2017 marked the product's Beta phase, where the solution was deployed to the first Indian client, ELICO Ltd, a Hyderabad-based analytical instruments manufacturer.

In March 2018, Crux LX was registered with Info-communications Media Development Authority (IMDA) Singapore. It has been trading in the open market since, and has achieved authorised vendor status for Singtel, Singapore.

## India connect and roadmap ahead

Crux Labs is set to open an office in Bengaluru, India in another six to eight months. With expansion plans, the company is fine-tuning its business operations by involving digital technology in areas like CRM and accounting, among others. The aim is to create a strong foothold among the Indian SMB chain.

However, Gupta foresees a couple of challenges. First, especially in tier 2 and tier 3 cities, lack of proper smartphone and basic resources with a large number of users may hinder the user experience. Therefore the company will start its services with tier 1 cities initially.

The second challenge lies in the lack of proper supplier and distributor chain for SMBs, like those available for big enterprises. The strategy is to deliver the products initially and slowly create a distributor chain.

In the long run, Crux Labs plans to reach out to the consumer and domestic segment as well. For that, it will scale down Crux LX into a more compact and plug-and-play form factor at cheaper cost. It will also venture out and expand into other industries to provide solutions across different verticals. For instance, the team is working on call accounting technologies to enable per user billing and call analytics, which is useful for hotels and other commercial entities. It is also looking into VSAT voice communication that can be used for maritime communication, or in remote areas.



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## All-in-One Wireless Router for Your Home and Office



Meet Crux LX - Get rid of wired phone instruments, cordless phones, wires, answering machines and intercom

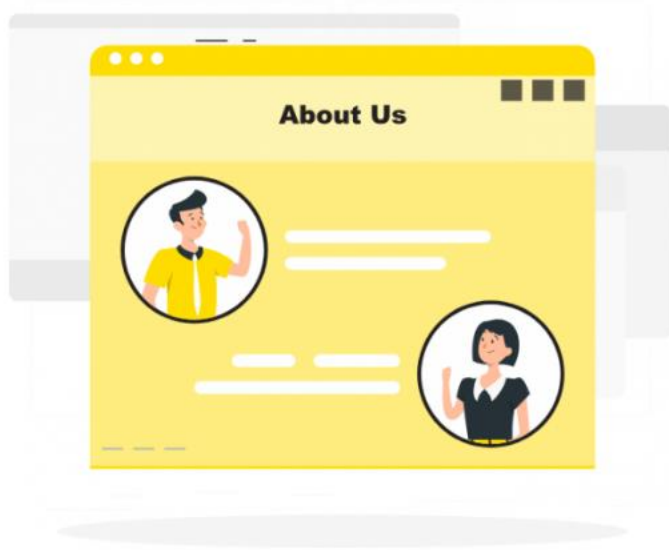
[www.crux-labs.com](http://www.crux-labs.com)

Created by

Rohit Gupta

45 backers pledged S\$ 14,584 to help bring this project to life.

# Meet the Team



**Rohit Gupta**  
Founder & CEO



**Zarina Stanford**  
Mentor, Investor



**Davis C. George**  
Mentor, Investor



**Join us now!**



**Bala Chandrasekharan**  
Customer, Investor



**Shrikant Shitole**  
Mentor, Investor



**Sunil Pillai**  
Mentor, Investor



**Nagi Kasinadhuni**  
Mentor, Investor



**Dr. Ramesh Datla**  
Customer, Investor



**Dr. Siddhartha Agrawal**  
Customer, Investor



**Dr. Meeta Agrawal**  
Customer, Investor



**Sumesh K. Garg**  
Customer, Investor



# Future Roadmap

A look at where we want to go in the next few years



**2023**

100,000 users  
Series A Funding

**2025**

1,000,000 users  
Series C Funding

**2026**

10,000,000 users  
Private Funding



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