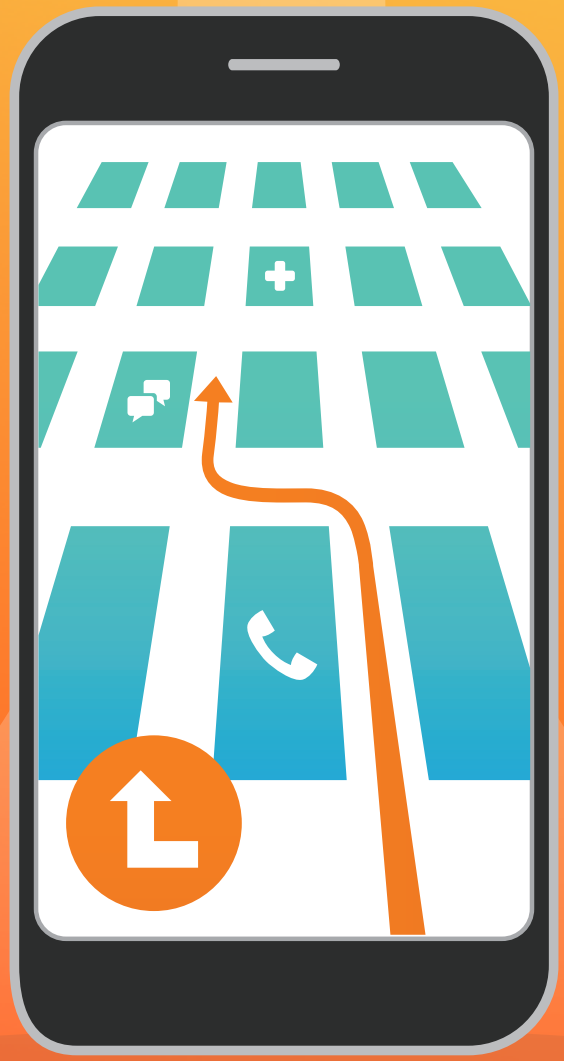
bandwidth

THE ULTIMATE GUIDE TO CPaaS

Everything you ever wanted to know about Communications-Platforms-as-a-Service, Communications APIs, and doing it right.



IN THIS GUIDE, YOU WILL LEARN:

- The origins of CPaaS, where it came from, and where it will go from here
- How CPaaS can transform your sales process, call center, customer experience, and more
- How to use an API, and what to look for to make it even easier
- Types of CPaaS providers in the market today
- The differences between CPaaS and UCaaS (Unified-Communications-as-a-Service)
- How to choose the best CPaaS provider for your business
- Getting started on the right foot with your CPaaS provider
- Common factors that cause quality issues, and what you can look for to ensure top-notch quality
- How to migrate between CPaaS providers without pulling out all of your hair (or losing any functionality along the way)



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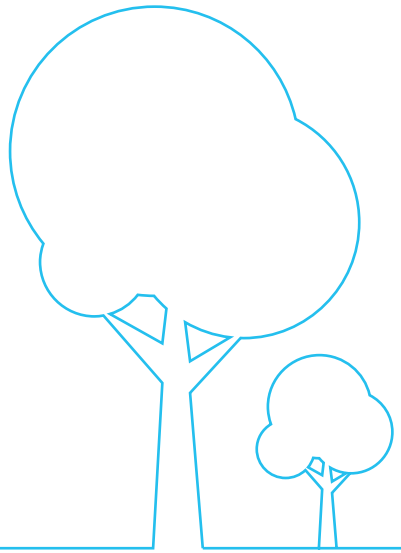
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1

CPaaS 101:
The Basics



CPaaS (n) */see-pass/*

Short for Communications-Platforms-as-a-Service. These platforms usually consisting of Communications APIs make it easy for product owners and developers to add telephone or communications functionality to internet-enabled applications or devices without traditional hardware or infrastructure.



This sector, once dominated by just a few players, has grown considerably due to the incredible demand for voice and messaging capabilities in business and consumer applications. A number of large, seasoned communications providers are now stepping up to the plate and offering CPaaS or CPaaS-like services, some as a compliment to their own traditional telecom offerings—and others as pure-play software vendors.

When you're creating your embedded communications strategy or developing business applications that need to go the distance in today's fast-paced technology arena, it's important to select a CPaaS partner that will deliver the right functionality, with the quality your users expect at a cost that's doesn't affect your bottom line.



BEFORE CPaaS (Timeline: Months or Years)

1. Purchase & install on-premise equipment & infrastructure
2. Hire or enlist devs knowledgeable in telecom to create app interfaces with multiple communication systems
3. Develop, test and launch multiple, single channel apps for calling, texting, video



AFTER CPaaS (Timeline: Hours or Weeks)

1. Mobile app developers hack out a plan
2. Leverage a CPaaS provider to make API calls to the cloud
3. Roll out an omni-channel app with one simple UI





2

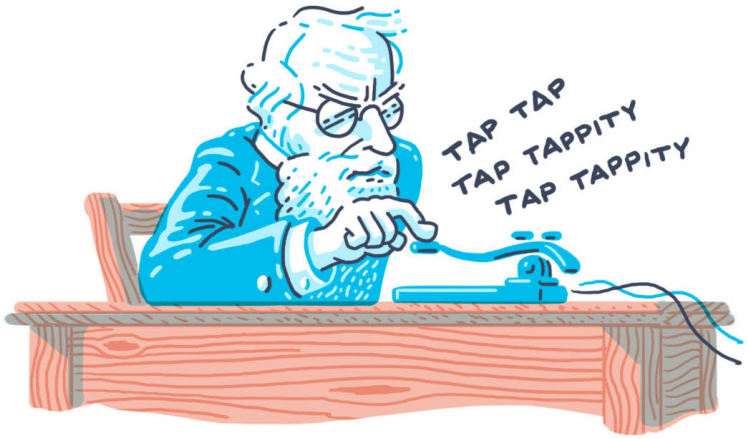
How CPaaS Came to Be

So, where did all of this come from anyway?

The act of getting a message from one person to another has done a lot of changing over the years.

0300 AD

Carrier pigeons and signal fires are the main means for quick, long-distance communication (seriously!).



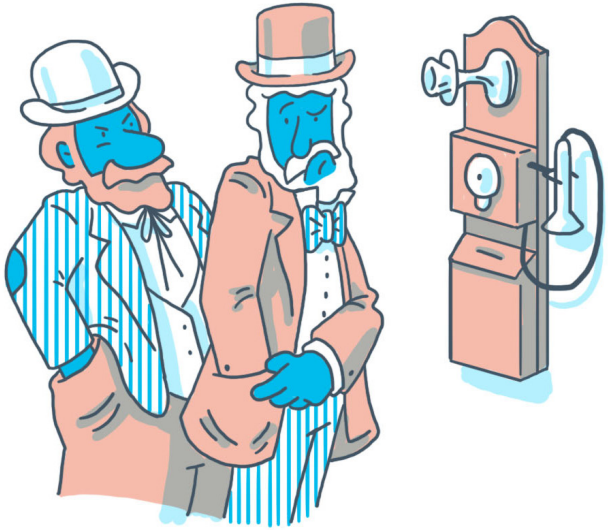


1837

Samuel Morse introduces Morse Code and his brand new Telegraph, with widestream adoption by 1851.

1876

Alexander Graham Bell wins a patent on his new invention: the Telephone. Bell Telephone Company opens soon after — later changing its' name to American Telephone & Telegraph — or AT&T as we know it today!



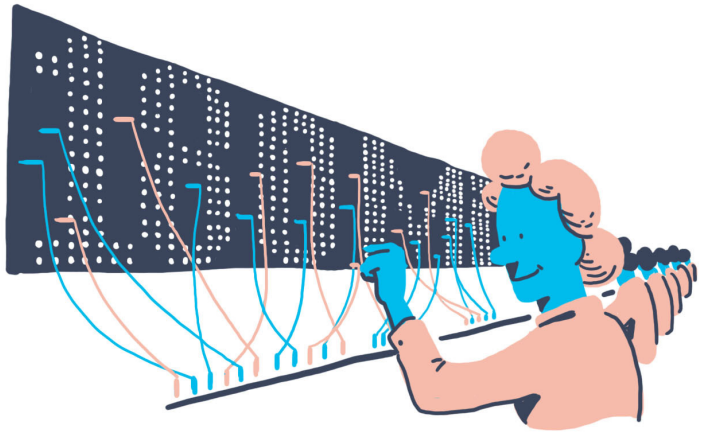


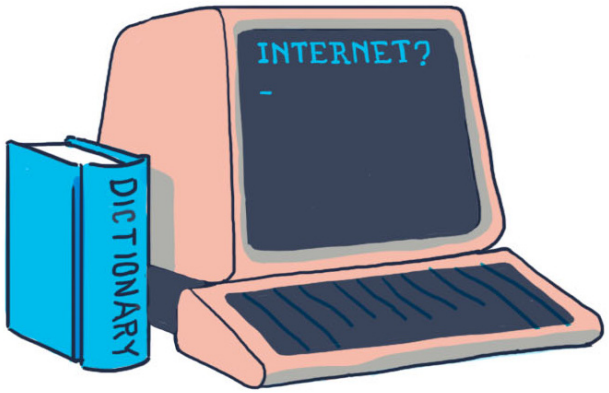
1891

The first payphone is introduced in the town hall of Milwaukee, WI.

1949

180 Million telephone calls are placed per day on average



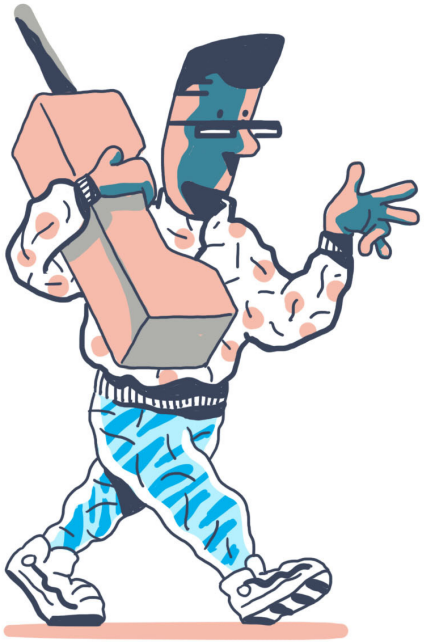


1974

The word “Internet” is used for the first time

1983

The first commercial cell phone system is introduced in Chicago.





