JULY 2018

Smart Gigabit Communities Playbook:

usignite
SMARTGIGABITCOMMUNITIES

Smart Gigabit Communities Playbook:

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PART 1: ONBOARDING GUIDE

WELCOME

We are thrilled that your community has joined the US Ignite Smart Gigabit Communities (SGC) Program. You have joined a cohort of 25 other SGCs across the globe, each made up of your new fellow collaborators, smart community colleagues, and smart regional partners. These are now your sister and brother cities!

Figure 1: US Ignite SGC Communities

As an SGC, your community has made a commitment to leverage next-generation Internet technologies to develop transformative gigabit applications, and to share those applications with other SGCs to create a sustainable gigabit applications development ecosystem for smart cities.

Like you, we can't wait to get started! We've developed a series of materials to help new SGCs get up and running quickly and efficiently. Most importantly, it's crucial that your SGC has the right team members, partners, and stakeholders involved to drive SGC initiatives. Remember, the more productive time and energy you commit to SGC efforts, the more transformative the results for your community.

If you have questions about the SGC project or feedback related to these materials, you can always contact Meghan Histand, Glenn Ricar, and Scott Turnbull.

ABOUT US IGNITE

US Ignite spurs the creation of next-generation applications and services that leverage advanced networking technologies to build the foundation for smart communities, including cities, rural areas, regions, and states. Our organization helps to accelerate new wired and wireless networking advances from research to prototype to full-scale, with interconnected national deployments.

US Ignite believes that the communities most likely to become smart are those with widespread, open, and flexible advanced networks. Through the below programs, we seek to establish and optimize the opportunities created by these networks across the country.

- **Smart Gigabit Communities (SGC):** Initially funded by a $6M grant from the National Science Foundation (NSF), the SGC Project organizes and energizes a community to develop, adopt, and share applications and services that address economic and social opportunities created by the adoption of ultra-fast, programmable fiber and wireless networks.
- **Platforms for Advanced Wireless Research (PAWR):** To help create the new wireless networks that will power smart community sensors and services, US Ignite is leading the PAWR Project Office. The PAWR program is a $100M effort, coordinating a public-private partnership of federal agencies led by the National Science Foundation and over 25 leading corporations to build wireless research testbeds in at least four communities across the United States.

- **US Ignite Forum:** The US Ignite Forum creates a unique opportunity for municipal leaders to share lessons learned and best practices for implementing smart city projects and applications. Smart city technologies are being deployed in more and more cities across the country, creating new services that offer safer streets, less traffic, and energy savings. While pilot projects have returned encouraging results, planning and deploying smart city services at a size and scale that will transform communities remains a challenge for many local leaders to navigate.

OVERALL SGC PROJECT GOALS

US Ignite here to help you and your community become a sustainable Smart Gigabit Community. The aim is to enhance and build your local innovation ecosystem to sustainably develop next generation smart cities applications and services to drive the local innovation economy. The most successful SGCs assemble a pipeline of incentive activities and resources for entrepreneurs and developers to take their next generation projects from ideation to development, deployment, and commercialization where possible.

The overall goals of the Smart Gigabit Community project include:

- Developing impactful gigabit applications and services that improve your community
- Creating a gigabit application ecosystem where applications, and best practices around them, are used and shared among SGCs
- Engaging in efforts to make SGCs sustainable
- Driving economic development and regional innovation

WHAT ARE NEXT GENERATION APPLICATIONS AND SERVICES?

Advanced gigabit applications and services move more information than current networks can support, respond without noticeable delay, and/or use advanced networking techniques that allow for customized and dynamic traffic flows. More vital information and services depend on networks than ever before, and the dependencies are growing every day.

The SGC project organizes and energizes a community to develop, adopt, and share applications and services that address economic and social opportunities created by the adoption of ultra-fast, programmable fiber and wireless networks. US Ignite believes that the communities most likely to become the first smart communities are those with widespread, open, and flexible advanced networks. With deep fiber and advanced storage and computing deployed locally, some communities have many of the necessary smart components already in place.

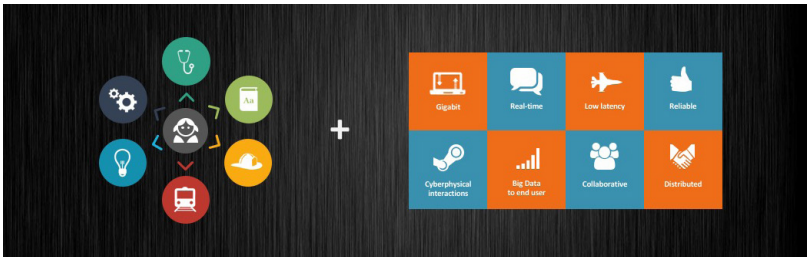


Figure 2

Collaborative efforts among research universities, local communities, and industry, encouraged by US Ignite, are yielding breakthroughs in applications and services leveraging new wired and wireless networking technologies. The applications and services that result from this work are enriching residents' lives while generating improved, potentially transformative, community services, investment in high-growth startups, and high-skilled jobs.

ONBOARDING STEPS (FIRST 60 DAYS)

Below are initial first steps that your community should undertake after joining the SGC project. Trust us—our recommendations are rooted in the hands-on best practices, data collection, and analysis we've been developing and conducting since 2013. That said, they can be modified to suit the specific interests and needs of your community when appropriate.

Figure 3

IDENTIFY A LEADING ORGANIZATION AND LEADER(S)

The Community Leader (CL) is the driving force behind your community's efforts to develop gigabit applications, and is responsible for leading SGC Steering Committee efforts as well as engaging key stakeholders in your community.

The best practice for identifying an SGC leader and organization is to talk to community leaders about who cares deeply about the community, has an appetite for high tech, and is well connected to the academic, civic, industrial, and charitable organizations supporting the community. If several names and/or organizations are suggested, you might issue a request for proposals (RFP) to your community to be reviewed and selected by the current SGC community contact, city government representative, US Ignite, and your SGC sponsor. Though other parties can review as well, this typically adds complexity and extends the time required to complete the process.

- The RFP is created from a template US Ignite has created and successfully used across communities to be filled out online (check out an example here). US Ignite will host the template online and collect responses.
- The RFP, which includes the networks of the selection community, is advertised and shared with your community. US Ignite will also advertise the RFP.
- US Ignite will coordinate the reviews and compile the results. The top 1-3 candidates are reviewed and interviewed via video or phone for final review and to make sure that they fully understand the required commitments.
- All of the reviewers meet virtually to decide on the best candidate, who is notified once chosen.

A Community Leader can be a:

- Nonprofit leader who is deeply connected to the local innovation ecosystem
- City leader in the smart cities space (CIO, CTO, etc.)
- University innovation leader if the university believes in driving local innovation

The ideal Community Leader will:

- Be able to engage other local leaders
- Be a thought leader in the community

The most successful Community Leaders are those who wake up every day thinking about community mobilization and innovation—often, this is already a part of their day-to-day job.

- Know how to motivate people, have strong stakeholder management skills, and excel at resolving conflict
- Lead the community's SGC Steering Committee
- Serve as a bridge to the local and national SGC community
- Promote creative innovation spaces
- Be excited by the idea of developing transformative gigabit applications

The Community Leader will:

- Communicate the benefits of advanced networking applications and services to the community. Please check out our terminology resources to learn more about what constitutes a gigabit.
- Work with US Ignite and local stakeholders to identify active community members to form the SGC Steering Committee, including a strong Technical Leader (TL)
- Lead and organize Steering Committee activities. Suggested activities include:
    - Attending monthly (frequency adjusted to community needs) Steering Committee meetings
    - Engaging in frequent communication with the SGC Technical Leader and as needed with other Steering Committee members
    - Creating a plan for SGC startup activities for gigabit apps ideation and development
    - Providing Quarterly written progress updates
    - Attending the annual US Ignite Application Summit
    - Organizing public relations (PR) efforts to showcase your SGC and your gigabit apps
- Serve as your community's point-of-contact to US Ignite
    - Attending a monthly one-on-one check-in/update report with US Ignite
    - Participating in US Ignite SGC Community Leaders meetings for updates, collaborations, resource, and application sharing, and more
- Facilitate collaborations with other SGCs
    - Engaging in working group collaborations across fellow SGC communities
    - Sharing information and best practices regarding gigabit application development and deployment, and deploying Smart Community services

SIGN THE MASTER SERVICES AGREEMENT (MSA)

Once you've established the organization that will lead your SGC, a Master Services Agreement (MSA) should be executed between the leading organization and US Ignite. An MSA is a contract reached between two or more parties, in which the parties agree to most of the terms that will govern future transactions or future agreements. An MSA permits the parties to quickly negotiate future transactions or agreements, relying on the terms of the master agreement and negotiating only the deal-specific terms.

The MSA will also govern the Task Orders that will be executed between US Ignite and your organization. Task Orders are task-specific activities that will guide major activities (e.g., Technical Leader, Startup Plan, Reverse Pitch, Application Development) that your organization will undertake as an SGC.

Self-funded SGC communities may be asked to sign a Memorandum of Understanding (MoU). A MoU is an agreement between two (bilateral) or more (multilateral) parties. It expresses a convergence of will between the parties, indicating an intended common line of action. It is often used in cases where parties either do not imply a legal commitment or in situations where the parties cannot create a legally enforceable agreement.

ESTABLISH THE SGC STEERING COMMITTEE

Please refer to the Steering Committee Best Practices Section regarding best practices and guidance regarding the build-out of your Steering Committee.

IDENTIFY A TECHNICAL LEADER (TL)

A Technical Leader (TL) is a necessary part of your SGC Steering Committee. Generally, the TL should commit one or more days per week to SGC efforts. The local TL plays a critical role in bridging operational concerns with planners, providing technical community management, fostering gigabit application development and exploring collaborative opportunities with other SGCs for continued growth. Solid technical skills allow them to interact effectively with IT professionals about local environments and with gigabit application developers on implementations and deployments. Solid organizational skills allow them to effectively coordinate activities to promote gigabit application development in the community. Solid collaborative skills allow them to discover and develop cross-community relationships to build joint programs or identify additional development partnerships. Working with their counterparts in other communities, TLs establish a network of interconnected smart cities that amplify local efforts by providing greater reach for gigabit applications, testbeds, and expertise to foster self-sustaining ecosystems of development.

