

A background network diagram consisting of grey circular nodes connected by thin grey lines, forming a complex web of connections.

# **I** ROKWIRE

Let's make **smart  
communities** a **reality.**

MAY 2021

AN OPEN SOURCE PLATFORM FOR MOBILE APPS FROM  
THE UNIVERSITY OF ILLINOIS URBANA-CHAMPAIGN

Do you have  
fragmented, siloed,  
legacy information  
systems?

**Rokwire integrates  
a community's digital  
resources and  
delivers them all  
on mobile.**

A network diagram with several grey circular nodes connected by thin grey lines, forming a web-like structure across the top and right sides of the page.

# Table of Contents

Executive summary	4
Rokwire solves a problem that everyone faces	6
Our vision	8
Goals	10
Recent app development	11
What makes Rokwire unique?	14
How it works	16
The Rokwire community	20
Why join Rokwire?	22

# EXECUTIVE SUMMARY

ROKWIRE is an interdisciplinary project of the Smart, Healthy Communities initiative at the University of Illinois. We are building an open source digital ecosystem for mobile devices to enable the smart, healthy communities of tomorrow. Our goal is to enhance human capabilities; to create healthier, safer, more equitable, sustainable places; to foster better decision-making; and to fuel innovation.

**We seek partners for this exciting adventure.**



Our open source platform combines multiple streams of data and sensor technologies and integrates that information through artificial intelligence to present users with personalized, timely support for meeting their goals.

Our approach to privacy is revolutionary. Users set privacy and corresponding functionality at levels they prefer. Rokwire collects and keeps only the data that users permit.

We are making the University of Illinois and the surrounding communities of Champaign-Urbana the leading innovation center and testbed for new smart technologies and services. Other communities can now adopt the Rokwire platform to create their own smart mobile services.

We are joined by partners from industry and academia around the globe. They are helping to create a service that unlocks the potential of smart technologies and systems.

We invite you to partner with us.

# ROKWIRE SOLVES A PROBLEM THAT EVERYONE FACES

The promise of information technology is staggering: innovation beyond our dreams, better decision-making in public and private sectors, higher quality of life for residents and visitors, increased economic competitiveness, and accelerated environmental sustainability.

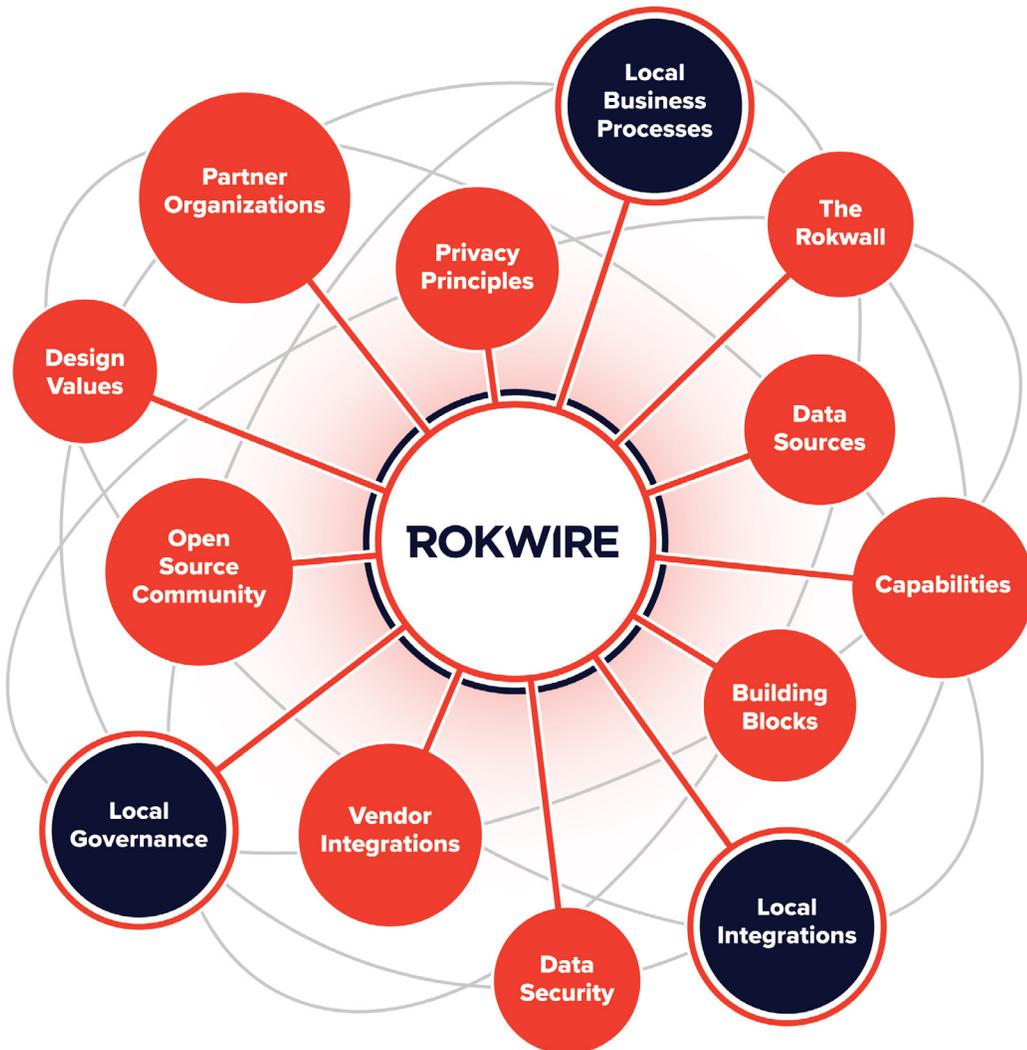
Among the barriers impeding progress toward this promising future, one stands out—many dozens of companies have developed proprietary software that allows their smart technologies and IT systems to communicate with each other, but not with other systems. Sometimes companies actively prevent other companies' technologies from communicating with theirs; other times it's more accidental. By building vertically (within their own collection of technologies) instead of horizontally (across systems and technologies), they make it difficult for different systems to communicate.