1985

Voice Over Internet Protocol (VoIP) is born as company VocalTec invents the first widely available Internet phone, with it's super creative name: InternetPhone.

1992

The World Wide Web is born.





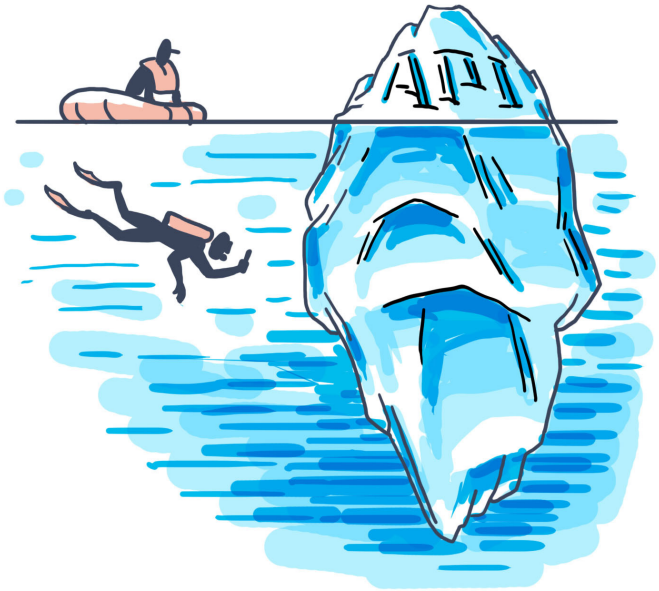
1995

Millions of people are logging into the now almost globally available Internet, and Internet-focused businesses begin to form.

1999

Mobile phones gain popularity — with flip phones, palm pilots, and more affordable pricing.





2000

Salesforce hits the market, and along with it, the first Application Programming Interface — or API — allowing software developers all over the world to interact with and use pieces of the Salesforce software within their own programs.

2003

Skype is introduced, and popularizes Internet-calling over VOIP.





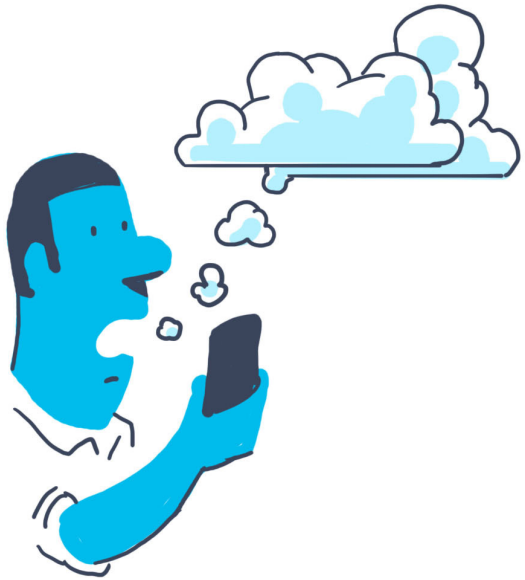
2007

The Apple iPhone is unveiled, changing the cell phone market forever with it's first modern "smartphone".

2008

The Apple App Store launches, paving the way for the mobile-first revolution with new business opportunities focused on the mobile phone.





2009

Communications APIs emerge from providers like Bandwidth, allowing developers to easily add voice calling and text messaging to their own applications.

Today

Texting is the most widely-used and frequently used app on a smartphone, with 97% of Americans using it at least once a day. On the voice side, consumers rate click-to-call as the most important feature available during their online shopping experience.



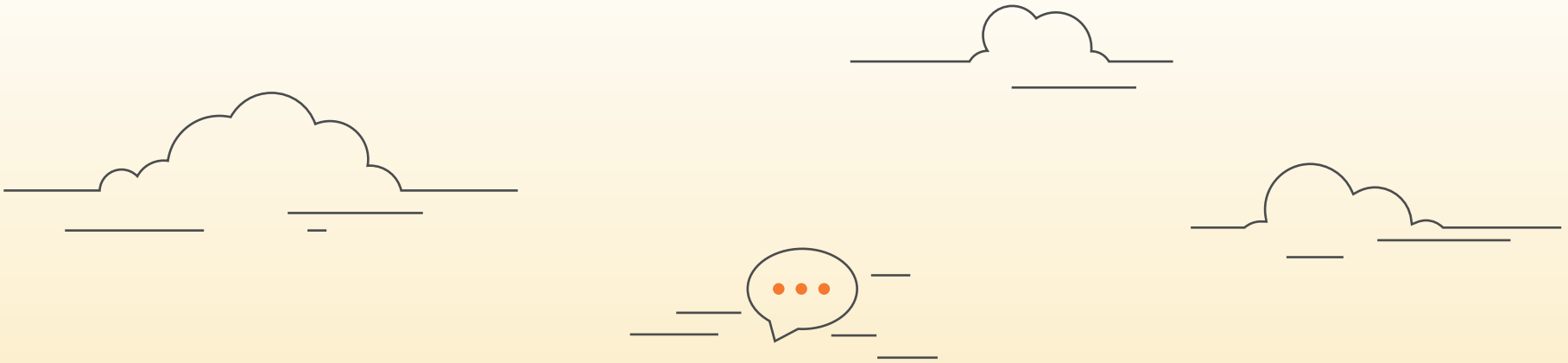


On the Horizon

With Smart Home features like Amazon's Alexa, Smart Watches, and personal assistants like Siri and Cortana, the well-connected life will continue to evolve and and expand with new voice and messaging needs for both business and consumer.

VIEW THE FULL INFOGRAPHIC

www.bandwidth.com/infographic



CPAAS IN ACTION

Create the ULTIMATE reminder that already gets noticed

Making sure your message meets your reader can be tough when email open rates are as low as 20%, and app notifications require yet another app download that's easy to ignore. With a nearly 98% open rate, texting is an effective and easy way to get your message across.

3

What's In It for Me?

The Big Benefits that CPaaS Brings

CPaaS is the newest trend in the decades-old movement toward cloud-based business processes. Just like cousins who came before, SaaS (software as a service), PaaS (platform as a service), CPaaS removes the need to own hardware—delivering simpler, quicker and more cost-effective access to the calling and texting functionality businesses need to build sticky applications with better user experiences.

Many of the **most successful companies** that have tapped into CPaaS are those well acquainted with using communications as an enabler and differentiator.

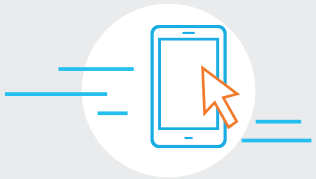
These no-stack startups, the likes of Google, Lyft, and Zendesk, are highly scalable, agile and disruptive to well established industries.

Google lyft zendesk

Today virtually everyone has experienced the value that communications APIS can bring to everyday interactions. Below are just a few examples.



Your doctor **texts you appointment reminders** to make sure you'll be there on time



You **click a link from a mobile app** to call a support representative when you experience problems with your cable television.

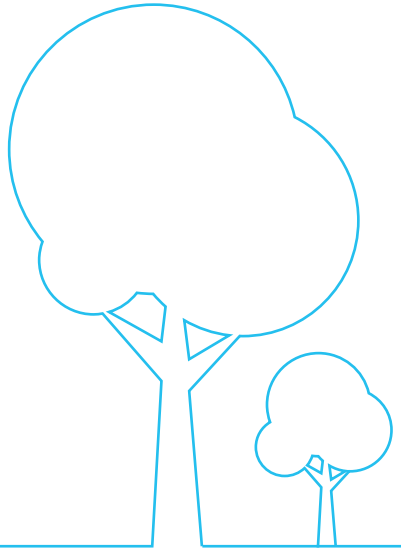


Your bank **texts you an authentication code** that you enter online to validate your account access



Never before has voice and messaging been so simple to deploy—**and CPaaS is the catalyst behind it all.**

CPaaS is entirely cloud based and software driven—catering to application developers and product owners who need to tap into today's most exciting digital and mobile features without having to build or locate any of the physical network infrastructure. Communications APIs eradicate the need for users to communicate within channel-based silos for instant messaging, web conferencing, text messaging, voice calling and more.



A CPaaS offering can consist of a combination of REST APIs, developer support, sample code snippets, documentation and forums that let any developer incorporate communication-enabled features (voice & messaging) directly into applications. Some companies also offer software development kits (SDKs) and libraries for building applications on different desktop and mobile platforms.

WHAT CAN YOU BUILD WITH A COMMUNICATIONS API?



Notify your users of important updates or appointments via SMS



Click-to-call or message from within your application



Request emergency help quickly, at the right location with 9-1-1 call routing



Translate speech to text for data entry, or quick response via email



Launch group calls and texts



Call analytics and lead tracking functionality



Two-factor authentication via SMS for increased security



Web-based chat within your application



Video chatting or call conferencing

AND MUCH MORE!



CPAAS IN ACTION

Creating the ULTIMATE sales experience is as simple as three letters: A.P.I.

Use APIs to add calling and texting throughout a prospect's interaction with your brand. When prospects are ready to talk, make it as easy as possible to get in touch with your team quickly. Take things up a notch with toll-free trackable numbers, so your team has some intel on what their interests are before they even pick up the phone. Should an important prospect speak to a special salesperson? Program it! The options are endless.