Each TL works closely with the local Community Leader and Steering Committee to develop an effective local strategy for sustainability and continued growth.

The Technical Leader will:

- Promote Gigabit Application Development
    - Host reverse pitches and hackathons
    - Build local innovation groups to spark discussion

  - Engage local developers in gigabit development activities
  - Increase awareness and participation in the Digital Town Square (DTS)
  - Work with US Ignite to identify national opportunities
  - Work with other SGC TLs to identify collaborative opportunities
- Establish & Manage a Digital Town Square
  - Engage local network providers and professionals in gigabit network development
  - Identify or establish local gigabit exchange point(s)
  - Coordinate connections of gigabit networks to the exchange point
  - Coordinate configuration of local network peering with providers
  - Coordinate connection of edge-computing cluster to the exchange point
  - If necessary, purchase hardware to fill gaps in local gigabit networks
- Advise & Assist with Deployment of Gigabit Applications
  - Ensure application architecture works within the DTS
  - Deploy SGC applications to the edge compute cluster
  - Foster application sharing between SGCs
  - Install applications from the SGC portfolio in your local environment
  - Demonstrate and present on smart community applications
- Communicate and Coordinate with Community and National Leaders
  - Coordinate closely with the Community Leader on all aspects of the SGC project
  - Help keep your Steering Committee informed of opportunities and critical needs
  - Report on local activities and progress to your CL and Steering Committee as well as the national US Ignite leadership

Please view the SGC Technical Leader Job Description document for more information to consider when writing a job description for the position and conducting a search for the position. The CL should provide the proposed TL curricula vitae to US Ignite, so that US Ignite can review and provide any initial feedback.

CREATING A COMMUNITY PROFILE

Upon becoming an SGC, the community should populate the Community Survey via Survey Monkey (Note: a US Ignite representative will coordinate this activity for you). US Ignite's Public Relations (PR) team is developing Community Profiles for every SGC community. The team will focus on narratives that galvanize US Ignite audiences, particularly humanizing and personal stories. This initiative will help inform stakeholders regarding your community's gigabit application efforts and your community's vision for the future. To obtain diverse insights, it may be valuable to confer with your community's Technical Leader, as well as your Community's Communication and Outreach support.

These Community Profiles will also encourage and support the development and formation of synergies among SGCs with common interests. For example, a small group of SGCs may commit to work on specific issues (i.e., transportation, education, healthcare, etc.) related to smart cities, and by sharing the knowledge and expertise with their fellow SGCs provide added value identifying and filling experience gaps.

Once these Community Profiles are completed, you can utilize the Community Profile to publicize the initiatives that your SGC is undertaking and you can share the Community Profile to educate stakeholders about your community's current and planned accomplishments. Further, you can utilize the Community Profile to prepare a local press release and raise awareness. This can be especially supportive in recruiting additional Steering Committee members.

START IDENTIFYING LOCAL PARTNERSHIPS AND ENGAGING THE RIGHT COMMUNITY MEMBERS

While recruiting the Steering Committee, the CL should aim to initiate conversations with key community members in order to set the stage for your success. These community members could be from civic groups, anchor institutions, local entrepreneurial groups (e.g., developer groups such as Mozilla Hive, 1 Million Cups, Girls Who Code, etc.), investor groups, developer groups, or corporate partners, including ISPs needed to connect the SGC to the DTS. Often times, engaging the right community members requires personal relationships, and the right formula of community partnerships will vary from community to community.

To further reach your community's goals as a SGC, your community should consider public-private partnerships. Public-private partnerships have worked well in existing SGCs such as Flint, MI, where the Mott Foundation, a local university, and a local corporation have joined forces to fund the SGC application development ecosystem.

Effective partnerships can help your community address costs, resolve technical or regulatory barriers to application deployment, and spread awareness and excitement regarding your community's SGC initiatives. National Telecommunications & Information Administration (NTIA) recently released the guide "An introduction to effective public-private partnerships for broadband investments." We recommend that leaders from your SGC review this guide (especially pages 5, 8-10, and 14) for additional ideas and best practices on how to increase your community's ability to succeed in the digital economy.

Broadening participation has been a primary goal at NSF for many years and remains a difficult challenge, which is why one of US Ignite's organizational goals and a goal of the SGC project is to discover and nurture talent wherever it may be found. Ultimately, this will help the United States lead in tech and STEM by giving all students and citizens the opportunity to participate regardless of their ethnicity, gender, or income.

US Ignite and NSF believe that broadening participation means reaching out to:

- Individuals from a wide range of underrepresented groups
- Institutions with diverse research and instructional goals and practices, including community colleges, minority serving institutions, women's colleges, and institutions for people with disabilities
- Geographic areas with lower rates of participation in NSF programs

We recommend that your community propose strategies to broaden the participation of individuals who belong to underrepresented groups:

- Alaska Natives
- Native Americans
- Blacks or African Americans
- Hispanics
- Native Hawaiians
- Other Pacific Islanders
- Persons with Disabilities
- Women (women remain underrepresented in the tech field)
- Early-career professionals
- Students (undergraduate and graduate)

Broadening participation promotes the future of the economy and workforce in light of changing of demographics, as it encourages collaboration among diverse social groups that can foster innovation.

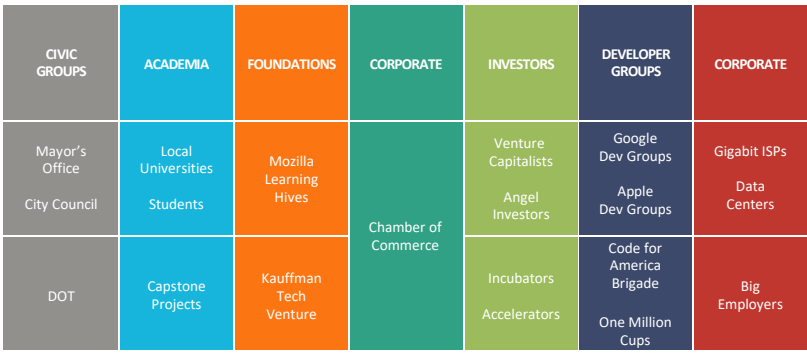
PART 2: STEERING COMMITTEE BEST PRACTICES

The SGC Leader should seek suggestions and build out the Steering Committee, a broad-based local steering organization within the community. The Steering Committee should consist of local business, civic, foundation, and academic leaders that represent focus areas, including local anchor institution partners. The Steering Committee serves as the catalyst for bringing together the resources necessary for the development of a sustainable gigabit applications ecosystem for the community. Many SGCs use their Steering Committee to coordinate local and regional smart community activities beyond advanced networking and next generation applications.

The SGC Steering Committee members should enable their sectors to become advocates for next generation technology development and the opportunities available through the SGC project.

A strong SGC Steering Committee is critical for a community's success. Each SGC Steering Committee needs active members from the following:

- The local city government
- Civic groups
- Foundations
- Universities
- Corporate groups including ISPs, anchor institutions, entrepreneurs, investors, and innovation networks



Typical Groups Involved in SGC Charter and Steering Groups

Figure 4

Your community's SGC Steering Committee should focus on project deliverables and fundraising to cover costs such as operating and maintaining the gigabit network, as well as community activities to drive application ideation and development. We recommend individuals with the following skills, experience, and networks be recruited to your community's SGC Steering Committee:

- Individuals with expertise in areas including transportation, healthcare delivery, public safety, energy, and education
- Local software developers and/or those with ties to local software developers
- Representatives of community anchor institutions that might commit to experiment with new applications
- Individuals with connections to city/county/state officials
- Individuals who can build and connect the steps to form a sustainable next-gen apps and services development pipeline

As a best practice, SGC Steering Committees should typically convene monthly. US Ignite's experience is that an effective Steering Committee is critical to the development of building sustainable local ecosystems, such as the ecosystem of gigabit application developers we seek to nurture in your community.

An SGC Steering Committee should:

- Enhance existing and/or create new incentive activities (meetups, competitions, accelerator events, co-working space events, online groups, seminars, etc.) to attract developers to learn about next gen apps and services and available resources, making them aware of the incentives for developing these apps
- Move the entrepreneurs and developers through a pipeline from ideation to development, testing, deployment, sharing, and potentially commercialization

For an interesting academic treatment of building local ecosystems, please see "Startup Communities: Building an Entrepreneurial Ecosystem in your City." Author Brad Feld uses Boulder, CO as a case study to suggest four requirements for building sustainable ecosystems:

1. Entrepreneurs must lead the startup community. Feld's research concludes that rather than top-down planning, a sustainable ecosystem requires a critical mass (often less than 12) of entrepreneurs to provide the needed energy. The proposed Steering Committees have or will find entrepreneurs in each city to lead.
2. The leaders must have long-term commitment, often embracing a forward-looking 20-year commitment that can see the city through alternative economic cycles.
3. The startup community must be inclusive of anyone who wants to participate in it. Rather than a zero-sum game, the ecosystem thrives with many varied skill sets and perspectives.
4. The startup community must have continual activities that engage the entire entrepreneurial stack. Such inclusive activities as hackathons, tech meetups, startup weekends and accelerator or makerspace events ensure continued infusion of new ideas and development of creative applications.

Please refer to the appendix for an Example Steering Committee Charter.

PART 3: TECHNICAL BEST PRACTICES

See below for our guide to implementing, managing, and maintaining the technology driving your SGC. We hope you'll find this resource useful and refer to it often!

A COMMUNITY ORIENTATION TO GIGABIT

Advanced gigabit applications and services move more information than current networks can support, respond without noticeable delay, and/or use advanced networking techniques that allow for customized and dynamic traffic flows. More of our vital information and services, and even our physical objects, depend on online services than ever before, and dependencies on online services are growing everyday. As the pace and quality of online services increases, the limits of a given environment's local networks will dictate quality of life for its inhabitants. This is why we are collaborating together to build useful applications and services in the Smart Gigabit Communities program. By connecting our expertise and filling in our respective gaps, we can maximize quality of life for the most people possible.