Most companies build their technologies from the ground up, creating the building blocks that allow their technologies to communicate with their own

IT systems and products. Because one company’s system has arbitrarily different building blocks than another company’s building blocks, it is incredibly challenging to integrate them. And because everyone’s software is proprietary, companies must pay large amounts of money to integrate.

We lack a comprehensive digital ecosystem that connects and integrates the various pieces into a whole—a whole that is so much greater than the individual parts. This new ecosystem should be managed by an entity that is trusted to operate a level playing field so all of industry can cooperate and compete for the integrated solutions of tomorrow.

With Rokwire, we are creating that ecosystem. We have developed a platform that enables integration of multiple data streams and systems. The source code of the Rokwire platform is open and available from the University of Illinois under the Apache 2.0 free software license. Although a single for-profit venture could never successfully integrate information systems and data across technologies, a trusted university can manage the development of an open source platform that transforms data sharing and delivers on the staggering promise of the digital age.



**The Rokwire Ecosystem** combines a variety of interacting components. These components include our design values, privacy and security practices, service integrations, data sources, external relations with vendors, partnerships, as well as the software platform itself. When adopted by a particular community, the ecosystem integrates local systems.

# OUR VISION



Rokwire is an open source platform that integrates information systems and data that enable smart, healthy, connected communities. Integrated smart information systems can enhance human capabilities and quality of life: to create healthier, safer, more equitable and sustainable places; enable better decision-making; and fuel innovation for all.

## **Rokwire enhances human capabilities**

A student is living away from home for the first time. The university has multiple apps to help her access class schedules, transportation, dining, extra-curricular activities, events, and counseling, but these apps bombard her with notifications that have little relevance to her needs at each moment. She feels increasingly overwhelmed, confused, and anxious.

Imagine if she has a mobile app that integrates all of the university's services into a comprehensive system. The system would use machine learning to present information in a curated way to support her agenda, decision-making, and ability to accomplish her goals.

## **Rokwire promotes health and well-being**

An elderly man lives alone and is having difficulty managing doctor's appointments, medications, and trips around town. He has trouble with his eyes and his knees and is afraid of losing his independence.

Imagine a smartphone app that integrates a variety of services: guidance and reminders, connections to support groups, and alerts for health care providers and family members. The app's voice assistance technology would

allow him to receive some of the help he needs even as his eyesight and fine motor skills decline. He could select a privacy setting to allow the system to collect health-related statistics and send them directly to his doctor, who can intervene before a crisis occurs. The man could use the app to request a ride to his doctor's appointment through the city's mass transit system.

### **Rokwire helps cities become sustainable**

A mass transit department notes that their buses are either too crowded or frequently empty, irritating customers, wasting resources, and contributing to greenhouse gas emissions. People complain because transportation isn't available when they need it, and buses are often behind schedule.

Imagine a smart transit system that simultaneously gathers and integrates sensor data from buses, buildings, and public spaces around town and uses machine learning to predict when buses are needed and how large the buses should be. The transit system would operate more efficiently, producing fewer greenhouse gas emissions. The smart transit system would communicate with transit riders to let them know when and where they will arrive.