4

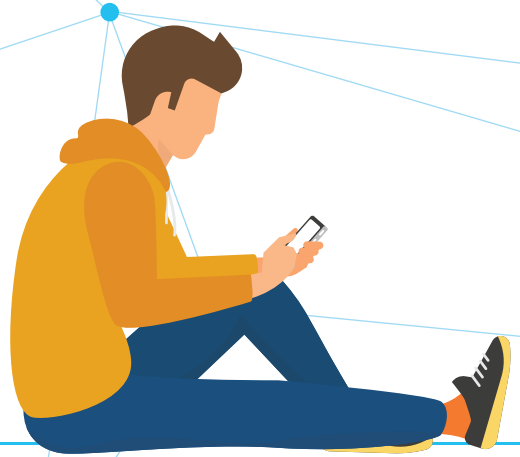
How to Use an API

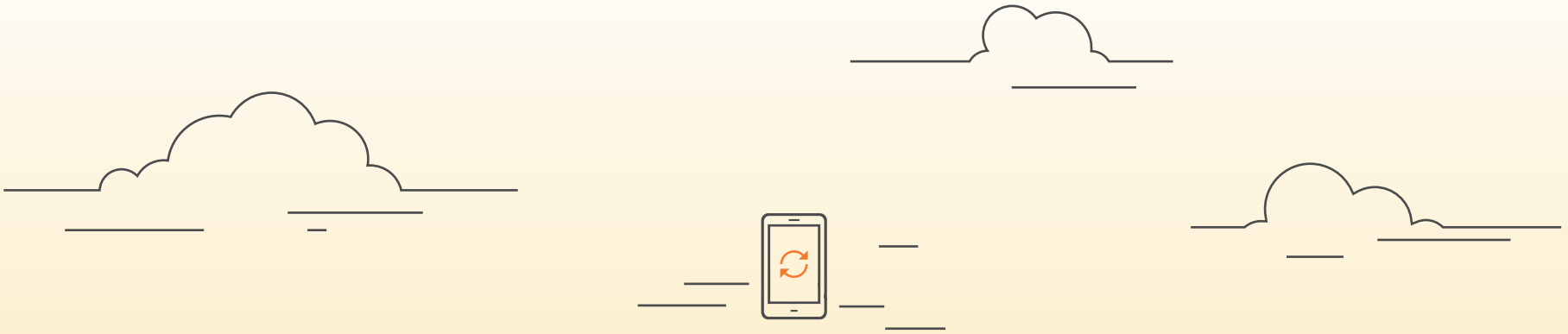
At the heart of any CPaaS offering, you'll find one common theme: APIs. What's an API you ask? An **API (Application Program Interface)** is essentially a software plug-in that makes it possible for applications to interact with each other and share data. These software shortcuts let developers quickly and easily integrate common functionality into websites, mobile applications and internet-connected devices.

Still sound complicated? Here's a real-world example. Have you ever used your Facebook or LinkedIn password to log into a different application altogether? Those are APIs at work. They make it easier for you (one less password to remember), and easier for the developer behind the scenes (one less piece of functionality he has to create from scratch). He can use Facebook or LinkedIn's APIs to securely access user data instead of creating a way to store and manage his own.



Another three-letter acronym that you'll want to look for when starting your CPaaS journey: **the SDK**. Software Development Kits (SDKs) help take APIs up a notch by getting some of the grunt work out of the way for common functionality. Common SDKs you'll see in the CPaaS world give you a headstart on buying phone numbers, making calls, or sending text messages. There's more on this in the future section "**Getting Started with CPaaS**" if you'd like to jump ahead and learn more on this topic.





CPAAS IN ACTION

Create the ULTIMATE call center utilizing the power of CPaaS.

Use Phone Number and Voice APIs to set up a round-robin system. If a customer has a named account executive, send them directly to the guy they know and deal with regularly—no special phone number required. Another customer calls with a password reset question—send them directly to your password security specialists. Want a particular song or sound to play when customers are on hold—no problem. Need to record the new guy's calls as part of his training process? Totally possible.



5

Types of CPaaS Providers

Pretty much every CPaaS provider delivers on the category's most basic and important promise—letting developers and product teams quickly and easily integrate voice and messaging communications into their sales, marketing and customer support applications. However, simplifying the front end app development only tells part of the CPaaS story. It might seem easy to bang out a few lines of code, run some tests and launch new communications functionality in a matter of hours. But when your users expect that every phone call sounds crystal clear, and every message is delivered, there are certain other characteristics you may want to check out.

First, it's important to understand there are two basic types of CPaaS providers:



1 API Providers

These are the pure-play software companies like Twilio, Plivo and Sinch. They're partners to many different types of businesses but ideal for startups that require quick speed to market, have lower network traffic volume, and have simple telecom requirements. A good choice for software engineers with no telecom background but not ideal when requirements include the ability to scale big, get volume pricing, create highly customized features or if hands on dev support is a requirement.

2 API Providers that are also Network Owners

These are companies like Bandwidth that started out as network owners and added APIs along the way. These providers, often referred to as “business-grade CPaaS” providers, appeal to a broad category of users including business product owners, software developers with no telecom background and also engineers with a telecom background. Because they own the network, they are able to offer fast speed to market, access to a large phone number inventory, quality voice and messaging services and more insight into call routing than other types of CPaaS providers.

3 What about those other guys? The big telecom giants?

The traditional telecom carriers like AT&T, Verizon and Level 3 offer telephony services, like voice, messaging and phone numbers, but they are not considered CPaaS providers. Carriers don't typically partner with developers because they offer limited or no APIs, are more bureaucratic in their operations and have much longer time-to-market cycles. They're a good partner to operations or tech professionals who have a deep understanding of telecom since they offer access to mass telephony, good cost and routing control, tons of phone numbers and SIP or traditional switch infrastructure.

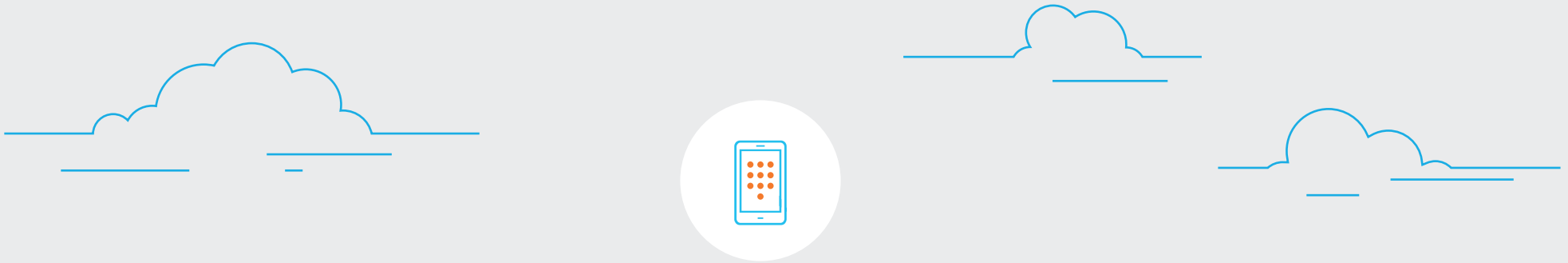
In the "**Selecting the Right CPaaS Provider**" section, we've included more details and a comparison chart featuring these three provider types. We've also included a set of key questions to ask as you evaluate the various options on the market. More than likely, if you're interested in CPaaS, your provider of choice will fall into either category #1 (API Providers) or category #2 (API Providers that are also Network Carriers). So here are a few differentiating areas to think about as you wrap your head around those groups of providers.





YOU JUST NEED THE BASICS - NO BELLS & WHISTLES, JUST SOME EMBEDDED VOICE OR MESSAGING FOR YOUR APP.

You're just trying out the functionality—taking it for a test drive, or want to see if it's something that might resonate for your user base. API-only providers may be a great fit here. They offer an excellent sandbox environment, tons of documentation, and specialize in speedy delivery without getting into the telecom weeds. At that stage, you don't need major customization or to be a telecom know-it-all—just easy functionality.



YOU DON'T NEED TELECOM EXPERIENCE YOURSELF... BUT DO YOU NEED TELECOM EXPERTS JUST A PHONE CALL AWAY?

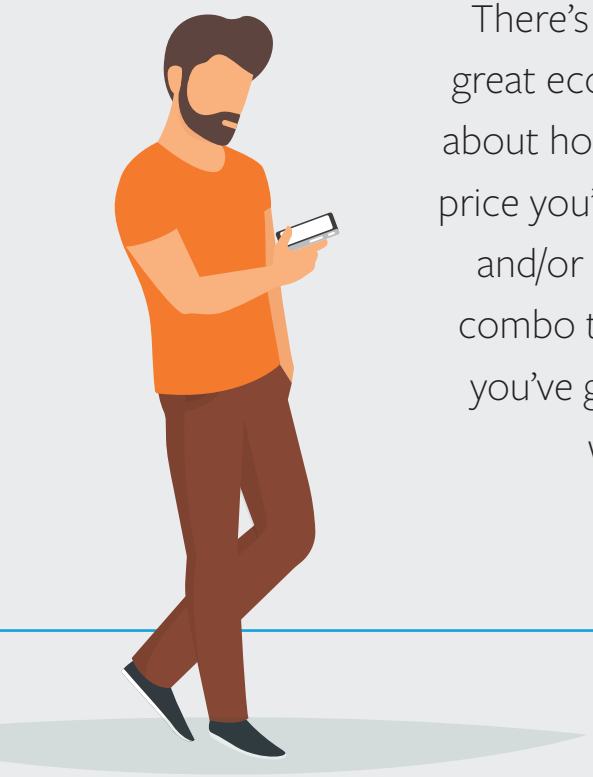
Both pure-play API providers and API providers that own a communications network let you access the most in-demand aspects of telecom with just a few clicks of the mouse—that's great news! But the pure-play software companies cater most to the quick-moving dev who doesn't require much (or any) hands on support through the stages of development. Depending on the complexity of your project, you may require more support infrastructure than document libraries, GitHub snippets and developer forums. The API/network carrier combination (or "business-grade CPaaS) providers tend to offer more dedicated support because they're setup to handle both SMB and enterprise customers.



WHAT DOES THE FULL SUITE OF APIS LOOK LIKE?

Not every API provider offers the exact same API functionality. Sure, voice and messaging typically "come standard," but it's important to know exactly what features you'll need both now and into the future so that you can choose the most robust feature set for your business needs. The API providers that are also network carriers will typically offer more APIs for number management functions such as bulk porting, placing calls and sending messages. Some providers also offer API-based 9-1-1 emergency routing, video conferencing, or IM chat which can be a rarities among the CPaaS players in today's market.

HOW DEEP ARE YOUR POCKETS?



There's no doubt that all forms of cloud-based communications deliver great economies of scale compared to more traditional models. But think about how your business will need to scale over time as you consider what price you're willing to pay today. When you need a high-volume of numbers and/or expect high network traffic, it's the API provider/network carrier combo that's going to give you the most value for your dollar. Likewise, if you've got low volume needs and a speed to market priority, partnering with a pure-play API provider just might be your best bet.

