# 4G CLINICAL

# Modern Technologies
*In Clinical Trials*

**Knowledge Sharing Series**

# Modern Technologies in
# Clinical Trials

*Demystifying the use of Innovative RTSMs
in a Highly-Regulated Environment*

Trial designs are becoming more complex. Most of these trials are supported by legacy/older technologies that have limited flexibility to quickly adapt to new trial information. The pharmaceutical industry is reaching a tipping point, where the need for flexibility is outweighing the need to be conservative and risk-averse in this highly-regulated environment.

What if you didn't have to choose between speed/flexibility and minimizing risk?

This paper serves to demystify the use of modern technology for randomization and trial supply management (RTSM), or arguably any clinical software, and highlights the benefits:

- Speed with flexibility

- Seamless maintenance and upgrades

- Full traceability and strengthened quality process

- Minimal validation impact for infrastructure changes

- Robust security and scalability

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# What is a **Modern Technology Stack?**

A modern technology stack is a fully cloud-based infrastructure for which the RTSM software is built and hosted. Within the stack, there are elements for the code (Python), front-end UI (Angular Java Script), database (PostgreSQL) and web framework (Django). The entire system is deployed in the cloud using AWS (Amazon Web Services) with redundancy to Google Cloud.

## What Does that Mean for You?

Most of you probably use a laptop. Your laptop has regular software updates to fix any bugs and add new, improved features. Up-to-date, modern, software increases security as well as offers faster processing speed and includes the latest functionality.

With a modern technology stack, the newest version of all applications is always available. Additionally, security issues are immediately addressed and seamlessly updated to protect against all known vulnerabilities without disruption to the system or applications that use them. Modern technology stacks are of the most benefit when coupled with modern software development practices such as Agile. An Agile process would include continuous integration, so every time the developers write lines of code, tests are run to ensure the new code does not disrupt what was

already written. If any flaws are detected, they are fixed before the update takes place.

**Bottom Line:**

Technology is evolving quickly. In order to not be left behind, it is important to be on the latest applications within a modern stack. A good RTSM vendor provides the sponsor with the option to utilize the most exciting new features. It's analogous to having an iPhone 7 vs. an iPhone 13, some of your apps just won't work on an iPhone 7. Using a modern stack ensures your RTSM is able to run on the latest applications and infrastructure, is regularly scanned for vulnerabilities and most importantly provides added security that everything continues to function as intended, without disruption.

# How Modern Technology Addresses Limitations of Traditional RTSMs

Traditional RTSMs (those that are not fully cloud-based) typically rely on their own data centres and hire staff/resources to maintain those systems. They require securing resources to scale, including new computers, servers, databases, etc. Additionally, the use of physical on-premise data centers limit disaster recovery options. There may only be 1-2 back-up centers in case of an outage which can lead to the system itself going down if all 2-3 data centers go down. Leveraging a fully cloud-based, modern technology stack addresses these limitations. Think about it this way. The "cloud" is simply a large data centre. Just like any data centre, there are servers, machines, and people that service those systems. Back-up facilities can now be located anywhere in the world.

Similar to how you would take your car to an expert to get it fixed, you can now leave the maintenance of your systems to the "experts" in the cloud model, namely Amazon Web Services (AWS) and Google.

## Speed with Flexibility

When using a modern technology stack, resources are just a click away. It is no longer necessary to purchase physical computers so there is no wait time on resources (web services, infrastructure). Think of your drop-box account – if you run out of space, you don't have to order an external hard drive, you just sign up to have more space.

This enables speed. Speed to create new environments (a new stack for a sponsor). Speed to clone an existing environment and troubleshoot issues without impacting or even touching the production environment. Speed to restore backups. This can be done in minutes as opposed to hours or days.

For study and supply managers, the speed and flexibility from the use of modern technologies translate to faster delivery of innovative RTSMs – from as little as 13 calendar days.