So what do we mean when was say "Gigabit" or "Real-Time Application" or "Advanced Networking?"

Gigabit just means we can move more information faster than we can on current networks. Gigabit speeds are greater than those achieved on current broadband networks, and allow you to deliver more in less time. Imagine an ultra-high quality live video that streams medical services, video fast enough to read lips, remote mental health services with high enough quality video to see facial tics, or highly-responsiveing video allow users to control and view very high quality scientific instrumentation. These just a few examples of apps that might need gigabit speeds.

Real-Time means that applications and services are able to respond faster than we can notice even a small delay, and systems can perform with an ease of interaction similar to a face-to-face experience. Imagine autonomous vehicles or drones that can respond to actions in the environment with an immediacy comparable to a natural interaction. Imagine video conferencing with a mental health professional without that phone-style delay that causes you to talk over one another. These are some of the benefits of true real-time interactivity.

Advanced Networking means highly-customized and adaptable systems of sending traffic across the network that allow applications to specifically control or customize behavior for security, privacy, or optimization. Imagine a network for community public safety services that can reconfigure itself in an emergency so the most vital services are guaranteed to perform well in emergencies. Or imagine a network that automatically isolates smart devices so they aren't vulnerable to hacking, providing safer communities. These are just some of the uses of what we call advanced or software defined networks.

APPLICATION VERSIONING

When releasing application code or distributable, an effective means to identify specific versions is critical to help administrators understand if they have the latest version or need to update their application.

Application developers are encouraged to develop a consistent and explicit system for documenting versions. Most software developers use some version of notation similar to <Major>.<Minor>.<fix>-<modifier> (i.e. 1.10.201911-prod).

Here's what this means:

- Major version is a significant change in the application with a number of new features, often this is not backwards compatible
- Minor version is a release of the project with new features or updates and is usually backwards compatible
- Fix indicates an update to an existing feature set that usually carries bug fixes or minor feature modifications
- Modifier is usually some indicator of a targeted release platform or environment such as 'dev' for development or 'prod' for production and is typically optional

BUG FIXES & SUPPORT REQUESTS

No application is perfect, and as they're shared across the SGC community various problems will be uncovered. SGC applications should have a process documented by which to take feedback and support requests. Mechanisms and responsibility for handling feedback may vary depending on the type of request, but these are generally separated into code fixes, feature requests, bugs & security fixes, and end user support.

Of the support request types, the most critical to address are critical bug/security issues and end user support requests—they'll be handled differently depending on the application.

CONTAINERS & APPLICATION DISTRIBUTION

SGC applications must provide some form of distributable for other communities to install. In most cases this is expected to be a Docker (https://docs.docker.com/) container or containers. Support is available for the creation of a distributable or dockerization of an SGC application in each community. US Ignite supports and encourages dockerization of applications as its main form of distributable between communities. There are a number of excellent resources available for learning Docker, and US Ignite continues to develop a set of related tutorials and use case videos (https://goo.gl/YFhHuV).

The community Technical Leader will provide guidance and help with creating distributables and making these available through the SGC application registry. US Ignite provides a DockerHub organization for the hosting of dockerized SGC applications (https://hub.docker.com/u/usignite/dashboard/).

Best practices with creating distributables are encouraged to provide adequate security, component isolation, application & data integrity, and to ease the sharing and installation of applications across SGCs.

CRITICAL BUG & SECURITY FIXES

When an application-breaking bug or important security flaw is discovered, it's best to move quickly to resolve this issue. In most cases this is best handled by the application development team. You can ease this process by publishing or linking to a set of best practices for bug reports and asking that users refer to it when reporting a bug. An excellent guide is published by Mozilla

on this topic (https://developer.mozilla.org/en-US/docs/Mozilla/QA/Bug_writing_guidelines) and can be used as reference. You should plan to give feedback on bug reports, including comments if the bug can't be confirmed or won't be fixed.

As part of the critical bug & security fix process, application developers should consider how best to provide application updates.

DEPLOYING APPLICATIONS

Application deployment strategies vary widely depending on the details of the specific application or service, but the goal should always be to use simplified, sustainable, and relocatable methods. Generally, each application is deployed using a distributable provided by the development team in consultation with the local TL. The application will be deployed to the local edge-computing cluster, then made available and promoted to the appropriate local user community. The local TL either directly deploys an application to the GENI rack, or works with an appropriate development team member to facilitate the deployment.

Most often SGCs will deploy to a GENI (http://www.geni.net/) rack hosted at a local anchor institution. When using GENI racks for deployments, community TLs should keep the following in mind:

- Each application should be deployed under its own GENI project to properly isolate environments
- Anyone deploying or maintaining the back end of an SGC Application will need a GENI account
    - Many existing institutional accounts will already work with GENI, so look for your organization on the login list or register for a free account (see below)
    - Free accounts for GENI can be requested from the GENI Project Office (GPO) (https://go.ncsa.illinois.edu/geni)
    - Accounts only need to be maintained by application team members doing work on the server (usually 1 or 2 people) and Technical Leaders
- Each application should be deployed under a unique GENI project
    - Projects should be requested through the GENI website or with the National Technical Leader who will help facilitate
    - GENI projects must have a globally unique name and should be namespaced by using the airport code of the primary regional airport for consistency and clarity (i.e. a project for the 4k Microscope in Chattanooga might be named "CHA-microscope")
    - The local Technical Leader and US Ignite National Technical Leader should be added to each GENI Project for SGC application deployments
- GENI lets projects run for a limited number of days by default. Long running projects, like SGC apps, must be issued a regular keep-alive via a script or by having a GENI admin mark a project as long running. Talk to the National Technical Leader about registering your SGC application as a long running project.

DIGITAL TOWN SQUARE

The Digital Town Square (DTS) provides a consistent gigabit experience from the local edge compute cluster to the end user and between local data-centers or other edge computing platforms, regardless of network provider. Near real-time latency is accomplished through local interconnect by establishing a local gigabit exchange point and configuring routers to keep local traffic local. Gigabit applications are hosted at regional edge compute clusters, like GENI, that offer ultra-low latency when combined with the local network routing across the DTS.

It has the following features:

- An edge compute cluster in the community, available to developers to incubate and deploy gigabit applications
- A local exchange point with fiber connections between all relevant local gigabit providers and any local edge-compute clusters used for application deployment
- Paths configured between local Autonomous Systems (AS) providing gigabit service in the community
- Configuration of edge routers between AS providers to route traffic for local prefixes across the local exchange to establish network peering between local systems
- Potential to develop a Software Defined Exchange at the local gigabit exchange point to allow for smart and configurable networks

Key activities of the DTS include:

- Establish a local gigabit network exchange point and effective policies for routing of local traffic through the DTS
- Establish access to and policies for the use of a local edge computing cluster for the deployment of gigabit applications
- Assist and advise gigabit application developers on the packaging and deployment of their apps and services to the DTS, and maintaining and improving currently deployed apps

DOCUMENTATION

Each project should provide adequate documentation to safely install, properly maintain, and manage applications they submit to the SGC registry. Links and references to this documentation will be provided in the SGC registry for reference. SGC application teams may provide their own documentation source or use the Wiki feature under a GitHub project as part of the US Ignite GitHub Organization. Required documentation should be separated into administrative, installation, and end-user documentation as appropriate.

EDGE COMPUTING

Edge computing resources are locally hosted compute clusters that provide the community direct access and control of the local application environment. They connect to the DTS through the local gigabit exchange point to enable ultra-low latency responses to the end user.

They connect to other Smart Gigabit Communities through national gigabit networks such as Internet2 (http://www.internet2.edu/) or state and regional optical R&E networks that connect to Internet2. Your academic partner will most likely already connect to such a network.

With the diversity of possible edge computing host environments, we recommend the use of containerization such as Docker (https://www.docker.com) where possible to enable wider sharing between communities by abstracting away from the underlying server architecture.

The most common edge computing platform used in SGCs is the GENI (http://www.geni.net) virtual laboratory for networking and distributed systems research, a network of interconnected platforms hosted at a number of universities nationwide and internationally. Typical scenarios for use are referenced in the "Deploying Applications" section below.

END-USER DOCUMENTATION

This covers documentation for users of the application or service and can include humans, devices or APIs connecting to the service. This should provide a clear understanding of what can and can't be done with the application from a consumer standpoint. Include any security or end user best practices and other information relevant for effectively getting users started using the application so other SGCs deploying it have a place to start with end user training.

If applicable you should also consider including information for users to troubleshoot problems on their own like FAQs or similar documentation. Additionally, you should include any information users should be aware of when using the application, like privacy concerns or effects on other devices, services, or other users in the system.

EXAMPLE OF BASIC DTS SCENARIO

The following illustrates the typical scenario facing communities implementing a DTS. Individual communities may vary on the details.

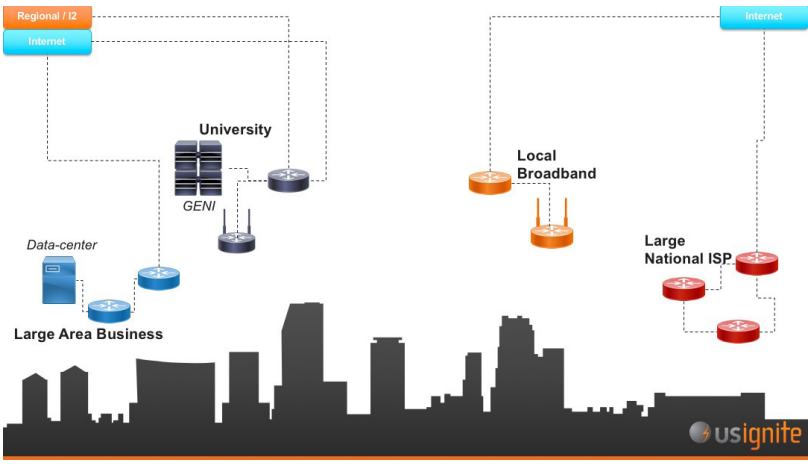


Figure 5

A common general scenario in most communities is expressed in **Figure 5**, and it may be familiar to you! A community might have a network provided by the local university or local industries, and they may have a local broadband provider or municipal providers, and also have some participation from large national broadband providers. Each might provide gigabit speeds on their network, but the experience of users on one network connecting to resources on another can vary widely based on the pathing and routes in place to connect those two networks. In some cases, it's possible for traffic between a client and a server that are only a few blocks from one another to travel hundreds of miles to an exchange point where the two network providers exchange traffic through peering or transit agreements.