Selecting your ideal CPaaS partner

is a highly personal decision based on a variety of factors—functionality, cost, quality, scale and support being some of the big ones. Success starts with a complete understanding of the provider landscape so that you can determine the right choice for your current and future needs.





CPAAS IN ACTION

Create the ULTIMATE customer retention strategy while protecting user privacy.

Keep conversations going within your app—not outside of it—to guarantee that users keep coming back for more. On-demand applications are popping up all over the place, and two of the most common challenges can easily be solved by CPaaS: user privacy and customer retention. It's important for users to work out details and logistics via phone or text, but it's equally important that they maintain their own privacy. Offer up a limited-time use, automatically generated phone number within your application using a Phone Number API. And bonus points: since the phone number is generated within your application and ever-changing, it'll keep customers coming back for more, instead of just dialing the same number again outside of your application. Customer retention and user security made easy.



6

UCaaS vs. CPaaS

How to Know What You Need

With all of these new "- as a Service" companies entering the market, the acronym dictionary is growing every day—it's hard to know what's what! The name Communications Platform as a Service, or CPaaS, is relatively new, and is often confused confused with the similarly communication-focused Unified Communications as a Service (UCaaS) grouping.

So what's the difference?

CPaaS could be viewed as an offshoot, subset or accompaniment to a company's Unified Communications strategy—but it can also be bitten off and chewed in very small pieces allowing any software developer to quickly and easily pack voice and messaging features into their own applications without building any backend infrastructure or interfaces. In the most basic description: Unified Communications (UCaaS) deals with the hardware– the phone on your desk, for example—Communications Platforms (CPaaS) isthe back-end provider– they are the power behind that phone.

As businesses have increasingly expanded to include remote offices, and remote employees, Unified Communications has become all the more important—this branch of communications allows for employees to collaborate and operate off of a unified phone, messaging, or conferencing platform. Creating one central hub for employee communication and collaboration is crucial for success—especially among enterprise sized businesses. CPaaS often plays a part here—whether that might be serving as the network power behind the phone calls, or delivering messages from an instant messaging system. A few UCaaS players have even purchased CPaaS companies over the past couple of years, further blurring the lines.

The chart below provides information on the key differences between UCaaS providers and CPaaS providers.

	UCaaS	CPaaS
What is it?	Combination of hardware and software that allow for instant and easy collaboration across office locations.	APIs that allow for customization and integration of voice and messaging features within outside software applications.
What enables it?	Enterprise communications including voice, mobility, audio, web & video conferencing, call control, and more.	Voice & messaging integration in desktop and mobile applications as well as traditional VoIP SIP service.
When did it emerge?	Mid-1990's	2008
Who uses it?	Primarily for business/enterprise	Apps, software or businesses
Technology Used	One premise or cloud hosted IP PBX required; Many offer APIs but users typically have IT and/or telecom resources on staff.	Cloud APIs give access to each piece of functionality (pick & choose); Entirely API based giving devs easy access without IT/ telecom experience.
Experience Needed	Build your own backend infrastructure/interfaces	No need to build any backend infrastructure/ interfaces



CPAAS IN ACTION

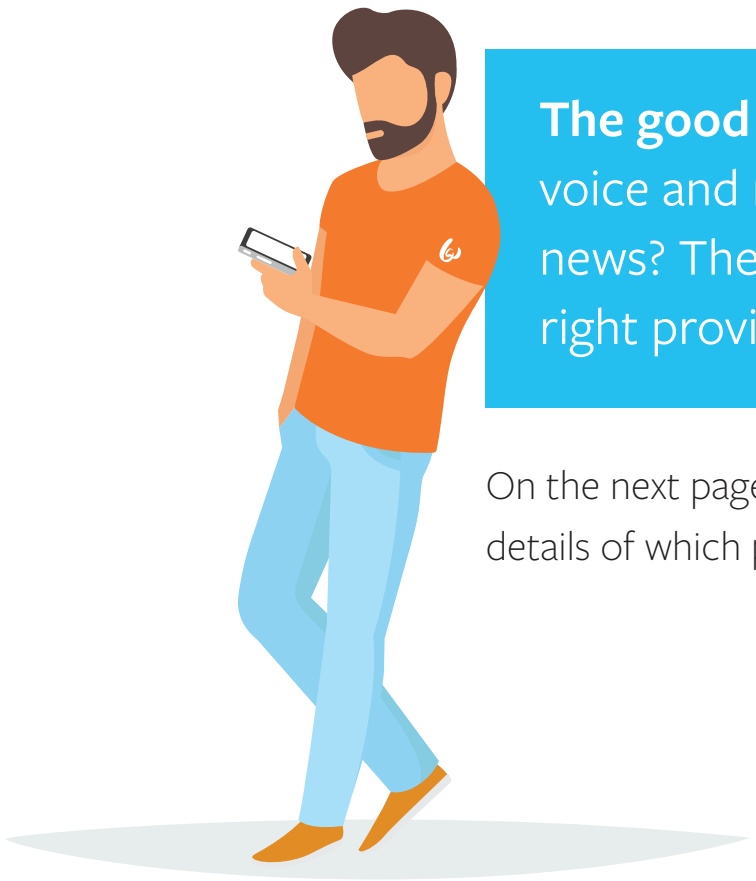
Creating the ULTIMATE CRM—track every interaction with CPaaS.

CRMs, analytics providers, and SaaS companies know that when it comes time to gauge customer interest, it's all about the numbers and information that you're able to provide. But with more and more conversations moving to text, it's crucial to ensure that you're seeing, managing, and measuring every customer interaction. Messaging APIs make it easy to integrate texting wherever you want within your application—and track it. Don't stop at tracking emails or phone calls, make sure you can see the whole picture and be prepared for the wave of text-loving millennials.

7

How to Choose the Best CPaaS Provider for your Business

In its early days (just a few short years ago), the CPaaS market was dominated by pure-play software companies like Twilio, Nexmo and Tropo that targeted software developers who needed quick and easy access to communications APIs for voice and messaging and who had little to no knowledge of the intricacies of telecom infrastructure. As the market evolved, the needs of many CPaaS customers also evolved—they outgrew some of the "off the shelf" API options—in some cases, they needed a solution that could scale, in others, they needed higher quality, and in others, a better cost structure. As a result, a number of new players emerged to meet the demands of the market.



The good news here: you've got lots of options to consider for voice and messaging, no matter what your use case. The bad news? There are so many options available, that choosing the right provider can prove to be quite the challenge!

On the next page, you'll find some tips to consider when selecting a partner, along with details of which providers are the best fit for various businesses.

	API Providers	API Providers & Network Carriers	Network Carriers (Not CPaaS)
The Players	twilio · Sinch! · plivo	bandwidth · Vonage Business	ONVOY · Level(3) COMMUNICATIONS · AT&T
Good Choice For	• Start-ups • Quick software deployment • Lower network volume • Simple telecom requirements • Scale and quality are less important • High speed, high volume	• Higher quality voice, better message deliverability • Number management tasks like buying and porting numbers from one provider to another • Business-grade solutions • Custom solutions • Cost control • Mass telephony	• Availability of phone numbers • SIP infrastructure or traditional switch infrastructure are available • Speed to market is less important
Intended Buyer	• Software developers, the “one-man-shop” start-up owner	• Product owners, solutions architects	• Telecom professionals (i.e. - prior telecom experience required!)
Challenges	• Ability to scale • Pricing structure • Customization • Limited amount of support available	• Depending on the provider, the feature set may not be as full as API-only providers • Network availability may limit international support, or make it more cost prohibitive	• Bureaucratic • Slow moving • Limited APIs • Limited amount of support available

ALL OF THESE PROVIDERS HAVE A LOT TO OFFER—BUT THEY'RE NOT ALL ALIKE.

It's important to carefully assess your business or application development needs as the first step in your buying cycle. Here are some key questions to ask, as you consider your options:

CALLING AND TEXTING

- **Q** What features do you require? Basic voice and messaging services are a typical standard offering for all of the above providers, but some also offer picture messaging (MMS), video messaging, group messaging, 9-1-1 connectivity, number management APIs for purchasing additional numbers and porting from carrier to carrier, and more.
- **Q** Do you require international coverage/support?
- **Q** Is mobile of particular concern to you? You may also require a mobile software development kit (SDK) package as well.

PHONE NUMBERS

- **Q** Do you simply need quick access to phone numbers for a few thousand users in a particular local area? Or do you need an unlimited nationwide supply?
- **Q** Does your application require users to transfer numbers from other carriers? Ability to handle number porting in bulk should be of particular consideration if so.
- **Q** Do you require features like call forwarding, call recording, call tracking, etc? If so, you may need a special type of number to accommodate these features.

SUPPORT

- **Q** What kind of support structure do you expect? Do you have a support SLA that needs to be considered?
- **Q** Are sample code, online forums and document libraries enough for you to solve problems or do you require on-call support 24/7 or a dedicated account manager?

