

CLOCK WORK

Tick Tock Clock Sync & Monitoring

Microsoft Azure

User Manual

1. Introducing TTCS

Tick Tock Clock Synchronization (TTCS) system is a high-accuracy, highly scalable clock synchronization system developed by Clockwork Systems, Inc. TTCS builds on the Huygens algorithm, and is a much-enhanced, production-ready implementation. In addition to accurate clock synchronization, its main features are: (i) sustaining high levels of synchronization accuracy in presence of server and network failures, (ii) fast fail-over to backup systems, (iii) multi-region clock synchronization, (iv) accurate basic telemetry of the network and computing substrates, and (v) user-friendly visualization and management interfaces.

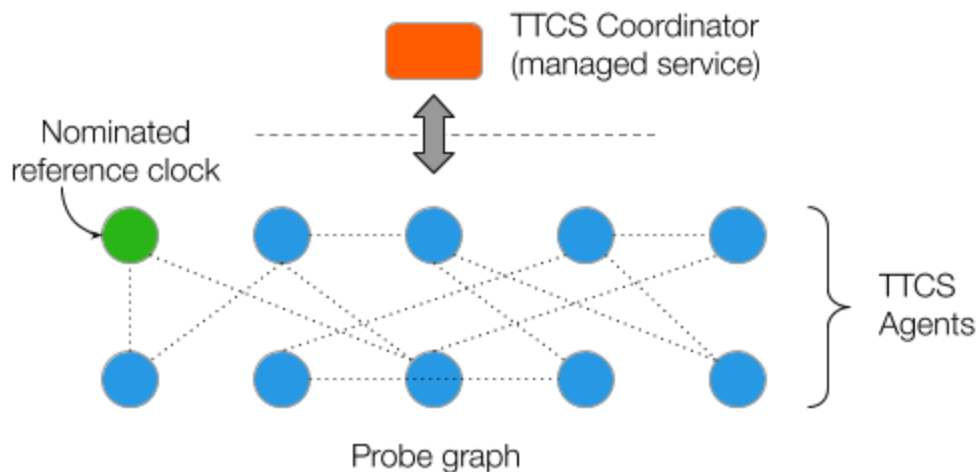
TTCS is available on Microsoft Azure through Azure Marketplace. It is offered as a managed service in three tiers with varying feature sets:

1. **Free:** A basic offering with a capability to sync up to 10 hosts in a single region.
2. **Pro:** An advanced offering with a capability to sync up to 1000 hosts spread across up to 3 regions.
3. **Enterprise:** Flagship offering with full-feature set including capability to sync unlimited hosts across multiple regions, full data retention for up to an year, advanced telemetry and alerting functionality with full technical support.

2. Deployment

2.1 Overview

There are two main components in a TTCS system: a TTCS Agent (i.e. a host) and a TTCS Coordinator. Each host runs a TTCS Agent, and the agents establish a mesh of probes and locally process the probe data. The TTCS Coordinator intelligently combines the locally processed probe data to determine the offset of each host's clock with respect to a nominated reference host clock. Finally, the agents apply this offset to the host's clock to maintain synchronization. The architecture of the system is shown in the figure below, depicting TTCS Coordinator (orange node) and TTCS Agents (blue nodes) with one of them nominated as a reference (green node).



TTCS architecture

In this offering on Azure, the TTCS Coordinator is run as a managed service by Clockwork. A customer only needs to install and set up TTCS Agent on hosts that need time synchronization. Please note a minimum of 3 hosts is required to run the TTCS system successfully. The system performance along with certain telemetry and alerting functions are made available through a web dashboard. Below we explain the different steps in setting up the solution and accessing the performance metrics.

2.2 System Requirements

TTCS Agent is distributed as a binary package that can be installed on hosts with the following requirements:

- Operating system: RHEL 7 or later, CentOS 7 or later, Debian 9 or later, Ubuntu 18.04 or later.
- CPU architecture: x86_64 CPU.

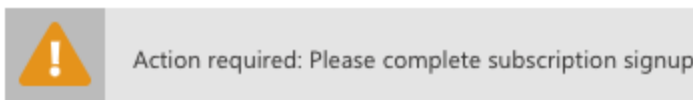
2.3 Installation & Configuration

Before installing the TTCS Agents, make sure the network firewall allows the following communication between the hosts:

- TTCS Agents probe each other on inbound-port 319 using UDP.
- TTCS Agents communicate with each other on inbound-port 6171 using TCP.
- TTCS Agents communicate with an external TTCS Coordinator (managed by Clockwork) on port 6176 of TTCS Coordinator using TCP.