The result is that latency for network connections can be higher than anticipated and can result in a high level of inconsistency in application response times based on pathing. Additionally, traffic may be subject to slow down due to inconsistency of speed in a path with many hops. For gigabit applications that depend on ultra-low latency response times this can be a barrier to implementation of cutting-edge transportation infrastructure, remote instrumentation, coordination of sensitive IoT arrays and more.

In **Figure 6** a gigabit switch is installed in the region with fiber connections made to each of the local area gigabit providers. This is establishing connections that can be configured to allow local network traffic peering in the region. Peering in this case refers to network peering and not transit/peering charges, the DTS is not intended to supersede existing transit and peering relationships.

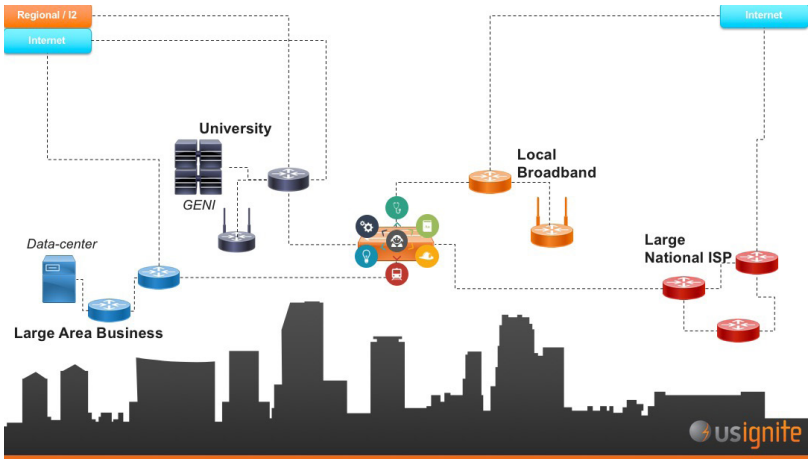


Figure 6

With a gigabit switch providing connections between local gigabit providers, traffic needs to be configured to route locally when going to a local IP. In **Figure 7** we see an example of an ideal network where the admins of edge routers at each of the providers configures an AS path to the other providers in the region and allow them to accept BGP configuration messages from each of them. Each provider then broadcasts a BGP configuration that includes IP prefixes that should be routed locally across the DTS switch. This sets up other providers to route local traffic locally and provides graceful failover if the switch fails by automatically tearing down the local BGP route and re-routing over the normal routes that existed prior to the DTS setup.

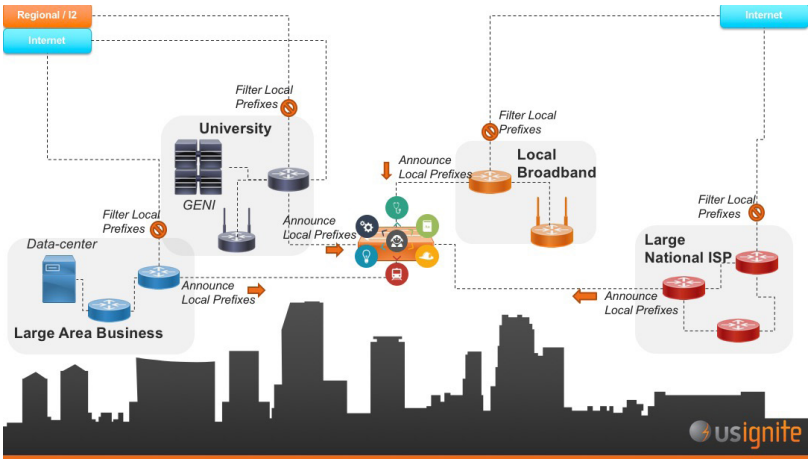


Figure 7

INSTALLATION & CONFIGURATION

This includes information about requirements for the application environment, networking, ways and options to configure the application, dependencies, and more. The more explicit this documentation can be, the better! This is particularly true when it comes to distinguishing between a requirement and a recommendation. Examples are an effective means for many administrators so consider providing short examples of command or configuration in the documentation, or including example files with the installation package as appropriate. Networking information should include required settings as well as any recommendations on security or other best practices. If you can include explicit listing of ports that need to be open, this can help administrators configure firewalls and Docker containers more effectively.

It's important to include any basic procedures for troubleshooting problems on the back end of the application. Additionally, documentation about important backup and restoration processes should be included.

LICENSING INFORMATION

Each project must include clear information about acceptable use policy, licensing, and any other documentation to ensure other SGCs are aware of and can comply with important intellectual property restrictions. This should include any information about third party dependencies used in the project and any other information that would be needed to properly operate a deployment or connection to the service. Open source licenses are commonly used in many instances, but it is important to consider which open source license is right for your project.

Many open source licenses vary considerably as to whether they allow modification of code or use in commercial projects. Attribution requirements, and restrictions on what licenses are acceptable for other third-party dependencies, can also vary. If you choose an open source license, it is important to choose the right one for your project and intended use cases.

GitHub maintains an excellent resource for comparing and choosing an open source license at http://choosealicense.com with some of the most common open source licenses used. Among them are:

- Apache 2 License (http://www.apache.org/licenses/LICENSE-2.0)
- MIT License (https://opensource.org/licenses/MIT)
- GPL v3 (https://www.gnu.org/licenses/gpl-3.0.en.html)
- Be sure to read and understand this before selecting it as there are a number of important details about the license of dependencies

A more extensive list of options for open source licenses is maintain at https://opensource.org/licenses.

If you maintain a proprietary license on software or services provided to the SGC project, US Ignite provides options for private GitHub and DockerHub hosting that restrict access to Technical Leaders of SGC communities. In the case of closed licensing it is very important to include the acceptable use terms and any other information that enables acceptable use under the SGC terms and properly protects your intellectual property.

Be aware that documentation may benefit from a license as well. Among the options available, the Creative Commons license (https://creativecommons.org) is flexible and covers a number of options for sharing and reuse.

LOCAL EXCHANGE POINT

A key concept of the DTS is that local traffic says local, meaning that if a request originates in the region and is bound for a service in the region (such as the edge compute cluster), it takes a short path and does not leave the local gigabit network. A common problem this overcomes is when a request originates on a different network carrier than a service, even if the two are physically close, the request may travel a long distance out of the area to a hub where network traffic is exchanged between providers. The result is unexpectedly or unpredictably high latency, which is exacerbated if services require multiple requests to satisfy a service call. Establishing a local exchange point that connects all the regional gigabit providers creates an environment of short and consistent routing in the region and enables local carriers to establish network peering for ultra-low latency responses.

It should be noted that the term peering refers to networking traffic and the DTS is not intended to supersede existing peering or transit relationships.

LOCAL TRAFFIC ROUTING

Network traffic peering in each SGC is a critical component to enabling ultra-low latency applications. There are several ways this can be achieved, but the most common method uses Border Gateway Protocol (BGP) to route traffic between local providers across the local exchange point. Once a local exchange point is available, admins from each of the participating networks should configure paths between relevant Autonomous Systems (AS) in the network and configure the edge routers to accept BGP messages from each other. Each admin then configures a BGP message that includes IP prefixes to be routed locally and broadcast to the other AS routers. This should include a directive to filter out these rules upstream so as to avoid routing table bloat outside of the region.

SHARING APPLICATIONS

US Ignite maintains an application registry that enables SGCs to promote gigabit applications they have developed and to discover applications developed in partner SGCs to deploy or use in their own community. The searchable registry will offer information about an application, information on recent updates, information on how to install and configure the application, links to distributable or source as appropriate and more. Each community creating an SGC application will be responsible for creating and maintaining an application profile through the local Technical Leader.

Support for the creation of a distributable and the creation of documentation and training will be available either in the community or directly from US Ignite. Talk to the community Technical Leader and the National Technical Leader to get the most recent copy of the requirements to apply for a US Ignite SGC Application Sharing Award.

Community Technical Leaders should work with each development team to ensure the distributable or service adheres to accepted common best practices for the framework and is reasonably shareable between community.

Key Activities:

- Work with gigabit application developers to create a plan for sharing and supporting their application with other SGC communities. US Ignite may provide support for application sharing through an application sharing fund.
- Work with gigabit application developers to develop a simple packaging and distribution strategy that supports deployment to SGC cities
- Work with US Ignite to update application information in the US Ignite application registry
- Work with gigabit application developers to create appropriate documentation, support and sustainability mechanisms that facilitate the deployment of the application or service to other SGC communities
- Work with other SGC communities interested in deploying locally developed applications to install it in their environment and explore further possibilities for collaboration or development of further features for the application

END-USER SUPPORT

The local Technical Leader should work with the application developers during deployment to determine how best to provide local end-user support. Links out to documentations, FAQs, and other supporting material can be beneficial, as can user groups and communities. In most cases, the specifics of this type of support will be worked out as part of the application sharing process, and should be addressed with mechanisms for seeking help clearly communicated to potential end users.

Consider employing:

- Issue Tracker (GitHub)
- Email lists or Google Groups with some understood method for replying to users
- Separate mechanisms for end user support requests and critical security fixes and flaws
- Feedback mechanisms to users requesting support, defining, and reaching a clear understanding of who is responsible for replying to what kinds of requests
- User groups for community-based support and development of best practices
- Documented potential workarounds and remediating steps if applicable until critical fixes can be deployed

SOURCE CODE CONTROL

US Ignite does not require the submission of original source code as part of being an SGC application, but there are significant advantages to consider about proper source control as it relates to SGC applications. US Ignite maintains a GitHub organization (https://github.com/us-ignite-sgc) as a resource for SGC projects that want to use it for source control or documentation. Though we encourage openness, projects may be either public or private as dictated by the needs of the project. For access and information about this option, please contact the US Ignite National Technical Leader.