### **Rokwire makes cities safer**

A company builds a smart streetlight with video cameras, gunshot detectors, and air quality monitors. The streetlight can share sensor data with its own IT system, but it can't communicate with other IT systems and technologies around the city.

Imagine if the smart streetlight could integrate with other systems—building occupancy sensors, bus cameras, police, and public health data. If the integrated data can be presented in a useful, curated way, with the most important information prominently displayed, city employees can be more efficient. They won't have to separately monitor different data streams to manage traffic flow, identify problems, and develop solutions to keep people safe.

### **Rokwire makes communities more equitable**

A young man is returning home after 11 years in prison. He needs to find housing, employment, food, transportation, legal assistance, and a health clinic, all while facing discrimination because of his record. He is encouraged to search websites and visit social service agencies to meet his basic needs, but he doesn't have easy access to a computer, and it's been many years since he used one.

Imagine if he had a smartphone with an app specifically designed to assist him in navigating life after prison. The app would be easy for someone with limited computer skills to use, and it could direct him to resources and support in the moments he needs them. It would integrate multiple social services and present them in a curated way so that he wouldn't need to visit multiple websites and agencies to get help. The app would connect him to a network of returning citizens and support groups so that he wouldn't feel so alone.

# GOALS

We are working to achieve this vision by:

- Developing an **open source software platform** for mobile and other networked devices to enable the smart, healthy communities of tomorrow.
- Providing a **testbed** for smart technologies at the University of Illinois campus.
- Enabling **research** through the development of a privacy-preserving process that supports IRB-approved research to be conducted using the Rokwire platform.
- Fostering a vibrant **open source community** that adds to the development efforts led on our campus.

## Current strategic priorities

Our current development themes in service of these goals are:

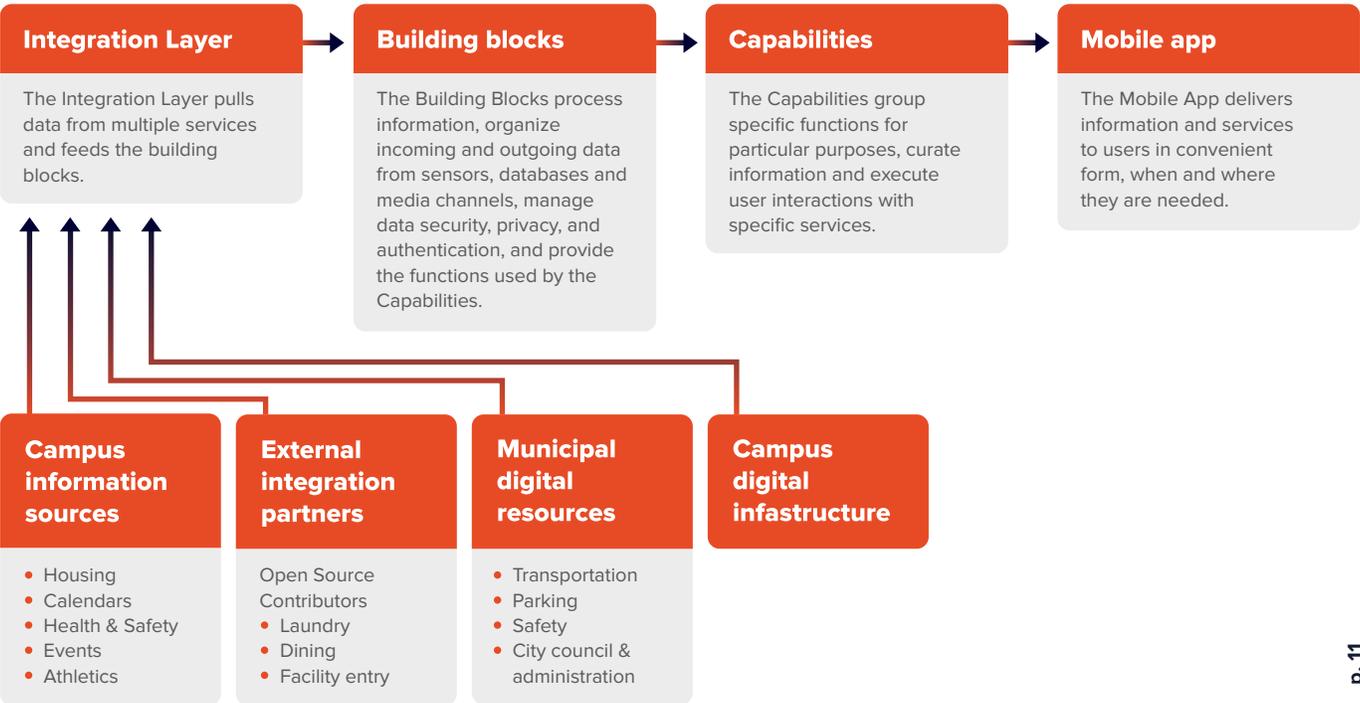
- Student success—creating the learning environments of the future to increase engagement, retention and completion.
- Health and wellness—integrating software that promotes health and wellness for students and employees.
- Research—designing a privacy-preserving data architecture to support HIPAA-compliant research.
- Service integrations—augmenting the Rokwire ecosystem with vendor-contributed services that support the daily goals of our users.
- Open source community—supporting a community of innovators from across the world who will help us identify challenges, frame problems, write code and develop new Capabilities on the Rokwire platform.