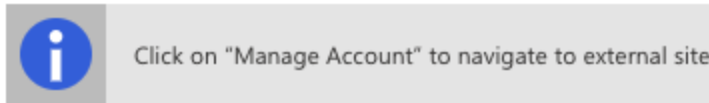
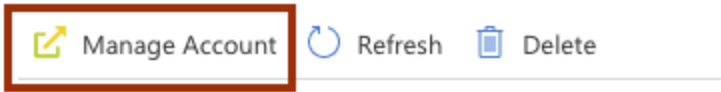
NOTE: If your agent doesn't have a public IP address, it will not be able to send external requests to the TTCS Coordinator. One way to allow these requests is to configure a Virtual Network NAT for your virtual network (for more details see [Virtual Network NAT documentation](#)).

Subscribe to [TTCS on Azure](#) using one of the three available plans. Once a subscription is deployed, view your subscription in the “Software as a Service (SaaS)” blade in Azure portal. Click on the link “Configure Account” to complete the signup and activate the subscription. You will be asked to sign in using your Microsoft Azure AD account, if not already signed in.



After activating your subscription, you will be redirected to the Clockwork subscription dashboard. Provisioning the services for your subscription may take a few minutes to complete.

You can also visit the Clockwork subscription dashboard anytime later by clicking on the link “Manage Account” in the “Software as a Service (SaaS)” blade in the Azure portal, as above.

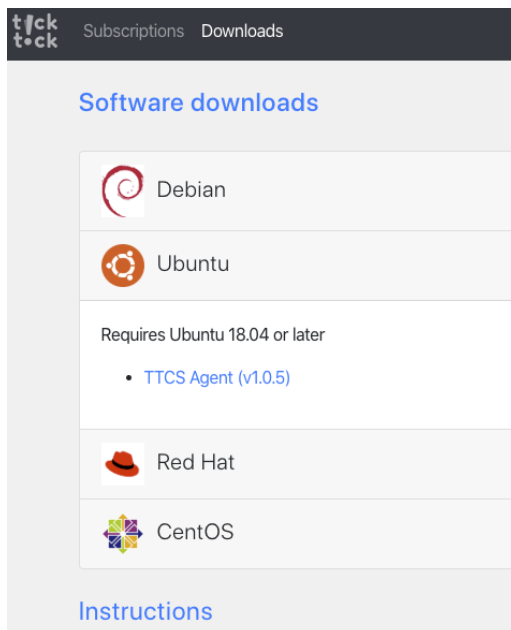


NOTE: We currently do not support multiple subscriptions per user account. A user account can only have **one active subscription** at a time.

Follow the steps below to install TTCS Agents on each of your hosts. We assume that you have a cluster of hosts already set up on Azure that need time synchronization. Creating and setting up your hosts on Azure is outside the scope of this manual (to do so, you can follow instructions from Azure [here](#)).

NOTE: Some commands (e.g. to install a package, or start a service) might need elevated privileges and may need to be run with [sudo](#).

- Click on “Downloads” to access the downloads page.



- Select your host operating system and download the TTCS Agent binary package.
NOTE: The download link to the package is password-protected and does not work without an authenticated session. In particular, fetching a package using this link with [wget/curl](#) fails. Instead, download it directly from the browser onto your work instance, and use a script to copy it to all the hosts.
- Make sure your host has [libcap](#) installed. If not, install using:
 - For RHEL/CentOS: `yum install libcap`
 - For Debian/Ubuntu: `apt install libcap2-bin`
- Install the TTCS Agent package on your host:
 - For RHEL/CentOS: `rpm -Uvh ttcs-agent-1.0.21-1.x86_64.rpm`
 - For Debian/Ubuntu: `dpkg -i ttcs-agent_1.0.21_amd64.deb`
- Download the config file for TTCS Agent from the link in the “[Instructions](#)” section. This config file is customized for the current subscription.

Instructions

- Download the TTCS Agent package for your operating system from the links above.
- Download the config file for TTCS Agent that is configured for your subscription by clicking [here \[TTCS Agent config\]](#).
- Follow detailed instructions in the [TTCS User Manual](#) to configure and start TTCS Agent.