TECHNICAL ADVISORY GROUP

Setting up a sustainable environment that promotes the development of innovative applications and provides the backbone needed to deliver them is a broad effort. In order to reach area developers who could develop applications and network engineers who can improve and provide advanced networks, a deep push into the local technical community is extremely useful. Maintaining a regular open dialog with various branches of the local IT community is vital for developing a robust application pipeline and for managing regional network environments efficiently.

The formation of an effective core group of advisors, drawn from key players in the local technical community can be an excellent resource for an SGC to increase its reach with local developers and respond effectively to local networking infrastructure needs.

The Local Technical Leader should consider the following:

- Creating an informal advisory group from key regional technical professionals, presenting the SGC goals for the DTS and gigabit applications, and getting critical feedback to form a regional strategy
- Group membership is most effective when it is diverse but not too large. Consider targeting a group of 4 to 10 that represent a cross-section of the major stake holders and participants in the SGC initiative. This might include:
- Network Engineering Leaders from anchor institutions, local carriers, or regional members of national carriers
    - CS Faculty with a history of or actively developing gigabit applications
    - IT Leaders/Movers from local start-up groups, hacktivist organizations, etc.
    - Lead Networking Engineers from local carrier hotels or exchange point hosts
    - Local Leaders from groups that support IT education or diversity in the region such as Code for America, Mozilla, Electronic Frontiers Foundation, etc.
- Leverage group members reach into the community to engage developer communities
- Leverage institutional knowledge of group members to identify strategies for building out the DTS

TECHNICAL COMMUNITY MANAGEMENT

At the heart of Smart Gigabit Communities are the application developers and networks that make them possible.

PART 4: HOW TO GENERATE GIGABIT APPLICATIONS

As soon as possible, your community should begin discussions related to potential applications that would be both beneficial to your community and practical to develop and deploy. In most cases, this discussion could be part of the agenda for the SGC Steering Committee's very first meeting/call.

The SGC Steering Committee should first identify their community's challenges and interests in national priority areas (list national priority areas) to facilitate the development of impactful gigabit application solutions.

- SGCs should think through the following general guidelines when brainstorming gigabit application ideas:
    - What are challenges that are facing my community? [Note: Generally, gigabit application themes should be selected based on your community's needs and national priorities]
    - Who will use the application?
    - Who can develop the application? Where would the user engage with the application (i.e., university, library, school, home, etc.)?
    - What will be the main application specifications?
    - Is there a similar application that already exists in some form within my community, another SGC, or the US Ignite apps index?
    - How much work is needed to create the application? Is creation of the application feasible?
    - Is the application scalable within the community and with other cities and SGCs?
- Further, gigabit applications should have one or more of the following attributes (also see Technical Best Practices Section):
    - Require very low latency (e.g., real time applications)
    - Require very high throughput (e.g., Big Data to the end-user)
    - Involve interactions with "cyber-physical systems" (i.e., the Internet of Things)
    - Require software-defined networking capabilities

Here are a few examples of exciting applications that our SGCs have developed:

- **Education:** Students in Chattanooga are experiencing biology and STEM like never before. Professors at the University of Southern California place live biological specimens under a Digital Cinema Microscope and capture ultra-high resolution (4K) movies of the microorganisms while simultaneously transmitting live, HD images from the microscope to a STEM class via a low-latency gigabit network. Students can view images, manipulate the microscope, and interact with world-class professors and curriculum from 2,000 miles away.

(Continued)

- **Workforce Development:** Kvasir-VR provides the benefits of expert instruction and virtual field trips to potential job sites for students who cannot visit in person. The platform livestreams a 3D teacher into the VR views of students and then integrates the stream with deployable classroom VR stations. Hundreds of students in Lafayette, LA have been educated about the basic concepts of solar energy production through deployment of the project. Numerous other educational and training applications are also possible through the platform.
- **Health:** One application offers patients the opportunity to receive physical therapy in the home with more frequent assessment and adjustment of prescribed exercises, resulting in more effective rehabilitation and health outcomes. The interactive interface leverages Google Fiber grade high-speed networking and low-latency network paths.
- **Other Videos:** Please refer to the videos from our US Ignite Application Examples to check out more gigabit applications that have been deployed or are in the deployment phase

There are a number of ways that your community can generate and/or identify transformative gigabit applications and application ideas.

- Create applications from an existing app (US Ignite app index, SGC apps)
- Ideate and create new applications
- Host hackathons, prize challenges, and reverse pitch events (please see Part 5: SGC Ongoing Activities for more information)

APPLICATION DEVELOPMENT

- **Refinement:** Once a list of application interest areas/ideas is generated, US Ignite can help to further ideate, review, refine, and provide feedback to the list, especially on how to craft gigabit-specific solutions. It is critical that application developers or potential application developers are involved in this process. US Ignite can also help your community develop milestones, timelines, and budgets for potential SGC applications. Feel free to ask your fellow SGCs for their input as well!
- **Finalize:** In most cases, before an SGC application can actually be created, software development resources for the project will need to be identified. To the greatest extent possible, your community should seek to engage local partners from industry and academia and developers identified from events such as meetups, hackathons, and reverse pitches before seeking to raise money to cover software development costs.
- **Funding:** Check out the next section to learn more about funding opportunities that may be available for your SGC community

APPLICATION FUNDING SOURCES

Your community should seek project funding from local, federal, state, and foundation sources for your most robust gigabit application ideas. The style of your project's funding may vary:

Self-Funded: Your city/county's operating budget may have the budget to develop and deploy a gigabit application.

Federally-Funded: Funding for application ideas advancing broadband is available through a number of agencies across the federal government. When reviewing the funding sources provided by the federal government, one should pay close attention to the purpose of each program, potential restrictions on funding, and rules for eligibility.

- **Grants.Gov:** As a first stop, US Ignite recommends checking out www.grants.gov, which is the federal government's central funding portal—this site provides information on all federal grant programs
- **The Catalog of Federal Domestic Assistance (CFDA):** The CFDA is another source of information about federal assistance programs
- **Federal Agency Websites:** Your community may have a gigabit application idea that's focused within a particular area of national priority, such as Education & Workforce, Energy, Health, Public Safety, Transportation, or Advanced Manufacturing. If this is the case, you may want to explore partnerships and/or grant funding opportunities with specific federal agencies, including:
  - **The National Science Foundation**
    - *Example grant programs:* Smart and Connected Communities, Advancing Informal STEM Learning, Improving Undergraduate STEM Education, Smart and Autonomous Systems, Smart and Connected Health
  - **Institute of Museum and Library Services**
    - *Example grant programs:* National Leadership Grants for Museums, National Leadership Grants for Libraries, Laura Bush 21st Century Librarian Program
  - **United States Department of Agriculture**
    - *Example grant programs: Community Connect Grants, The Distance Learning and Telemedicine (DLT) Grant Program*
  - **Department of Commerce**
    - *Example grant programs: Economic Development Administration, Economic Development Assistance Programs*
  - **Environmental Protection Agency**
    - *Example grant programs: Smart City Air Challenge*

For current federal funding opportunities, please visit US Ignite's list of Current Funding Opportunities, including Smart and Connect Communities, NSF Smart Health Grants, and Smart and Autonomous Systems.

State or Local Government Funded: Funding for gigabit application ideas may be available through your state or local government. For example, the State of Maryland has the Governor's Grants Office, which helps Maryland state agencies, local governments, and nonprofit organizations find, win, and manage grants. US Ignite can help direct you.

Foundations: Foundations are a virtual resource to search for funding opportunities that may be applicable to your gigabit application idea. The below list, though not exhaustive, provides a good starting point for you to search for foundation grant opportunities:

- The Rockefeller Foundation
- W.K. Kellogg Foundation
- Aetna Foundation
- American Library Association
- Andrew Mellon Foundation
- Ausherman Family Foundation
- Honda Foundation
- Lockheed Martin Corporation
- MacArthur Foundation
- NASDAQ Educational Foundation
- MacArthur Foundation
- Chase Foundation
- Ford Foundation
- Bloomberg Philanthropies
- Knight Foundation
- Alfred Sloan Foundation
- Bill and Melinda Gates Foundation
- HP Foundation
- Cisco Foundation
- RGK Foundation
- Annenberg Foundation

Other Funding Mechanisms:

- Non-Profits
- Public-Private Partnerships
- Local Corporations

US Ignite SGC Newsletter: US Ignite publishes a newsletter of funding opportunities available from the Federal Government, foundations, and other sources specifically for our SGC communities. Please sign up for the newsletter here.

APPLICATION SHARING

One of the benefits of being a part of the SGC project is sharing applications with other SGCs. Communities are strongly encouraged to develop their applications to be sharable through the Digital Town Square with other SGCs (link dockerizing, technical info). Your community will also have access to many of the gigabit applications developed by other SGCs.

GIGABIT APPLICATION GENERATOR

Trying to think of a gigabit application idea? Use our online idea generator to help spark your creativity!

PART 5: SGC ONGOING ACTIVITIES

There will be many concurrent activities that are occurring during the first few formative months of becoming a SGC—typically, these activities should continue throughout the life of your community's SGC status. US Ignite will continue to add information to this section, as ongoing activities should continue to build month by month.

Community Support: This is central to your community's success, as community support will provide additional momentum to your SGC efforts. Your SGC should:

- Connect to local foundations and build partnerships (it is crucial to involve others)
- Develop overall strategic Smart Community goals or plans with local municipal governments
- Ensure that messaging regarding SGC/Smart Community efforts are unified and consistent
- Utilize local conduits, such as local media, local politicians, schools, and libraries to get your community's public excited about your SGC's Smart Community goals and the benefits that being an SGC will bring to the community
- Have an active presence in whatever social media is most convenient to your SGC to inform the public of your community's SGC initiatives
- Organize local developer groups to support and sustain smart gigabit community infrastructure and applications
- Organize entrepreneurial events with local foundations, incubators, accelerators, and investors for developers and entrepreneurs
- Promote podcasts and local media on community features
- Develop a Smart Gigabit Innovation Playbook for your community for best practices on creating a sustainable smart gigabit ecosystem

Remember: uneven buy-in across the region can be a major roadblock to a community's success. In some communities, earning public buy-in may require shaping or changing local mindsets.