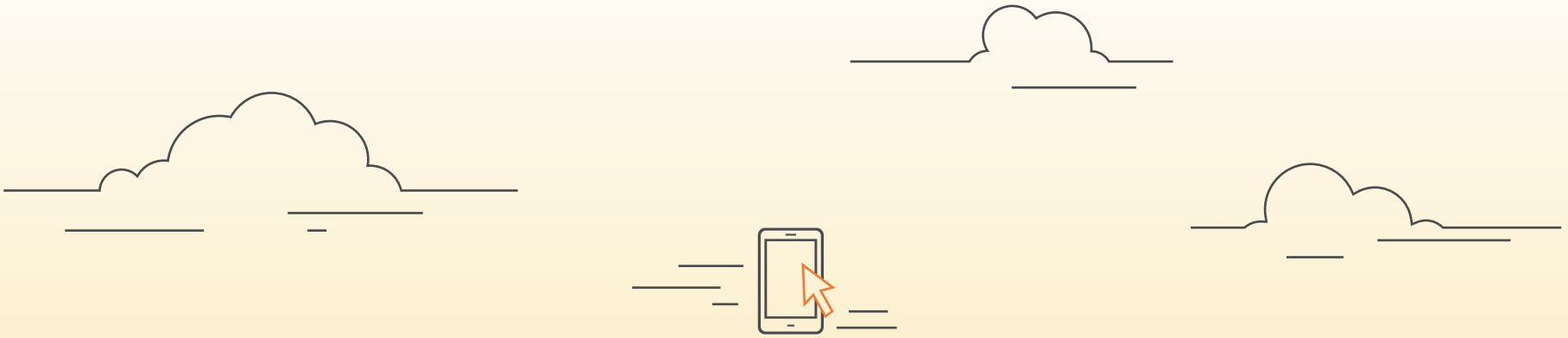
NETWORK CONTROL

- **Q** Do you need the flexibility of choosing or designing your own call routes to optimize for quality or cost? Some network providers will offer true customization, or pre-designed routes to make it easy to control costs or quality.
- **Q** Do you need quick responses and root cause for any potential issues? Dealing directly with a network carrier will provider quicker, more detailed responses should issues arise.
- **Q** Is quality of concern to you? Working directly with a carrier means more directly connected calls—no hopping around via third-party network vendors—resulting in a higher quality call.

THE BOTTOM LINE

Which CPaaS option is best for your business? Ultimately, the decision is yours. For speed to market, a CPaaS provider with SDKs and a solid library of documentation will get your application up and running quickly. To keep costs low and quality high, consider a provider with network carrier roots.





CPAAS IN ACTION

Creating the ULTIMATE in consumer convenience with click-to-text.

Have you ever thought “man I really should schedule that doctor’s appointment I’ve been putting off”, but put it off yet again due to meetings, pop-ins, or other daytime commitments? Businesses can make it easier than ever to book appointments, schedule meetings, or answer quick questions by embedding click-to-text functionality within their applications. For top-of-mind, quick interactions texting is the method of choice for so many of us-- and the audience is growing. The preference for texting as a method of business communication grows every year as millennials enter the job force.



8

Getting Started with Your CPaaS Provider



Communications APIs are the quickest, easiest way for virtually any developer or business to add calling and texting into software applications. CPaaS providers make the whole process simple by delivering both the software APIs and a suite of tools and resources to help you along the way. Your typical CPaaS package will include communications APIs for voice and messaging, how-to guides, sample code and API helper libraries. Many providers also offer mobile SDKs to make developing specifically for mobile simple as well.

So, how do you get started working with a CPaaS provider?

Here are some tips to help you along the way.



Tip 1

Start with a free trial.

You won't know what it's going to be like working with a CPaaS provider until you've peeked under the covers. Once you've done some initial research and found some providers you think will meet your needs, it's time to sign up for some free trials. Most CPaaS providers will give you a login and let you explore their dev tools, document libraries, sample code and more—with absolutely no commitment. That makes it pretty easy to play around with the merchandise before you make any big decisions.

Once you've got your free login, create a sample app. Get a free number to test your app, check out each provider's voice and messaging features and make sure the options are adequate (or better) to meet your needs.



Tip 2

Ask the right questions.

During this trial phase, you'll also get a sense for other important aspects of working with the provider and you'll be able to answer important questions such as:

Does the provider have APIs for everything you want to do? Every CPaaS will offer some standard calling and texting functionality, but things such as number purchasing and porting and, video conferencing, MMS (picture messaging) are sometimes more limited or specialized depending on the business.

What kind of support does the provider offer? Is it more of a DIY environment where you're finding answers through documentation and a dev community—or do you also have a dedicated resource you can call on for help? Different applications and businesses require varying levels of support. It's important to factor your specific support requirements into the equation when evaluating providers.

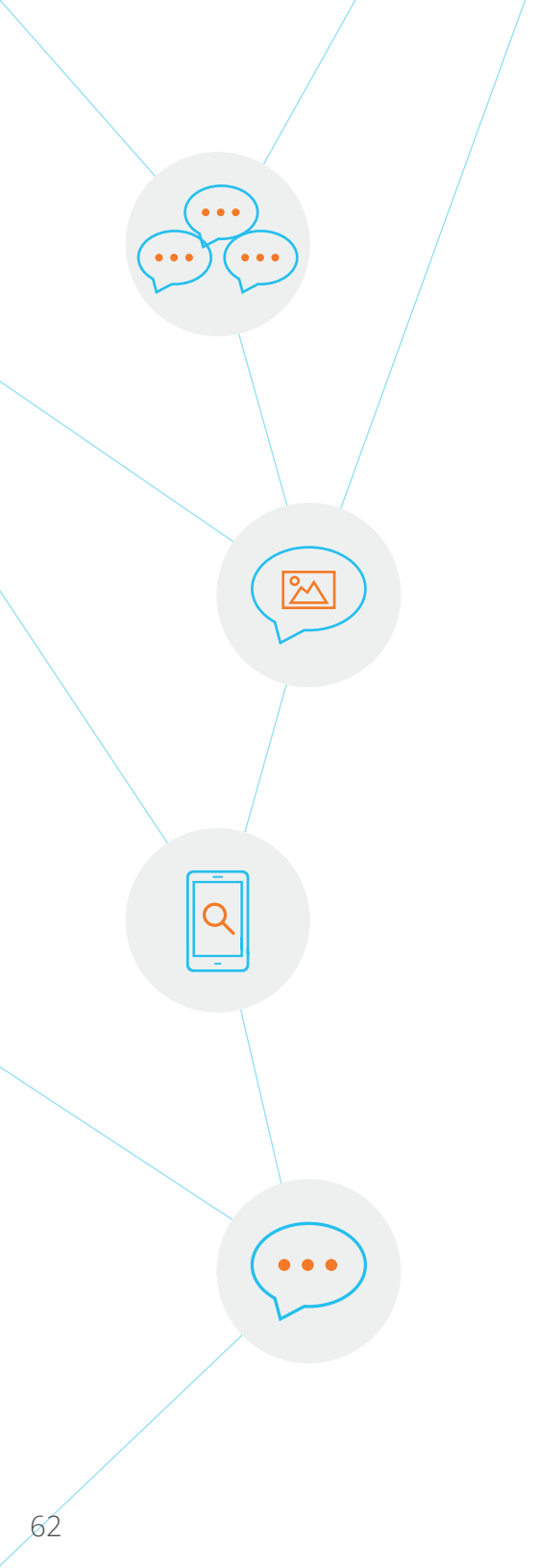
When you think about the future, can the CPaaS scale for the volume you'll require with a cost structure that supports your business's needs? Depending on your volume, and your growth plan you should think ahead here.



Think about your own customer SLAs—can the provider support your needs when it comes to network availability and uptime? Do they have reference customers that give you confidence in their product?

Tip 3

Dig deep into the developers' console.



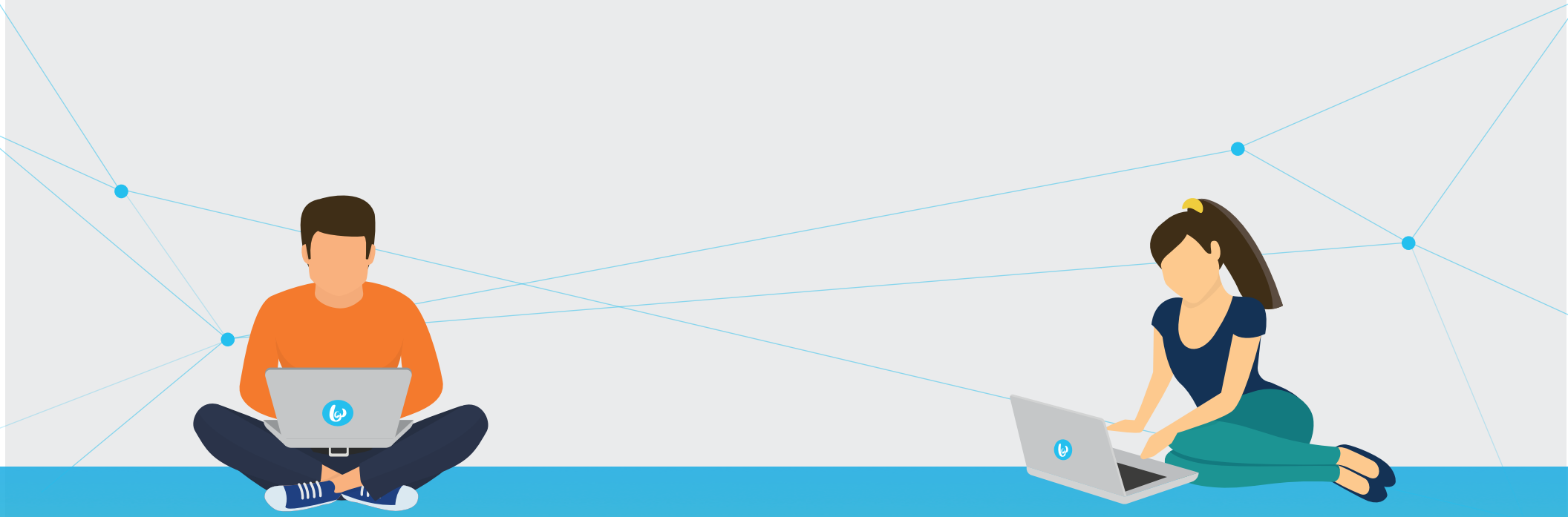
Before you make this important decision, it's important to dig deep and explore all of the core features and functionality each provider offers. Some key tasks you should be able to check out include:

- Send a message and make a basic call
- Search for available numbers
- Set up a conference call
- Send/receive a picture message
- Manage call recordings
- Upload media
- And more—if there's a key feature you need, now's the time to make sure the provider can deliver

These are the steps you should take before you select the best CPaaS for your business...but what's it really like working with a CPaaS provider? Keep in mind that someone, somewhere, will need to actually write some code. You should check for code samples and example applications that demonstrate how the building blocks of the API are assembled. Everything should be easily accessible and organized in an intelligent manner. You should also get a feel for how their customer support operates. Are you going to have to spend hours searching the Internet after an unresponsive help ticket? Or do you get a prompt reply with detailed answers for your question, saving you time and dropping stress?

THE MOST IMPORTANT STEP IN GETTING STARTED IS TO DIVE ON IN!