## Seamless Maintenance and Upgrades

With legacy/older technologies, system maintenance and upgrades are disruptive to the trial. The legacy/older RTSM is updated to the new version, which requires downtime and can lead to technical issues as new functionality is added, code is changed, etc. Using a modern technology stack allows RTSMs to be upgraded using the software industry standard: Blue/green deployment.

# How Modern Technology Addresses Limitations of
# **Traditional RTSMs**



Live Deployment

Pending Deployment

Switch
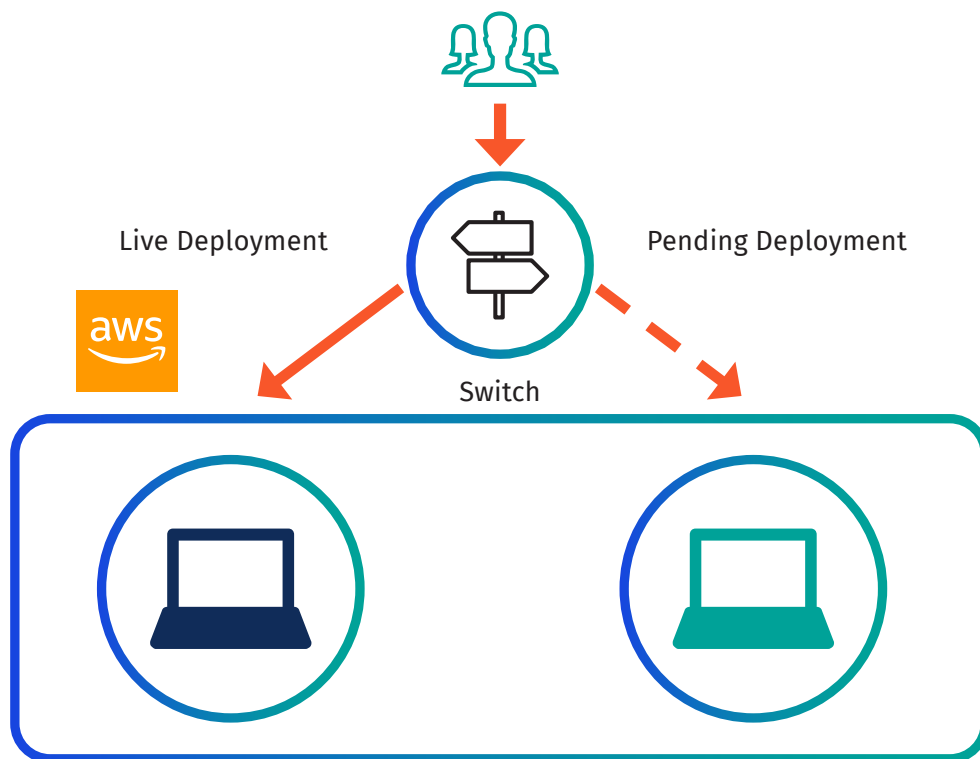
With Blue/Green deployment, the current RTSM (blue) is cloned to RTSM (green). The upgrades are performed on the cloned RTSM Green. This way, if anything were to go wrong during the upgrade itself, the original RTSM Blue is left untouched. Upgrades can be done in as little as 10 minutes up to 1 hour depending on the scope of the upgrade. Upgrades are scheduled ahead of time to ensure no disruption to a study (e.g. midnight on a Saturday).

Another process made possible by modern technology stacks are microservices. **Microservices**, also known as microservice architecture, is an architectural style that structures an application as a collection of loosely coupled services, which implement business capabilities. It enables the continuous delivery/deployment of large, complex applications.