Application Developer and Entrepreneur Community Development: It is crucial to engage the application developer network within your community. The following are a few ideas of ways to engage local developers and entrepreneurs:

- Hold local gigabit meetups and contests for application ideas and application development
- Sponsor hackathons and focus on prizes in key areas
    - Grants/prizes can be provided to application teams to document and support application development to enable other communities to use the application

- The Kansas City Hackathon and Hack Kansas City are examples of successful hackathons. The following sites provide some great guidelines to consider when planning hackathons:
    - 8 best practices for running a successful hackathon
    - Hackathon Best Practices Guide
    - Lessons Learned and Best Practices
    - AT&T Hackathon Best Practices

- Reverse Pitch: In a Reverse Pitch, proposers (sponsors located by and coached by the Steering Committee) pitch a problem to community entrepreneurs and developers to ask them to develop solutions. Usually, the proposer suggests both the problem and also provides local funds to encourage local teams to find solutions. Community entrepreneurs and developers are given a deadline to develop application ideas and submit those ideas to the proposers. Often, there is some kind of incentive provided to the problem community members/implementers, such as money or prizes. Launch Tennessee and Kansas City Reverse Pitch are both examples of successful reverse pitches.
- Prize Challenges: A prize challenge is an open innovation tool used to pose a specific problem or ask a specific question, and crowdsource the solution. An award is offered to the participant who best solves it. Prize challenges have an established record of spurring innovation in the private and philanthropic sectors.
- Provide training for local developers and entrepreneurs to use Digital Town Square facilities.

Collaborative Opportunities: US Ignite serves as a resource to help identify national-level partnerships.

- Work with other SGC cities to engage in cross-community activities, share best practices, promote better uses of the SGC project as a community, and create lasting relationships and interoperability with each other
- Utilize tools to communicate with US Ignite and other US Ignite SGCs: Frequent and robust communications with US Ignite sets the stage for a successful, more collaborative partnership
- Frequent email interaction
- Slack: US Ignite has a Slack community available for the greater US Ignite community at https://us-ignite.slack.com. Anyone with a us-ignite.org email can join. Invitations to anyone else can be generated by members.

- Conference Calls (ad-hoc and regularly scheduled)
  - One-on-One conference call with US Ignite
  - Monthly conference call with all communities
  - Monthly meetings of your application developers
  - Typically monthly meetings of your Steering Committee
- Reports
  - Brief monthly report
  - Ad-hoc reports
- SGC Team Member Visits
- US Ignite Events

PART 6: REVERSE PITCHES

WHAT IS A REVERSE PITCH?

In a Reverse Pitch, proposers, such as your community and local businesses, pitch a problem to local entrepreneurs, hackers, makers, developers, and other creative minds to ask them to develop innovative solutions, including gigabit application ideas. Ideally, the organization doing the pitching has a stake in the solution of the problem and provides (a) the problem to be solved with any context necessary, (b) monetary or other incentives to solve the problem, and (c) an ongoing interest in using or licensing the winning solution. Often, there is an incentive provided to the winner(s), such as money or prizes. Reverse Pitches can establish your community members as thought leaders and community mobilizers, and create a platform to develop relationships which can contribute to a healthy, flourishing gigabit application ecosystem.

Reverse Pitches provide community entrepreneurs and developers the opportunity to collaborate on groundbreaking work that fosters development of next-generation gigabit applications to impact communities across the world. Hosting a Reverse Pitch within your community will encourage new local investment and partnerships to leverage US Ignite investments in your local innovation ecosystem.

In summary, holding a Reverse Pitch within your community will help to:

- Encourage new local investments and partnerships in the local innovation ecosystem
- Engage more companies and developers in the gigabit application creation process
- Meet core local company needs with gigabit applications and services
- Support the local entrepreneurial community

REVERSE PITCH BEST PRACTICES

From Arizona to Texas to North Carolina, US Ignite has co-hosted and sponsored eight Reverse Pitch events for technologists and entrepreneurs, as detailed above. Based on US Ignite's expertise in this field, we wanted to share some best practices, gathered from observations and experiences of Reverse Pitch Events.

COMMUNITY ENGAGEMENT

- Engage the community early and often. The Steering Committee can tap into existing networks, such as Meetup and Facebook, and can leverage partners and other sponsors to spread the word and make use of their networks. You can also utilize listservs and incubator mailing list—an example includes StartupDigest.
- Contact potential developers from many different backgrounds—this includes academia, meetups, tech companies, and the entrepreneur ecosystem. Remember that you can further diversify your potential developer pool by reaching out to neighboring cities and your fellow SGC communities.
- Use a variety of communication channels (i.e., social media and the local media) to communicate with developers in order to build and foster a gigabit application environment. Your community's Reverse Pitch website should be well-functioning and provide frequent updates to stakeholders.

- Interview developers and other key stakeholders pre-and-post Reverse Pitch to gather personal experiences to tell a story via a series of blog posts. These blog posts can aim to showcase the developers and their talents.
- Coordinate a solid, consistent communications strategy across all partners in order to reach the right audience.
- Record the Reverse Pitch Kick-Off Event and Finale Event and make the recording available to interested stakeholders via your website

SPONSORS, PARTNERS, AND PRIZE INCENTIVES

- Reach out to potential project sponsors—both obvious and non-obvious partners. Monetary contributions from sponsors can help cover the costs of the event, lead to branding opportunities, and expand exposure to the event. For a few of our SGC cities, city governments have played an instrumental role in the Reverse Pitches.
- Provide both cash and in-kind incentives to Reverse Pitch winners, and attempt to match these contributions as much as possible by leveraging local partners. Additionally, in-kind incentives, such as equipment, memberships, and credits will further entice the local developer population to participate in your Reverse Pitch.
- Leverage the assets of your sponsors as much as possible. Many of our Reverse Pitch communities found that it worked well to have sponsors interfacing directly with the developers.
- Define Intellectual Property (IP) attributes with all of the sponsors
- Assign each member of the Steering Committee a specific task for the Reverse Pitch—task categories may include media, marketing, schedule management, venue selection, and partnership and stakeholder management

SCOPE AND STRUCTURE

- Create a roadmap for success and meet with the Steering Committee to consider the following questions:
    - Should our community run a Reverse Pitch?
    - Does our community have enough developers in place for such an event?
    - Can clear problems be identified, and does our community have the right resources in place?
    - Does our organization have prizes and incentives to offer the winning developers?
    - Can the community solve the problem?
    - Will the solution(s) be supported by the community?
    - Will the community use the developed application?

- Piggyback on complementary events and groups that are leading innovative-related initiatives, such as university hackathons, developer meetups, and local accelerator events. The motives and missions of the Reverse Pitch and these groups/events complement each other.
- Focus on one or two topic areas to better present "problems" that your community and its residents are trying to solve. In most cases, you may want to narrow the "theme/problem" of the Reverse Pitch to a specific topic. In a few cases, you may wish to keep the "theme/problem" of the Reverse Pitch open.
- Turn to local residents to help identify potential problems/areas of improvement within the community.
- Offer a structured Reverse Pitch competition that gives participants structure, access to mentorship, and time to develop their applications and application business plans. We recommend hosting an initial kick-off event followed by a period of time between five weeks to a few months for developers to create their gigabit solutions.
- Provide prizes (both cash and in-kind) to winning developers partially upfront and then via installments corresponding to key milestone delivery.
- Engage speakers to participate in the event as keynote speakers—keynote speakers may include US Ignite personnel, leaders from the corporate community, and leaders from the civic community, just to name a few.
- Develop a timeline for the entire lifecycle of the Reverse Pitch—this timeline should include structured check-in points with developers along the course of the Reverse Pitch. Ideally, your community and sponsors will develop a timeline of required deliverables for developers to hold them accountable for developing gigabit applications.
- Leverage your access to valuable local resources such as accelerators and incubators.

DETAILED REVERSE PITCH PLANNING

Preparations for the Reverse Pitch

Below are a few key points to keep in mind when preparing for your Reverse Pitch event:

- **Engaging Your Steering Committee:** Your Steering Committee is an invaluable asset—members should be leveraged to manage the entire Reverse Pitch process. Ideally, each member of the Steering Committee should be assigned to lead a particular task for the Reverse Pitch.
- **Engaging Reverse Pitch Groups:** You should engage various groups/organizations to help you organize the event and provide guidance.
- **Tapping into Local Corporations:** Local organizations have a wealth of talent and cash/in-kind resources that can be contributed to the Reverse Pitch event. Once you determine the objectives of the Reverse Pitch (i.e., the "theme/problem"), reach out to local corporations/businesses that may have a vested interest in participation.
- **Defining the Objectives of the Reverse Pitch:** The Steering Committee should work to define the Reverse Pitch objectives and define what success of the Reverse Pitch means to the Steering Committee. In most cases, you may want to narrow the "theme/problem" of

the Reverse Pitch to a specific topic that is sponsored by a single organization or multiple organizations that "own" the problem. The Steering Committee should work with pitchers and US Ignite to define problems in a relatable way that can be solved by gigabit solutions. For additional details regarding defining, exploring, and understanding the objectives of your Reverse Pitch, please be sure to check out Challenges 101 : How to Run Your Own Incentive Competition.