Whether you've been working with telecom infrastructure for years and are looking to consolidate, or you are just looking to add messaging as a side feature in your application, working with CPaaS APIs is easier than you may think.





CPAAS IN ACTION

Creating the ULTIMATE safe haven with 9-1-1 connectivity.

With the ever-growing presence of technology in our lives, the threat of hacks and Big Brother-esque takeovers are making more and more homeowners turn to their own DIY solutions for keeping their homes secure. The basic elements of any DIY home security solution consist of a webcam, a mobile application, and a powerful and automation-ready door lock. The other necessary element? The ability to accurately and quickly route 9-1-1 calls right from the web application. Connected 9-1-1 APIs make it possible to contact the authorities at the right location, to get help when it's needed the most.

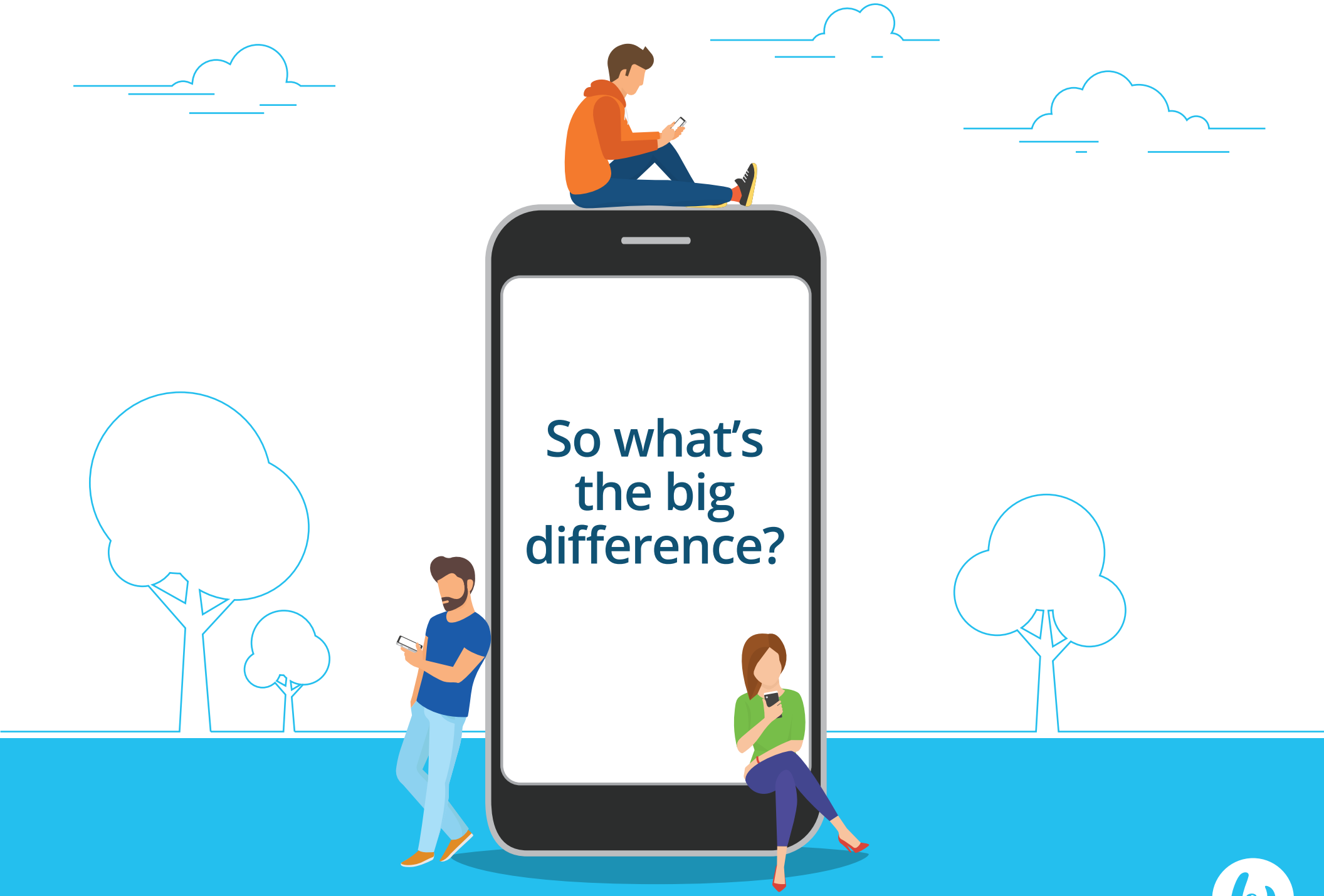


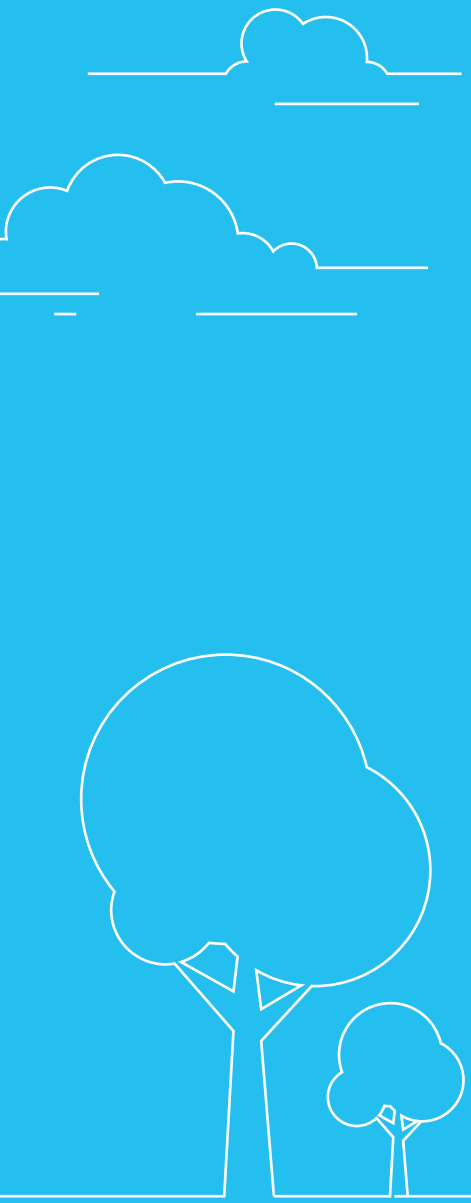
9

Looking Under the Hood

It's All About the Network

It's the voice and messaging APIs you get from a CPaaS (Communications Platform as a Service) that enable all of the rich, real time communications experiences your users demand—but the APIs only tell **part of the story**. When you're evaluating CPaaS partners, it's smart to consider how your potential provider's network ownership status could affect your business. For some companies, selecting a CPaaS that's also a carrier is a top priority, whereas others may not require the same level of control.


So what's
the big
difference?



An API provider's carrier status most comes into play when companies need to deliver enterprise-grade customer experiences. Why? The reason is simple. When your provider owns the underlying network technology, that means you (and your provider) have ultimate control not only over the code that makes those real-time communications happen—but also over how, when, and with what level of quality your voice calls and messages travel from point A to point B.

The benefits business users need - what working directly with a carrier can do for you



Quality and deliverability

When every single word in a conversation needs to be crystal clear, and your text messages can't be delayed, network quality is key. An unpredictable, congested network can lead to signal delays. When you're in control of call routing, you can decide what's most important for you (or your customers) in any given situation in terms of cost versus quality.



Cost savings

Typical CPaaS providers work with network resellers or carriers to provide the actual phone and messaging service to their customers behind the API interface. By skipping the middleman (and in some cases, middlemen) and working directly with a carrier, you'll find **savings of around 30-60%** on average compared to pure-play CPaaS providers.

Network availability and support

Network ownership means more granular controls to influence resiliency and network availability. When an issue occurs, getting it resolved is quicker and easier when you're dealing directly with a carrier that has both in-house knowledge of the network and resources that can respond to issues right away. A carrier partner can also integrate directly with your own support centers, change management procedures, and incident management policies so support is completely seamless to your customers.



Enhanced access to network diagnostics

Going direct to carrier means no more support black holes. Knowledgeable software and network teams are always on stand-by, ready to troubleshoot end-user issues—and since they own the network, they're able to give you more details fast.



CPAAS IN ACTION

Creating the ULTIMATE connected device.

The devices we use to call and text friends, family and coworkers are no longer just telephones or cellphones— they're increasingly becoming watches, speakers, even cars. CPaaS-powered APIs enable the exciting developments behind these new-age devices, making it easier than ever to deliver your message no matter where you might be.

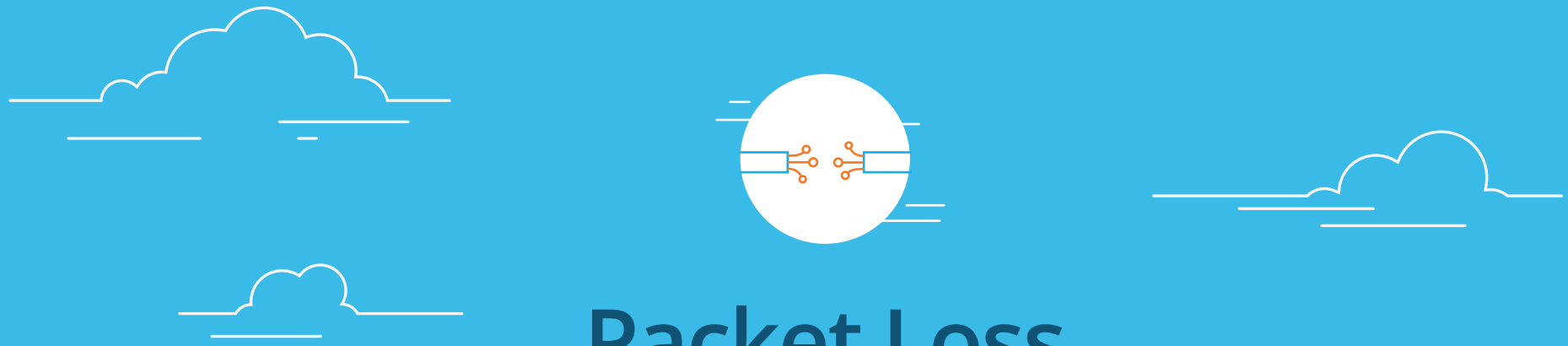
10

Common Factors that Cause Quality Issues, and How to Solve Them



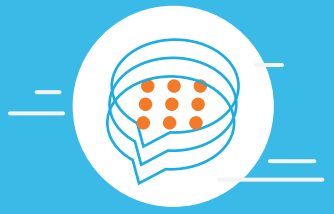
Available Bandwidth

Think of this as a pipe through which you get data. The bigger the pipe, the more simultaneous conversations you can have. But how big of a pipe do you need to have one conversation? The answer to this question depends on the codec—how the data is compressed to be sent and received. When analog voice is digitized, it is sampled 8000 times per second. Each sample is encoded in 8-bits. So, we need to have a bandwidth of 64,000 bits per second (or 64 kbps) one way to send that voice file. In other words, there's a ton going on behind the scenes to facilitate a simple phone call.