# RECENT APP DEVELOPMENT

The Rokwire platform affords rapid development and deployment of mobile applications. Rokwire tools enable communities to integrate digital resources using mobile technologies to deliver a range of services when and where they are most useful. Mobile apps built on Rokwire are customized for specific communities and purposes. Here are some examples.



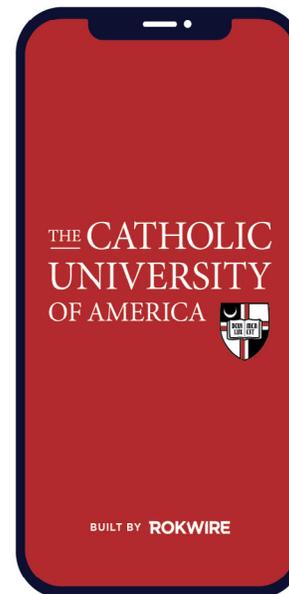
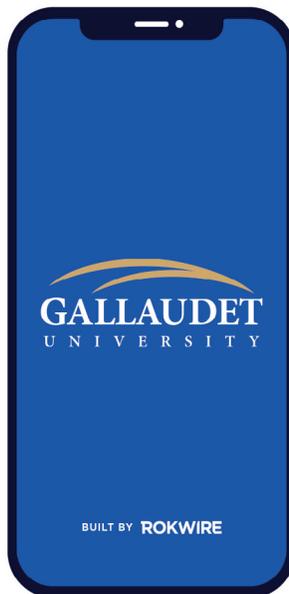
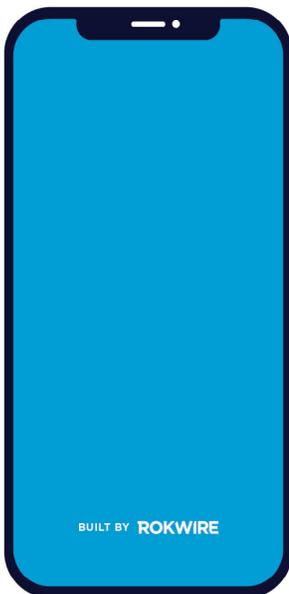
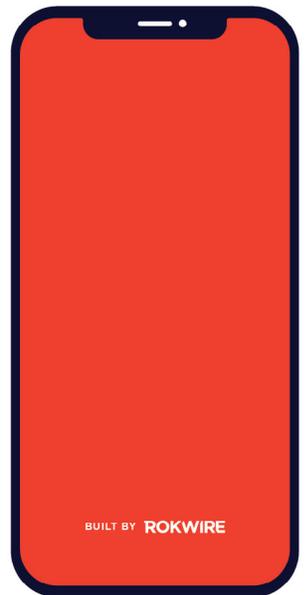
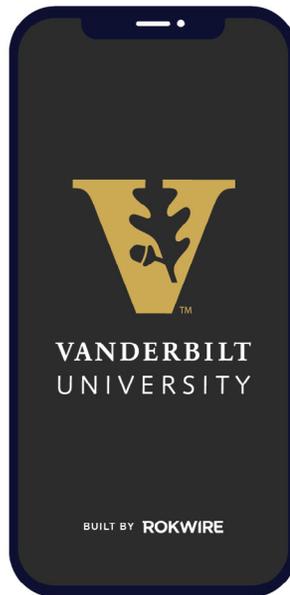
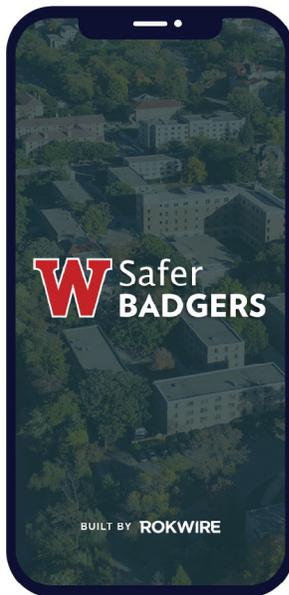
**Illinois app**, the official campus app of the University of Illinois, is the only university all-campus app built on an open source platform. The Illinois app integrates mobile delivery of multiple digital campus services. Students find their dining hall menu, laundry, campus cash, campus ID, bus pass, events, wellness and athletics, maps, course schedule, grades, reminders of deadlines, and more, all in one app that is always at ready access. And more services are being added all the time.