Take Google as an example. Gmail is updated dozens of times a day and we never feel it. Maybe there is one link that doesn't work, but when you hit refresh it has been fixed. The philosophy behind this is enabling zero down time for upgrades. Imagine instead of one piece of software, you have 10. At any given time, one of the 10 pieces of software can be updated and the other 9 are always running. In other words, microservices is able to de-couple certain

# How Modern Technology Addresses Limitations of
## Traditional RTSMs

features from the application so that updating them does not require revalidation of your RTSM application as a whole. This is the power of a modern stack – your studies would never be impacted by upgrades. No down time, no frustration for end-users.

In addition to Microservices, another cutting-edge technology in a modern stack is Kubernetes (K8s). Microservices and Kubernetes go hand-in-hand. Kubernetes is an open-source container orchestration platform developed by Google. K8s allows rolling software updates with zero down time and the ability to roll-back to previous versions if necessary.
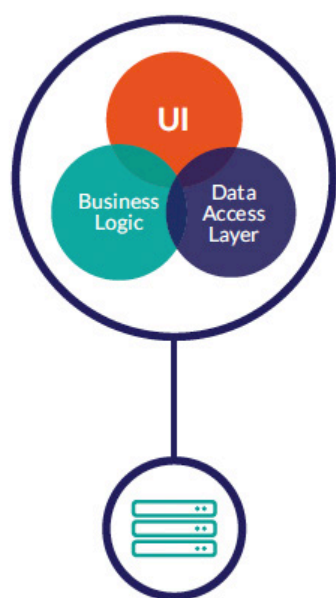


**Monolithic Architecture**
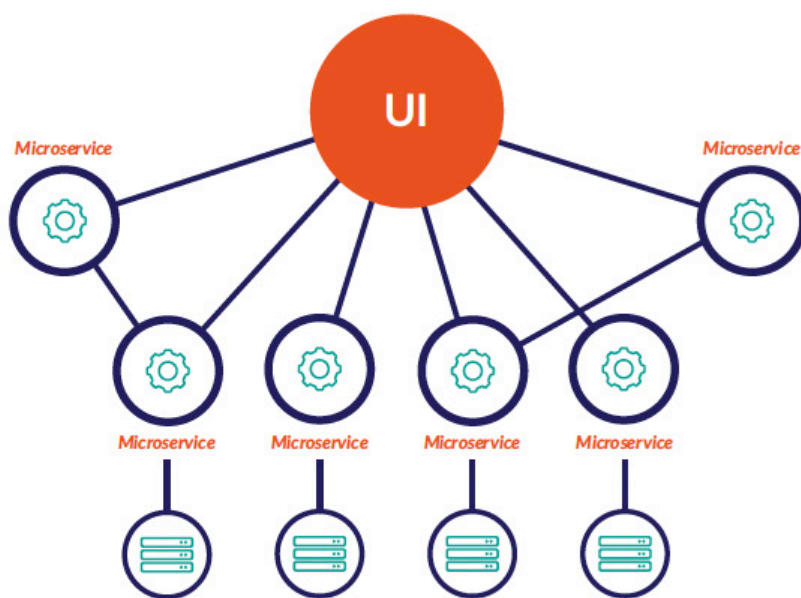
**Microservice Architecture**

All this boils down to having your cake and eating it too. You get access to the latest features frequently, without disruption. Software vendors, if they use Agile Development as well, can release new versions quickly. With blue/green deployment and microservices, your vendor can deliver many, smaller improvements on a regular basis to keep your RTSM at the cutting edge.

# How Modern Technology Addresses Limitations of
## Traditional RTSMs

## Full Traceability and Strengthened Quality Process

As mentioned above, everything in the cloud is locked down and secure except for those for whom access is deemed necessary All infrastructure for the RTSM is version controlled including any resources that are created/updated. Reports exist detailing everything that was done in that environment (what was the change, file used to push that change, logs as a result of the change, etc.).  Since changes are controlled and documented, it enables full traceability for your infrastructure.

That full traceability of your infrastructure allows you to be compliant with all the pertinent industry regulations such as 21 CFR Part 11 right from the start. This allows flexibility to make decisions around upgrading and using the latest technologies, while weighing the business and validation risks related to those choices, enabling compliance to guidance documents such as GAMP 5 and Computerised Systems Used in Clinical Investigations.