- **Reaching Potential Participants:** The Steering Committee should look for talented individuals with background and diversified interests, including technology, entrepreneurship, design, coding, communication, and education to attend the Reverse Pitch. The Steering Committee can tap into existing networks, listservs, and incubator lists, such as Meetup, Facebook, and StartupDigest, and can leverage partners and other sponsors to spread the word and make use of their networks. Remember, it is in everyone's best interest to have the widest audience possible—don't forget to use the local media to help spread the word!
- **Marketing to Potential Participants:** Don't forget to market to potential participants—this includes students and influencers who can spread the word (social media and word-of-mouth).
- **Considering the Budget:** The Steering Committee should define the budget size and allocate budgeted funds towards specific Reverse Pitch activities, such as prize funds, marketing/media, venue costs, and day of logistics (supplies, electronics, refreshments, etc.).
- **Engaging Outside Pitch Experts:** Consider engaging Reverse Pitch or Hackathon experts within your community or from the 20+ network of SGC communities.
- **Locking Down a Venue:** Depending on your community's budget and venue availability, your venue could be a K-12 school, a hotel, a museum, a corporate venue, or a university, just to name a few options.
- **Picking a Date:** Select dates for the initial Reverse Pitch, as well as the gathering of the selected Reverse Pitch finalists (anywhere from five weeks to a few months after the initial Reverse Pitch). We recommend that you co-locate with other events within your community to increase attendance, and hold the event while semester is in session to reach students.
- **Securing Partnerships:** As noted above, having a broad range of partners and sponsors is crucial for the success of your Reverse Pitch. Monetary contributions from a sponsor can help cover the costs of the event, lead to branding opportunities, and expand exposure to the event.
- **Creating a Website:** Make sure there is a website that stakeholders can visit to learn more about the event and share with prospective participants. Ideally, participants should be able to sign-up for the Reverse Pitch competition online.
- **Defining the Scoring and Evaluation System:** The Steering Committee should establish an objective Scoring and Evaluation system for assessing each of the pitches. Ideally, the Steering Committee will create a checklist with a scoring system linked to the event's objectives and priorities. Scoring metrics may include: business viability, sustainability, economic impact, social impact, and/or pitch quality.
- **Identifying Judges:** In addition to the Steering Committee, it is best to have a panel of judges that are independent from the planning logistics of the Reverse Pitch. US Ignite representatives would be thrilled to participate as judges in your upcoming Reverse Pitch.
- **Determining Day-of Roles:** The Steering Committee should establish (verbally and in writing) "who will be taking care of what" on the day of the Reverse Pitch.

REVERSE PITCH – THE DAY-OF

- **Providing Food:** Providing food and light refreshments (i.e., pizza, food trucks, catering etc.) to Reverse Pitch participants is necessary. Remember to ask participants to note any special dietary needs.
- **Sending Reminders and Connecting with Media:** The night prior to the Reverse Pitch event (or the day of), remember to send reminder emails regarding logistics for the event. Also be sure to connect with media regarding an event press release, as well as media coverage of the event.
- **Engaging the Public:** Remember to engage both your audience and the public. This includes social media updates and webcasting. Be sure to let your stakeholders and the public know of the next steps after the initial Reverse Pitch Event occurs. Be sure to take photos as well!

REVERSE PITCH – AFTER THE INITIAL PITCHES

- **Conducting After-Pitch Discussions:** For companies or organizations with problems pitched that include proprietary information, plan follow-up one-on-one calls with those pitchers and those proposing a solution
- **Making Finalist Selections:** As soon as all pitches have been presented, the Steering Committee and judges should decide on Reverse Pitch finalists
- **Selecting the Winner:** Anytime from five weeks to a few months after the initial Reverse Pitch event, the finalists will pitch their ideas to the Steering Committee, the panel of judges, and the community.
- **Announcing the Winner:** Selecting the winning application(s) is the culmination of months of hard work and collaboration! Make sure to announce the winning application(s) in a public way.
- **Sharing the Story:** Your community should share the adventure of creating the Reverse Pitch and create a story that can be shared with the broader community. Make sure to record the kick-off of the Reverse Pitch Event, as well as the finale event, and share these recordings on the Reverse Pitch webpage and social media accounts.

OTHER RESOURCES

- Health and Human Services Department: My Air, My Health challenged participants to design a system to measure both air pollution and related health effects
- City of New York: NYC BigApps awarded participants up to $25,000 to develop technology products that address civic challenges
- Launch Tennessee
- [Re]Verse Pitch Competition
- Entrepreneurship Upside Down: What If You Start With What You Have?
- Challenges 101 : How to Run Your Own Incentive Competition
- Federal Prize Authority: Fiscal Year 2016 Progress Report

RESULTS FROM US IGNITE 2017 REVERSE PITCHES

To learn more about the Reverse Pitch Competition events held in the last year, please visit: https://www.us-ignite.org/smart-gigabit-communities/reverse-pitch. Winning applications from US Ignite's 2017 Reverse Pitch competitions, among nearly a dozen winning gigabit applications, included an application that provides key features for sharing educational virtual reality experiences, an application that uses virtual reality to train emergency service providers for large-scale disasters, an application that makes it easy to find parking in crowded areas, and an application to teach middle schoolers how to use the programming language Python.

In October 2017, US Ignite announced the commencement of the 2018 Smart Gigabit Communities Reverse Pitch Competitions. For more information, please visit the announcement here. The 2018 Reverse Pitch events were held from December 2017 through May 2018 – US Ignite is thrilled to collaborate with SGCs and stakeholders to ideate and develop gigabit applications that provide transformative public benefits.

Please see the community summaries below for highlights and key takeaways from the eight Reverse Pitch events that occurred in 2017.

NORTH CAROLINA–NCNGN

The New City Ventures and RIoT organizations co-hosted Reverse Pitch events throughout North Carolina on February 28, 2017 to launch North Carolina's Reverse Pitch for Smart City Gigabit Applications competition. This event, produced with the support and partnership of US Ignite, NC Next Generation Networks, and North Carolina State, took place in Greensboro at HQ Greensboro and was simulcast to audiences in Charlotte and Raleigh.

This Reverse Pitch challenged the most innovative and creative engineers, entrepreneurs, developers, designers, data scientists, coders, and civic hackers to develop ideas for a chance to win one of two $19,000 prizes. Other prizes included over $120K in IBM Watson IoT/Bluemix Cloud Credits.

The two winning gigabit applications from this Reverse Pitch were:

- **Virtual Reality:** A shared virtual reality application where multiple people can learn from, analyze, and annotate 360-degree video
- **Dropark, An Innovative Approach Towards Smart Parking:** An application that enables parking through real-time mobile application

For more information, please visit:

- Ignite NC Facebook Page
- Reverse Pitch Site

Photo Credit: Duke Today

AUSTIN

The City of Austin's GigaTECHs Application Competition encouraged the ideation and development of next-generation gigabit internet applications that provide transformative public benefit. The GigaTECHs Competition is made possible through a collaboration among the City of Austin's Communications and Technology Management Department, the Office of Innovation, and the Telecommunications and Regulatory Affairs Department.

The competition kicked off in early June at the ATX Hack for Change, and received 26 outstanding entries. Round 1 judges picked 11 finalists from among the 26 entries, and then selected the two winning applications in August 2017. The competition awarded $38,000 in seed funding to support the development of two next-generation applications focused on opportunities in local transportation, education, clean energy, health, and public safety.

The two winning gigabit applications from this Reverse Pitch were:

- **Just In Time VR:** Just In Time VR uses virtual reality to train emergency service providers for large-scale disasters
- **Kiwi Compute:** Kiwi Compute is a free application to teach middle schoolers how to use the programming language Python

For more information, please visit:

- HeroX
- Austin offers $38K for civic-minded app developers
- The City Of Austin's GigaTECHs App Competition
- San Marcos team Just in Time VR wins GigaTECH app competition

Photo Credit: AustinGO2.0 @atxgo

RICHARDSON

The Richardson, Texas SGC community, in partnership with US Ignite, hosted a Reverse Pitch event for application developers from the Richardson/Dallas-Fort Worth local high-tech ecosystem. This event was designed to present software developers with a challenge to develop two gigabit applications that will provide advanced technology solutions to issues faced by the community. A total of $20,000 in cash prizes was made available to the top two developers/development teams that can come up with applications ideas that utilize gigabit bandwidth and/or require extremely low latency.

The competition kicked-off on February 24, 2017 and included presentations from US Ignite National Technical Leader Scott Turnbull, President of iWire365, and Richardson Technical Leader Gi Vania. Later, judges reviewed proposals and business plans submitted by participants by the March 31, 2017 deadline.

The two winning gigabit applications from this Reverse Pitch were:

- **Security on Poles:** Security on the Poles uses smart LED-powered street lights equipped with HD cameras, microphones, and sensors to monitor UTD parking lots for safety and parking space availability as well as campus streets for congestion. The system provides driver exit and entrance alternatives via smart phones and license plate tracking.
- **Emotive Virtual Patient (EVP):** EVP is an augmented-reality application for training nurses and healthcare workers using the Microsoft HoloLens viewer and an "emotive virtual reality patient" with complex natural-language conversation paths that accurately represent the emotions, unique cultures, and overall behavior patterns of real-life patients for training healthcare professionals on patient interaction and diagnosis

Photo Credit: Dallas Innovates

For more information, please visit:

- Reverse Pitch yields winning innovative projects to power smart cities
- Richardson Community US Ignite Initiative Smart Gigabit Community Application Challenge

CHATTANOOGA

The Chattanooga Reverse Pitch event, held on February 15, 2017, was an opportunity for professional developers to hear more details about the background and framework for proposed next-generation application topics from event program sponsors. Sponsors and partners of the Reverse Pitch included The Enterprise Center, US Ignite, CO.LAB, Electric Power Board of Chattanooga (EPB), Chattanooga Public Library, and Mozilla. The proposed next-generation application topics included transmission of encrypted telehealth services and data, navigation of the complexities of available linear and Over-the-top content packages, and creation of an accessible interface and documentation for users of LOLA software.

The winning gigabit application from this Reverse Pitch was LOLA for All. LOLA, an open source Low Latency audio and video conferencing technology that enables real-time, simultaneous, live musical performances across long distances, is emerging as an exciting opportunity for schools and libraries to fully leverage their advanced high-speed connectivity. This technology allows students to greatly expand their musical horizons and community members to share their unique musical talents with the rest of the world. The project itself creates an easily installable node for organizations to lower the bar for schools and other adopters to implement a LOLA project of their own.