**Safer Illinois** is an app supporting the University of Illinois comprehensive COVID-19 mitigation program. Safer Illinois coordinates virus test administration, delivers test results, transmits community health recommendations, displays a building access status pass, and provides proximity-based exposure notification. With Rokwire as a starting point, Safer Illinois was able, within a matter of weeks, to combine the expertise of medical scientists and public health and safety officials to serve our university community.

Customized variants of Safer Illinois, developed by our service partner Rokmetro, have been deployed at dozens of institutions, including universities, high schools, K-12 schools, and large museums such as the Smithsonian.



To date, Rokwire apps have **more than 350,000 unique users**. The COVID-19 apps together have delivered **more than 3.5 million tests** for the COVID-19 virus.

# WHAT MAKES ROKWIRE UNIQUE?

Rokwire is a digital ecosystem built to improve the lives of community members in a variety of different domains.

Open source Building Blocks form the foundation of the platform and enable the integration of multiple smart technologies and services. The Rokwire platform can be customized and deployed by cities, universities, hospitals, and other large organizations. We call these deployments Rokwire instances.

Our design philosophy and values lead us to create a system that is flexible, expandable, and oriented towards providing an environment that encourages collaborative development and stimulates innovation.



## OPEN SOURCE

We build open source because we are deeply collaborative; we actively ensure access and seek to include the innovative ideas of others. We are creating a community of developers from around the world who make suggestions, contributions, and improvements to Rokwire. Because the community is involved in building the platform, they are invested in maintaining it too. We rely on our diverse open source collaborators to identify problems, examine and write code, and submit solutions.

Similar to Linux, Rokwire's open source platform has the potential to disrupt the smart technology industry. We envision that Rokwire's free open source platform will eventually displace proprietary ecosystems from commercial entities.



### **EXTENSIBLE**

Rokwire's software platform can host hundreds of services and streams of data directed towards individuals, communities, agencies, and businesses. Data from multiple data streams can be shared within the platform securely and without compromising privacy.



### **PRIVACY-AWARE, TRANSPARENT, SECURE**

Privacy is woven into the design of the system from the ground up. Apps collect only the data necessary to allow them to function. Data are stored for the shortest possible period and then deleted. We protect individual privacy and allow users to choose their preferred privacy levels. We ensure that users can delete their data at any time from apps and servers. For data security, whenever personal information is collected by Rokwire-based software, it is protected with industry best practices in data security to minimize risks due to data loss, misuse, unauthorized access, and unauthorized disclosure and alteration.



### **HUMAN-CENTERED**

We put users first. We create experiences for people who have too much to pay attention to, hate being confused, and who are often overwhelmed with responsibilities, deadlines, and data. Through machine learning and artificial intelligence, Rokwire weeds out the superfluous and presents a curated experience to help users meet their goals.



### **ACCESSIBLE**

We break through barriers associated with gender, race, income, and physical abilities for the people who use our software. We build for the mobile devices and voice assistant technologies of the future. We work to recognize exclusion. We know that designing for inclusivity results in products that are better for everybody.



### **SMART COMMUNITY TESTBED**

The first Rokwire instance was developed for the University of Illinois campus, with services and resources for students, faculty and staff. This instance is being used as a smart city testbed. New Building Blocks and technologies developed on the Rokwire platform are tested on the University of Illinois campus, Rokwire's smart-city sandbox, before they are deployed elsewhere.

Many companies refine and test their products and services in artificial sandboxes, but cities are much more diverse and complex. Rokwire provides a testbed at the University of Illinois campus, with sixty thousand people, born in 50 U.S. states and 78 countries, who speak dozens of languages and have varying accessibility concerns. We live and work in 651 buildings spread out over almost ten square miles, which means that developing with Rokwire can yield a wealth of real-life data.