## Robust Security and Scalability

### Security
AWS built their cloud offering with security in mind. Everything up in the cloud is tightly secured unless the security is specifically loosened (opt-in). Data is encrypted in transit (modern tech forces https for added security). AWS has multiple data centres in many regions all over the world. Flexibility exists to determine where in the world the data is stored (which is important in many EU countries) as well as the option of storing the data close to the customer (i.e. Japan only study). It also enables fool-proof disaster recovery. Even if an entire data center goes down, the RTSM can be transferred to another centre automatically.

Another reason why disaster recovery and security is robust is the use of containerised technology. A container is segmented and includes all the isolated processes and their dependencies. Here is how it works. Let's go back to the laptop analogy. Someone sends you a file using excel 97. You then get another file that needs excel 2007. Within one container, the files needed to run both versions are included.

When using containers in software development environments, the same container is moved from testing to development. It will work in both environments because it is not dependent on anything outside the container to run.

Between regional data centers, containers, and the intrinsic nature of the cloud, you have perfect copies of the whole picture that only the right people can access.

# How Modern Technology Addresses Limitations of
## Traditional RTSMs

**Scalability**

Since AWS is being leveraged for storage, capacity at scale will never be an issue. Tools used automatically scale to meet demand or cut back as needed. Servers are never overwhelmed by a spike in traffic. The user-interface (UI) never slows down, keeping the integrity of the system for the end-users.

So, if you get that boost from your Investigator meeting and your enrollment rates triple, the last thing you have to worry about is your RTSM running out of room or your sites not being able to access a busy server.

*The **full traceability** of your infrastructure **allows you to be compliant** with all the pertinent industry regulations such as 21 CFR Part 11 right from the start.*

# Conclusion

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## *Embracing Modern Technology*

*Unless you are the rare sponsor who never has protocol amendments and keeps to simple protocol designs and long timelines, your legacy infrastructure is going to struggle to keep up.*

*Modern technology sets the foundation to leverage the best new features and innovations in an infrastructure architecture, without sacrificing security and quality.*

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# Meet **Rob Campanella**

### About the Author

**Rob Campanella,** Director of DevOps at 4G Clinical, has over 2 decades of experience in IT. He spent most of that time focused on system implementations and integrations as a consultant primarily involved in the biotech industry. He comes to us most recently from MIT, where he served as both a Technical Architect and an IT Manager for the Identity & Access Management team. Rob loves technology in general but believes the best technological solutions can only be identified by those who completely understand the business side and the use cases that need to be addressed. Rob is a Certified Scrum Master and Product Owner. He has a BA in Economics from Duke University and a MBA from Babson College.

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# About
# 4G Clinical

*We reduce the time it takes to commercialize vital medications by delivering validated, easily extendable RTSM capabilities to Pharma and CROs faster than anyone in the world.*

4G Clinical is driven by a single purpose: bring crucial medicines to those who need them, faster. 4G Clinical believes that the way to accelerate clinical research is by disrupting the way trials are executed. That's why we have revolutionized RTSM (randomization and trial supply management) and supply forecasting capabilities and services from the ground up.

4G Clinical is committed to helping sponsors and CROs follow the science, wherever it may lead, as quickly and as safely as we can. While we will not discover the next novel compound in the lab, we are doing our part by leveraging our extensive experience and technological innovations to bring speed and agility to clinical trials.

## Prancer RTSM®

*Our 100% configurable and agile RTSM is built for the clinical trials of today and tomorrow.*

**4G's RTSM platform, Prancer RTSM®,** utilizes natural language processing alongside integrated clinical supplies forecasting and management functionality to slash development timelines, increase operational efficiencies and offer exceptional quality.

# 4G
## CLINICAL

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those who need them, *faster.*

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