For more information, please visit:

- EPB, Chattanooga Public Library seek help to tap super-fast Internet
- Reverse Pitch
- Chattanooga hosting "Reverse Pitch" focused on gigabit applications

LAFAYETTE

Cajun Code Fest is an annual coding competition open to all students and professionals with knowledge in software development and technology innovation. In 2017, teams had 24+ hours to develop a Smart Communities application with civic data provided by Lafayette Consolidated Government. Cajun Code Fest 5.0 was held from March 29-April 1, 2017.

The Cajun Code Fest provided participants access to Lafayette Parish datasets and other federal data sources to create applications and tools that will ignite the Lafayette Smart Community. Teams had a chance to win over $10,000 in cash and prizes.

Cajun Code Fest 5.0 Summit Speakers included US Ignite's Community Leader Nishal Mohan; Andrew Rodgers from The Enterprise Center in Chattanooga; Jenn Beard, Gigabit Fund Manager, Mozilla Foundation; and Joel Robideaux, Mayor-President, Lafayette Consolidated Government.

The Cajun Code Fest 5.0 awarded cash and prizes for the following:

- **Popping and Locking the Stack:** First Place
- **Thrive or Die:** Runner-Up and Team Favorite
- **Band of Squanchers:** Best Student Team (College)
- **David Thibodeaux STEM Magnet Academy Coding Krewe:** Best Student Team (K-12)

Photo Credit: Cajun Code Fest

For more information, please visit:

- Cajun Code Fest
- Cajun Code Fest Facebook Page
- How to make Lafayette a 'Smart City'

PHOENIX

The Institute for Digital Progress (iDP) partnered with US Ignite, the city of Phoenix, Cisco Systems, and Cox Communications to launch its Reverse Pitch competition: the Cisco IoT Challenge. Challenge organizers sought the top technologists in Phoenix to participate in this Reverse Pitch to help the city go green and move closer to its goal of achieving zero waste. Phoenix is attempting to divert 40 percent of trash from landfills by 2020, and to achieve zero waste by the year 2050. Participating teams worked closely with the city's Public Works Department, who opened specific data sets for the teams to leverage and use to build their solutions. Additionally, Cisco and iDP provided access and training on innovative technologies to the participating developers.

The winner of the Cisco IoT Challenge received $20,000 to further develop their technology solutions, and was given the opportunity pitch at the 2017 Smart City Hack Finale in October for a chance to represent the City of Phoenix in Barcelona.

The winning gigabit application from this Reverse Pitch was Pickup Minder by Hathority. Pickup Minder integrates the City's "open datasets" with fleet-based IoT/sensors (onboard systems) in an Integration Platform-as-a-Service (iPaaS), sending actionable notifications to opted-in residential customers. Hathority's solution integrates technology that the City has already

invested in to connect customers with the Public Works Department. Hathority built a platform for this integration that uses IoT data to help customers know when and how to place their bins, gamifies and incentivizes learning about trucks, refuse and recycling, helps supervisors better manage routes and routing, and helps drivers with route information.

For more information, please visit:

- Pickup Minder
- Phoenix Partners with Cisco, Institute for Digital Progress to Offer $20K to Local IoT Developers

Photo Credit: iDP

CLEVELAND

The Cleveland SGC hosted an Impact Pitch—a Reverse Pitch for makers developing ultra high-bandwidth hardware, software and business applications that want to impact their local community. The competition was organized by DigitalC, US Ignite, The Cleveland Water Alliance, USA Firmware, and the Cuyahoga Public Library. The kick-off event was held on May 3, 2017, and provided the opportunity for $1,000 cash rewards for finalists. Based on the pitches from the kick-off event, the Reverse Pitch became the Internet of H20 Water Innovation Competition.

On October 27, 2017, The Cleveland Water Alliance, in partnership with DigitalC and US Ignite, selected the winners. This competition challenged communities to come together to solve for real-world issues and establish a Smart Lake strategy that requires the integration of sensors, advanced networking, and insights generated from data science. Five teams, made up of individuals and companies from around the country, presented their ideas to a panel of judges. The winners received $50,000 in cash prizes and additional support services.

The winning ideas from this Reverse Pitch were:

- **Team Glass, End-to-end Solution Prize:** Team GLASS was a collaborative effort between OHM Advisors, H2Ometrics, Green Eyes, and HESCO. Together, the team delivered a robust, scalable, interoperable, real-time nutrient monitoring system. The team members offered unique expertise and access to technologies that allowed for advanced nutrient detection, telemetry, cloud data analytics, and system integration.
- **Team ExtremeComms + MicroBuoy, Technology Innovation Prize:** A partnership between two teams of engineering PhD candidates and Professors from Florida Atlantic University and Wayne State University. This team is working towards the first field deployment of electrochemical nanosensors for phosphorus paired with hyper-compact batteries and smart underwater modem technology to enable software-defined wireless networking of fixed sensors and unmanned aquatic vehicles.
- **Team HyrdoTrek, Network Technology Prize:** The HydroTrek team included contributors from Global Quality Corp., Sayantek, and Roietronics who developed advanced electronics and software to create a next generation IoT platform for Smart Water monitoring and modeling

For more information, please visit:

- Water Innovation Competition Aimed at Monitoring Harmful Nutrients in Lake Erie
- Cleveland Water Alliance
- Internet of H20

Photo Credit: Internet of H20

KANSAS CITY

KC Digital Drive hosted the Gigabit App Workday on March 30, 2017. The Kansas City Gigabit Workday was part hackathon, part workshop, part learning opportunity and all about growing the community that is actively building applications and deploying projects that form our gigabit app ecosystem.

Beyond the Reverse Pitches, the Gigabit Workday also featured panel discussions, a keynote speaker, gigabit co-working, and time to provide project updates and share other relevant information. Additionally it featured one-on-one sessions with our visiting National Technology Leader. For 2017, the event was focused on expanding the community in transportation, public safety, energy/sustainability, and advanced manufacturing.

PART 7: APPENDIX

APPENDIX – STEERING COMMITTEE CHARTER

Smart Gigabit Communities

******** Steering Committee Charter***

Steering Committee Overview

The ***** Smart Gigabit Communities (SGC) Steering Committee is a broad-based local steering organization within the ***** community, aimed at making key SGC decisions and driving SGC community awareness and activities. The ***** SGC Steering Committee will serve as the catalyst for bringing together the resources necessary for the development of a sustainable gigabit applications ecosystem for the community.

The ***** SGC Steering Committee should consist of local government, business and organization leaders that represent focus area industries, partners, or infrastructure partners, including local anchor institution partners. The ***** SGC Steering Committee will focus on project deliverables and fundraising to cover costs such as the operating and maintaining the gigabit network and incentivizing community activities to drive gigabit applications ideation and development.

Meetings

Frequency. The Steering Committee will meet monthly or as required to keep track of issues and the progress of the SGC project's implementation and on-going community-wide support to its stakeholders. The Community Leader leads the Steering Committee and facilitates the Steering Committee Meeting.

Program / Project Status. At each meeting, program / project status will be reported to the Steering Committee by Community Leader using an agenda outline such as the following:

A. Introductory Items such as:

- Review Agenda
- Minutes from last meeting
- Review of actions arising from previous Steering Committee meetings.

B. Review SGC project Status

a. Recommendations – (1) Provide a quick dashboard review of SGC initiatives that are on schedule, within budget and experiencing limited changes. (2) focus on SCG initiatives that are experiencing changes in schedule, budget, scope, as well as those that requiring requests for resources.

- Overall Status
- Schedule status
- Budget status
- Milestone status
- Gigabit application status
- Events and other activities (i.e., community meetings, hackathons, reverse pitches, etc.) status
- Cross-SGC collaborations and requests
- Accomplishments
- Public relations
- Review and approval of project change orders
- Specific requests for assistance of the Steering Committee

C. Responsibility for actions from this meeting

D. Plans, date and location for next meeting

Decision Making

Assumption: City of ***** Code must be followed when making decisions related to technology purchases, projects and services. All program / project decisions must be documented. Otherwise, the Committee will follow this procedure for decision making: The Community Leader leads the Steering Committee and facilitates the Steering Committee Meeting.

Voting

Steering Committee members will make decisions via consensus, unless consensus cannot be reached, in which case voting majority rules (show of hands).

Other Rules of Operation

- Agendas will be distributed at least three (3) business days before the meetings
- Meeting notes (of significant decisions and action items) will be distributed to committee members within three (3) business days of each meeting. All corrections to the notes must be submitted by the end of the subsequent meeting.

***** **Steering Committee Members** (voting members unless otherwise specified)

- SGC Charter Committee Members
- 1 person from the Public Safety Industry
- 1 person from the Transportation Industry
- 1 person from the Gaming industry
- 1 person from the Manufacturing industry
- 1 person from the Technology Hardware industry
- 1 person from the Education Industry
- 1 person from the Healthcare Industry
- 1 person from the Finance/Banking Industry
- 1 person from the Environmental Industry
- 1 person from a local Technology Accelerator
- 1 person from a local Technology Incubator

Name	Role	Organization
	Community Leader	
	Technical Leader	
	Charter Committee Member	
	Member	
	Member	

Responsibilities of a Steering Committee Member

It is intended that the Steering Committee leverage the experiences, expertise, and insight of key individuals at organizations committed to building professionalism in project management. Steering Committee members may not be directly responsible for managing project activities, but provide support and guidance for those who do. Thus, individually, Steering Committee members should:

- Understand the strategic implications and outcomes of initiatives being pursued through the SGC project and SGC results
- Appreciate the significance of the project for some or all major stakeholders and represent their interests
- Assumes appropriate level of responsibility for the initiative and be an advocate for broad support for the outcomes being pursued in the SGC project
- Have a broad understanding of project management issues and approach being adopted.

In practice, this means:

- Review the status of the program
- Advocate the program
- Vote on proposals and decisions related to projects
- Ensure the project's outputs meet the requirements of the key stakeholders
- Help balance conflicting priorities and resources
- Provide guidance to the core project team (i.e., Community Leader, Technical Leader, Application Developers, etc.) and users of the program's outputs
- Openly consider ideas and issues raised
- Check adherence of project activities to standards of best practice both within the community and in a wider context
- Report on project progress to those responsible at a high level, such as elected officials, community officials, interested technology companies, academia, and members of the community.