# HOW IT WORKS

The Rokwire platform includes a front end (the apps that people engage with) and a back end (the code and infrastructure that enable and communicate with the Rokwire apps).

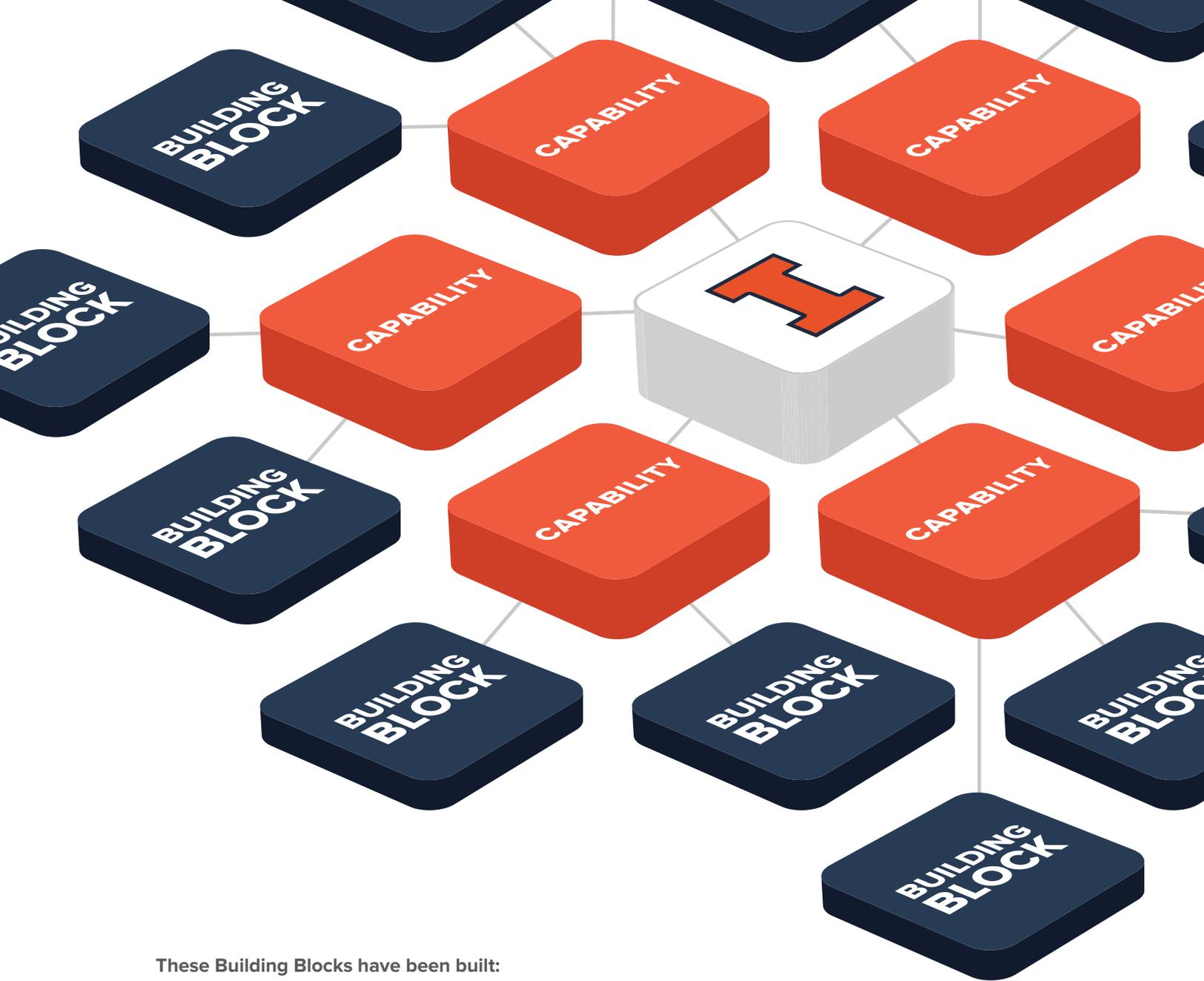
The main components of the platform are Building Blocks, Capabilities, Talents, and an Integration Layer.

The Building Blocks run in the background on the cloud. Building Blocks support a set of Capabilities whose functions are deployed through mobile apps. Capabilities can be open source or proprietary. The Integration Layer allows Rokwire to incorporate data from a variety of sources, providing the flexibility to connect to various cloud storage services as well as to existing services within an organization's digital infrastructure.