Packet Loss

You know when the voice drops in and out randomly on a phone call? That's packet loss. Packets can be dropped randomly while files are being delivered from one phone to the other, resulting in those blank spots you might recall. The good news here: today's IP network equipment is super reliable and even at a loss of around 3%, the quality listeners hear is still better than what you'd hear on an average cell phone. So what's to blame for packet loss today? Older network equipment or piecemeal IP voice networks are the main contributors to bad voice quality. You'll want a briefing on a provider's network architecture before making a smart buying decision if quality plays an important role in your solution—it's like looking under the hood before buying a fancy car. You want to know if you're buying a car built to last or an old clunker that's been torn apart and put back together.



Jitter

Everyone's been there—you're on the phone and there's a bit of a delay, so you keep talking over each other and finally have to take a pause or hang up. That's jitter at work—another network enemy. Jitter occurs when packets are delivered across the network at delayed or inconsistent times. Some providers tackle this problem by introducing jitter buffers—essentially an agreed-upon delay. Jitter buffers can be a double-edged sword as a big buffer will introduce latency, and a very small one might not be effective. Work with your network provider to determine if this is a good fit for your needs—it's typically better to have a jitter buffer on the endpoints vs. the network itself. This ensures that no additional delays are introduced while still smoothing out the voice signal.



Latency

Have you ever seen a movie that's been badly dubbed into a different language? This miss-timing is an example of how latency can affect call quality. Latency is introduced when voice data travels from point to point across the network—the more endpoints or other networks your call has to cross, the more latency you're likely to experience. A network's on-net infrastructure can help you minimize latency. Staying on-net means the call doesn't have to bounce from carrier to carrier to be completed. The number of rate centers (areas of direct coverage) or directly peered networks (direct access to another network's on-net coverage) that a provider touts can directly correlate to call quality potential. The less hops a call has to take, the better the call will sound. An easy way to think about this is airline travel—most of us prefer to travel on a nonstop flight, minimizing layovers. There's a lot of benefits to traveling nonstop—quicker time of arrival, and less chance that the airline will lose your luggage. Just like airlines, your call will arrive faster at a higher quality, without packet loss or latency if you're able to direct-connect instead of hopping from network to network.

Cost vs Quality

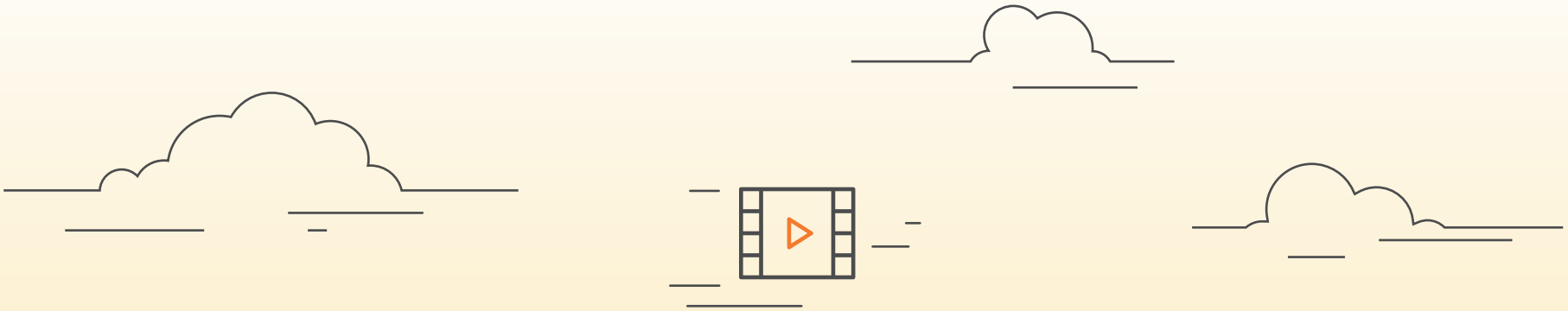
What's More Important?



When it comes to routing calls, most would agree that both the quality of the transmission and the overall cost of making those connections are both important factors to a business. When you're evaluating providers, the rate deck will determine the level of quality, the carriers you'll work with, and the cost you'll agree to pay for each call or message. Typically providers will have several available rate decks targeted at specific business needs, size, and area of coverage.

A variety of factors are at play in creating the ideal call routing experience for a particular business or application. For example, a company that's running a call center is wise to never cut corners on call quality-whereas a penny-pinching start-up that offers click-to-call from its app but has a super low volume of call traffic might choose to save money on call routing and accept a slightly lower quality experience.

Ultimately, the decision is up to you on whether every cent matters more than every second of a call. The great news here is that there's usually a happy medium available that works with both your budget and your quality standards.



CPAAS IN ACTION

Create the ULTIMATE immersive entertainment experience.

Imagine being able to start a group chat with your friends while you all watch the same movie or TV show. WIth so many cutting the cord and moving to Internet streaming services, it's only a matter of time before messaging or voice become a crucial part of our experiences with television or the movies. By using a Messaging API, a streaming device could incorporate powerful features within their applications that would make it possible to start group texts, or invite friends to tune in and watch with you. Instead of watching a show at home alone on a Friday night, suddenly you're watching with your friends no matter where they might be. Imagine the possibilities!

11

Migration Guide:

Making the Move Without Losing Any Functionality Along the Way

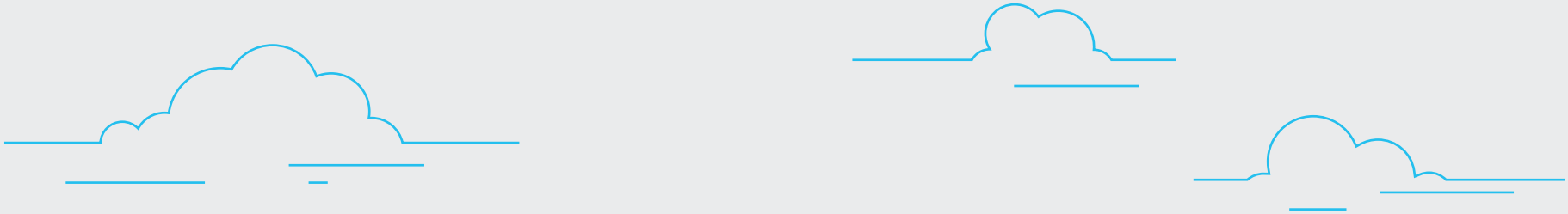
There's never been a better time to be in the business of helping people communicate. Whether you're developing an Over-The-Top (OTT) app, embedding Real-Time Communications into your software, enabling in-app texting for the first time, or empowering your users with new voice notification functionality—you can access it all through the power of voice and messaging APIs.

If you're already working with a CPaaS provider, you may feel somewhat stuck with that provider and keeping things "status quo." Maybe the quality isn't quite what your users expect. Maybe your bill is skyrocketing as you grow. Whatever the reason, you need to be prepared to approach the migration process in a smart way. The idea of making a move inevitably brings to mind all those phone numbers you'll need to port, the software you'll have to move and test, and the staff you'll need to train. But making the switch to a new provider doesn't have to be painful. Some providers may even have special migration bridges—connectors to help ease the transition burden—depending on your specific use case.

To make a smooth transition, there are 3 important steps you'll need to take with important considerations along the way.

1. Learn the differences between the APIs
2. Determine the scope of what needs to be changed
3. Implement the changes





Step 1

Learn the differences between the APIs





CPaaS providers have lots in common, but there are a few important differences. Every provider pretty much has the basics covered: Make a phone call and receive a phone call. Send a text message and receive a text message. The list goes on and on... but how each provider allows its users to accomplish these tasks can differ greatly. Some of the key differences to focus on include:

- Incoming Calls
- Incoming Messages
- Number ordering
- Answer events
- Hangup events

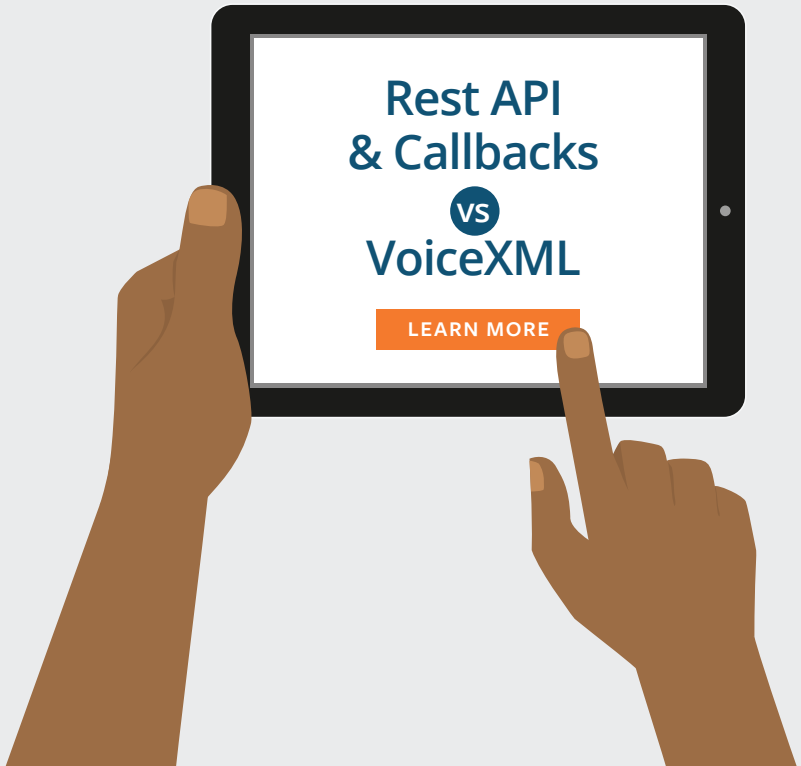
Rest API & Callbacks

VS

VoiceXML

Just about every CPaaS provider on the market has a VoiceXML (VXML) offering. Each provider calls its programming language something slightly different – for example, Bandwidth's XML offering is called BXML while Twilio's is branded TwiML, Plivo is Plivo XML and so on.