## **BUILDING BLOCKS**

Building Blocks are the core components of the platform. Each Building Block provides a basic functionality that any large community-based system would require. These components enable the rapid development of Capabilities, which provide services to the user. All Building Blocks are present in all Rokwire instances developed for cities, universities, or organizations, eliminating the need for individual applications to develop code for these basic functionalities.

Each Building Block has a defined domain. Most Building Blocks interoperate with other Building Blocks.



**These Building Blocks have been built:**

- App Configuration
- Authentication
- Events
- Polling / Survey
- Profile
- Talent Chooser
- Images
- Logging
- Transportation
- Sports
- Groups
- Health
- Assets
- Locations
- Platform Administration

**These additional Building Blocks are in development:**

- Contributions
- Contributions Catalog/  
Packager
- Workflow & Forms
- Reports
- Course Info/Registration
- News
- Wellness
- Notifications
- Reminder/To Do
- Space Utilization
- Attendance
- Campaigns
- Dining
- Wallet/Payments/  
Identification
- Door Access
- Branding
- Calendar
- Privacy Assurance
- Navigation
- Resource Reservation





## CAPABILITIES

Capabilities sit on top of the Rokwire platform and provide users with abilities and services to help them achieve their goals. The creation of Capabilities is simplified by leveraging Building Blocks. Building Blocks provide some of the basic functionality that Capabilities require and allow Capabilities to be added rapidly to the Rokwire system.

Companies, research centers, or individuals can develop and integrate Capabilities on the Rokwire platform for specific community needs. For the University of Illinois Rokwire instance, researchers have contributed Capabilities to help first year students be more successful. So far, we have developed Capabilities for university dining, sports news and information, and event promotion. We are currently adding Capabilities related to health and wellness, academic support, and support for group communication.

Service providers can sell their Capabilities to cities or organizations to deploy on the Rokwire platform. Some service providers may decide to offer their Capabilities for free on the platform so that they will be more widely used. Service providers can also propose to deploy their Capabilities on the University of Illinois Rokwire instance to test and refine them before making them widely available.

### Examples of Capabilities

The following service integrations are planned or currently implemented as Capabilities in the Rokwire platform:

- Event Recommendations
- Meal Plan
- Laundry
- Financial Transactions
- Student Response Systems
- Mass Transit District
- Recreation Management
- Turnstiles
- Media
- Parking Meter
- Safety
- Housing Management





## TALENTS

A Talent is a set of user interface components that enable a Capability. Each Capability includes at least one Talent, and a Talent maps to one and only one Capability. Talents are independent of each other and are enabled or disabled based on what is known about the user. We are working to apply machine learning to sift through the information provided by the user and by the Capabilities to enable or disable Talents. In this way, we can provide a curated experience for each user. Multiple interfaces (e.g., voice, API, web) may be available for each Talent.



## INTEGRATION LAYER

An array of APIs provides an adaptive Integration Layer between the Building Blocks, Capabilities, and the underlying infrastructure where each instance of Rokwire is deployed. The Integration Layer enables customization of Rokwire instances at different organizations. Different Rokwire instances may have different back-end implementation requirements and employ different cloud services, databases, and security services. Rokwire provides a collection of methods to facilitate implementation of Rokwire instances on different cloud and security services.



## PRIVACY

Rokwire is distinguished by its commitment to putting users in control of their data. On the back end, privacy is woven into the design of the system at the Building Block and Capability level. Most systems scatter personal information all over the system, which makes personal information difficult to protect and impossible to remove. On the Rokwire platform, every Building Block and Capability is designed to respect users' privacy levels. APIs communicate user privacy settings to the Building Blocks.

On the front end, users are invited to select a privacy setting that best meets their needs. Privacy settings are presented as trade-offs between privacy level and services offered. For instance, if users want more personalized guidance about their health and academic coursework, they may need to select a privacy setting that allows the system to collect more personal information about their grades, academic plans, or health. Greater privacy means that fewer services are available. Users can change their privacy settings at any time, and the platform ensures that the data they have shared disappears.

# THE ROKWIRE COMMUNITY

Creating an integrated, open source digital ecosystem that enables smart, healthy, connected communities is tremendously ambitious. We are confident that it can be done by developing rich, diverse partnerships. The Rokwire community consists of a rapidly expanding network of contributors, partners, and users.

## How we work with partners and contributors

Rokwire forms partnerships with leading companies and universities. The Rokwire platform is licensed by the University of Illinois under Apache 2.0 as free software so that cities, universities, government agencies, and other large organizations can adopt it to create customized smart systems for their communities.