VoiceXML is a digital document standard for specifying interactive media and voice dialogs between humans and computers. It is used for developing audio and voice response applications, such as banking systems and automated customer service portals. VoiceXML is a w3 standard upon with call CPaaS providers' XML offerings are based.



In addition to an XML offering, some providers also offer a REST API and Callback option while others just offer the XML. So, what are the differences between these two options?



REST API & Callbacks

YOU CONTROL EVERYTHING

Using a REST API with callbacks allows for the most complete control over calls and messaging. Think of this option as a race car with manual control.

For a single call flow, each step needs to be verbosely configured. Incoming calls need to be answered, each call leg must be manually put into a bridge, each call needs to be hung up. Essentially, zero state is managed by your CPaaS provider and must be maintained externally. This leads to EXTREME flexibility.

Examples: Calls can be added and removed to a bridge, allowing developers to add/remove callers on a single bridge. Conference calls have the ability to speak notes or play audio to individual callers. Call recording can be toggled on/off. Calls can be forwarded to simulring any number of phones.

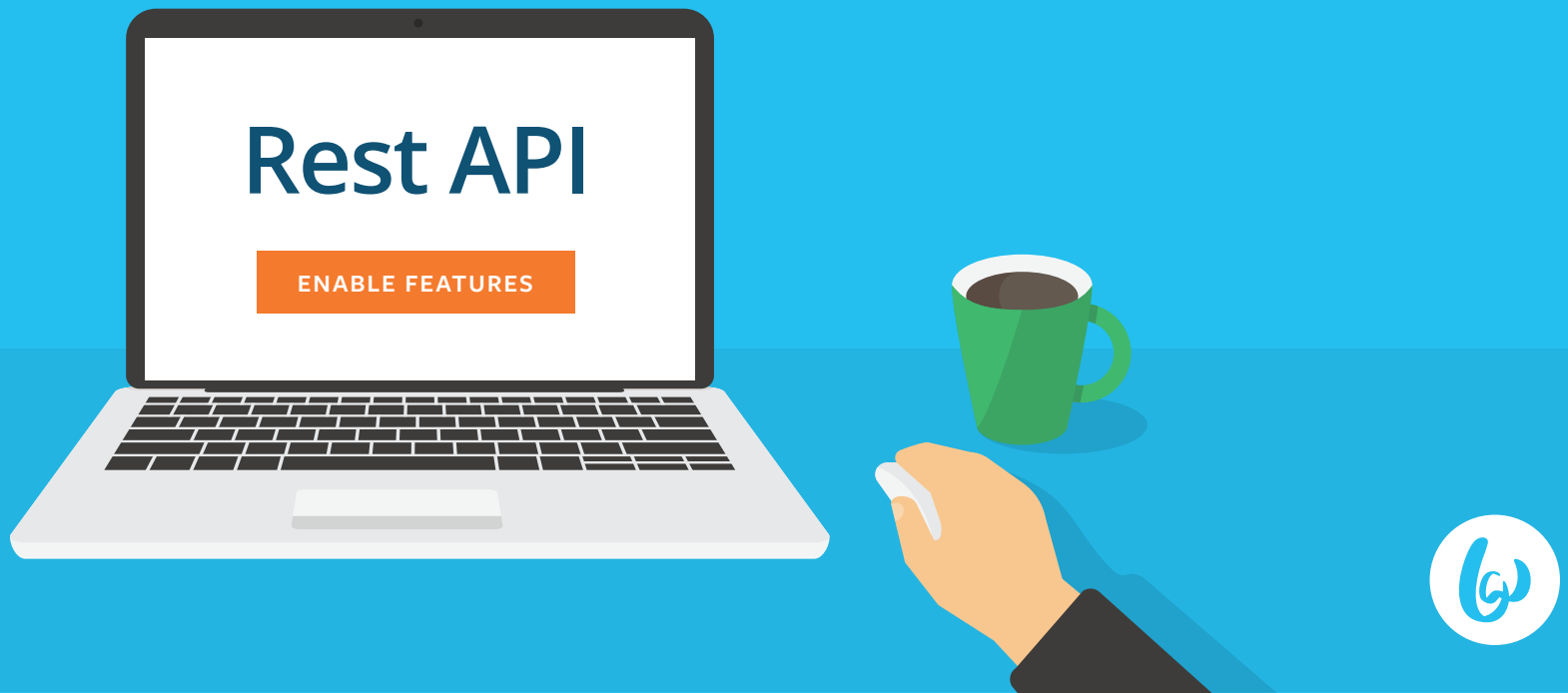
VXML

THE CODE CONTROLS YOU

VXML relies on an XML document to control call flows and messaging. Think of this option as a car with automatic steering. VXML simplifies complex scenarios like conference calling and simulring forwarding. Where Rest API requires call state to be managed externally, all state for VXML is handled within the XML document.



If your requirements are pretty simple, a VXML option is probably just enough to get the job done. But if you've got complex requirements—don't try to squeeze a round peg through a square hole. Choose a CPaaS that has a REST API option and enable the most advanced features in the simplest possible manner.



Step 2

Determine the scope of what needs to be changed



Once you've identified the main differences between the CPaaS providers you're evaluating, it's time to scope out any code changes. Some of the key focus points should be around:

- Callback events, such as:
  - Incoming Call
  - Answer
  - Hangup
  - Incoming Message
- Outbound call creation
- Outbound message creation
- Database changes

Most of the call logic remains the same, but it's important to spend time investigating the code around the logic. Certain things like message and call creation require different parameters with each of the CPaaS providers. Further, it's important to keep any database tables and calls up to date to reflect how your chosen provider will track minute usage. You must also ensure that any endpoints are updated to accept your provider's callbacks. Depending on whether you're using a REST API or VXML, you should expect different responses from the called web server.

Focus on identifying the pieces of code that interact with your current CPaaS provider and estimate the amount of work involved to transform them.



Step 3

Implement the changes



Obviously, implementing the changes you discover in your evaluation process will take varying amounts of time based on the business logic. For example some Bandwidth customers have been able to migrate in about a week with a single engineer. Other customers with more complicated call flows migrated in a month or so with a single engineer. Luckily, all CPaaS offerings require the same level of fine-grained thinking. Each 'call event' has to be handled somewhere or another. Each incoming message will always be sent to a callback URL.

Keep in mind that the devil is in the details, so to speak. Be sure to narrow and focus on any trickeries or hacks used to achieve certain flows with previous providers. These are activities you typically don't want to perpetuate in the long run. Also, check to ensure that your provider of choice offers the SDKs you need to complete your offering. Skipping this step can result in major challenges down the road.



CONCLUSION

Following the steps above will ensure that the migration goes smoothly in a timely manner. Key takeaways are to identify and learn the key differences between your current and future providers' APIs, implement the changes, leverage SDKs, and ensure that any billing logic is updated before launch day with your new provider.

GLOSSARY





CPaaS has joined one old industry (telecom) with a new industry (software). That means there's lots of room for confusion with terminology that runs the gamut of old and new. Here's a few common terms to help familiarize yourself with some of the head-scratchers you might run into.

API	Application Programming Interface is a set of subroutine definitions, protocols, and tools for building application software. Communication APIs are APIs that control voice calling and text messaging functionality within an application
CPaaS	"CPaaS (Communications Platform as a Service) solutions—which include voice, messaging, and other communication-focused APIs are a software shortcut that allows developers to quickly and easily integrate calling, texting and other telecommunication functions directly into applications. "
MMS	Multimedia Messaging Service (MMS) is a standard way to send messages that includes multimedia content (pictures, video) to and from a mobile phone over a cellular network.
SMS	Short Message Service (SMS) is used to send text messages to mobile phones. The messages can typically be up to 160 characters in length, though some services use 5-bit mode, which supports 224 characters.
VoIP	Voice over Internet Protocol (VoIP) is technology that enables the use of Internet Protocols as the standard transmission medium for telephone calls by sending voice data in Internet Protocal packets rather than by the traditional circuit switched transmissions of the PSTN.
Number Management	Porting, ordering, and provisioning phone numbers for use on a carrier network.
Call Routing	The act of delivering a phone call from one phone to another. Call routing includes local and long distance voice communication exchange and can also include interconnected data communications exchange such as text messages.
SIP Trunking	Session Initiation Protocol (SIP) is a method by which business phone systems can operate using an internet connection instead of a traditional phone line. SIP facilitiates peer-to-peer communication over the VoIP network including voice calls, emails, texts, instant messaging, video conferencing, voice mails, faxes, gaming and more.
Origination	A technical term for describing inbound calling.
Termination	A technical term for describing outbound calling.
DID	A technical term for describing a phone number. Stands for Direct Inward Dialing.
TN	An abbreviation for Telephone Number.
LNP	Stands for Local Number Porting - the process of transferring phone numbers from carrier to carrier.
CLEC	Competitve Local Exchange Carrier - CLECs own and operate their own communications networks
Web RTC	Web Real Time Communications - the ability for internet-connected devices to make and receive calls and text messages
SDK	Software Development Kit - a software development shortcut that gives developers an easy to use toolkit for development
PSTN	Public Service Telephone Network - The major network that all telephone calls traverse over.

So that's it! You've learned everything there is to know about this new and exciting world we call CPaaS. Got a question we didn't answer? Interested in starting your own adventure with voice and messaging APIs?

Give us a shout at
letstalk@bandwidth.com or 844-849-3152.