We have engaged a dedicated team of software developers to create the platform's Building Blocks. As the Rokwire ecosystem grows, we will work with software developers around the world to create dozens of Capabilities that leverage the functionality of the Building Blocks.

Here are a few of the different ways that partners collaborate with us.

**Contributors** from industry and academia contribute code to the Rokwire open source platform—adding Capabilities, modifying them, recommending changes, and by creating or recommending modifications to the apps. Each Building Block contains Open API documentation that contributors can follow. Before contributing, individuals must agree to our rules of conduct, rules that are standard for many open source communities.

**Service providers** develop Capabilities and smart technologies that can be integrated into the Rokwire platform. Service providers can



leverage existing Capabilities to integrate their services on the platform, or they can build new Capabilities. Capabilities can usually be tested on the University of Illinois Rokwire instance before they are offered for other communities to use. Capabilities are listed in a Rokwire Capability Catalog. Cities or universities who deploy the Rokwire platform in their communities select which Capabilities best meet their needs.

**Adopters** are the cities, universities, hospitals, and businesses who use the Rokwire platform to develop customized apps that offer a particular set of services for members of their community. Adopters are given a package that consists of everything needed to begin developing a smart city app for a community. Adopters have access to all of the open source Building Blocks, eliminating the need to build the basic functionalities of their app from scratch. They can select a variety of Capabilities and services from our Rokwire Capabilities Catalog, some offered free of charge and others offered by service providers for a fee. Adopters can use a Rokwire template for their customized app or develop an app of their own. The API array in the Integration Layer adapts Building Blocks and Capabilities to a community's existing services and data infrastructure. Once the platform is configured for a particular community, it can be deployed on Amazon AWS, Google Cloud Services, IBM Cloud, Microsoft Azure or another provider.

**Researchers** from academia and industry collaborate with us to study problems and develop solutions. When an IRB-approved study is designed, Capabilities that provide micro-services to users can also collect user-generated data affording insights that would otherwise be unavailable to scholars. Research projects can be designed to collect, de-identify, and analyze data using ethical human subject research practices. Privacy-preserving systems for analyzing such data afford researchers the ability to make novel discoveries about human behavior and smart technologies without compromising user privacy.

# WHY JOIN ROKWIRE?

We seek a variety of partners—individuals, industry leaders, universities, nonprofits, and others interested in contributing to this path-breaking work.

## **Open source partners**

Join a vibrant community of open source developers to enable better integration of smart technologies, systems, and services. Together we can develop a robust open source platform that supports the smart-city technologies of the future.

## **Service providers**

Join us to make your smart city capabilities and services available to cities and universities around the world. Save 75% of the cost of integrating capabilities onto smart city platforms by leveraging our open source Building Blocks. Collaborate with other computer scientists and service providers to integrate and improve the capabilities you offer. Develop and test capabilities in our smart city test bed, the University of Illinois campus. You will have immediate access to a large campus community to prototype and test your capabilities.

## **Adopters**

By working with Rokwire, you can reduce the amount of time needed to develop a smart, health-supporting community mobile app from years to a few months. We have put together a platform that allows you to focus on developing the specific capabilities your community needs. You can leverage existing open source Building Blocks, instead of hiring someone to develop basic functionalities. You can select Capabilities from Rokwire's extensive Capabilities Catalog that meet your community or organization's unique needs.

Do you need a Capability that isn't yet provided? Work with our community of researchers and software developers to create what

is needed. We provide resources and support to help you utilize the Rokwire platform. And you will have access to a large user base on the Rokwire framework. Because we have built the platform, vetted it, and deployed it already, you can be confident about deploying Rokwire in your own community.

### **Researchers**

Work with us to unlock the power of integrated data and make new contributions related to the health and well-being of communities. Data shared with Rokwire according to HIPAA-compliant consent practices can be stored using a novel privacy-preserving data architecture called the Rokwall. This secure archive for data analytics supports queries on sensitive user data without compromising user privacy. The ability to collect, anonymize, and analyze user-generated data, using ethical human subject research practices, promises to enhance scientific discovery, identify problems, and propose novel solutions. We are engaging with researchers to adapt their projects to Rokwire. We welcome the opportunity to collaborate on your proposals.



At Rokwire, we are building  
a **digital ecosystem** to  
enable the smart, healthy  
communities of tomorrow.

If you would like to contribute to this  
mission and be part of the transformation  
we are creating, we are interested in  
talking with you.

You can reach us at **rokwire@illinois.edu**  
Or call Gloria Jackson at **217-300-6886**

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