For more details and troubleshooting, please refer to [TTCS User Manual](#).

NOTE: If a subscription is reinitiated after a cancellation, the config file can be different. We strongly recommend downloading the new config file whenever a subscription is initiated.

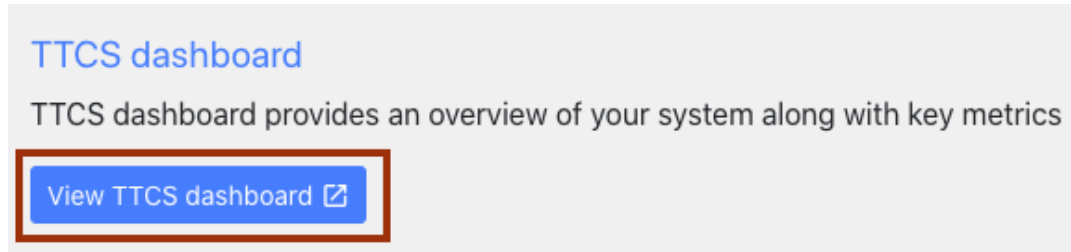
- Edit the config file and fill in the `management_address` and `probe_address` fields with an IP address/hostname for the host, or a CIDR block, or an interface name. The same config file can be used for all Agents when using a common CIDR block or interface name. `management_address` refers to the IP address that the agent binds to for general communication. `probe_address` refers to the IP address used for probing. In most cases, `management_address` and `probe_address` are identical unless they use different network interfaces, and correspond to the **private IP address** of the host.

```
1 management_address: "<AGENT IP/CIDR/INTERFACE>"
2 log_dir: "/var/opt/ttcs/log"
3 subscription_mode: true
4 coordinator_address: "0.0.0.0"
5 coordinator_subscription_service_port: 6176
6 probe_address: "<AGENT IP/CIDR/INTERFACE>"
7 clock_quality: 1
8 correct_clock: true
9
```

- For the Agent that serves as the reference clock, set its `clock_quality` to a number higher than 1 (e.g. 10), and set `correct_clock` to `false`.
- Move the updated config file to `/etc/opt/ttcs/ttcs-agent.cfg`. This will overwrite the default config file at this location.
- Make sure that no other time synchronization services (e.g. NTP, Chrony) are running on your hosts, except on the one nominated as a reference. Disable such services on your hosts (e.g. using `systemctl stop ntp` and `systemctl disable ntp`). Only enable them on the host nominated as reference to provide the source of time.
- Start the TTCS Agent service by running: `systemctl start ttcs-agent` (with upstart service manager run: `service ttcs-agent start`).
- To automatically start the agent at startup, run: `systemctl enable ttcs-agent`.
- The TTCS Agent log file can be monitored at the location `/var/opt/ttcs/log/ttcs-agent.log`. In addition, the status of the TTCS Agent can be queried and displayed by running the command `ttcs-agentq` on the host.

2.4 Dashboard

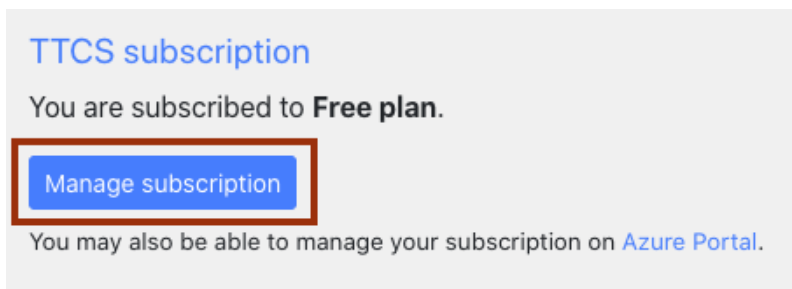
The Clockwork subscription page presents the current subscription plan, and provides a link to the TTCS dashboard. Clicking on this link opens a new tab/window with TTCS dashboard.



The TTCS dashboard presents the current system performance metrics (e.g. median clock offset, 90% clock offset, active hosts, etc.), along with several interactive visualizations to explore the entire cluster. A network visualization depicting the cluster of TTCS Agents and TTCS Coordinator presents the current offset at each host. Mousing-over a node in the network presents the current metrics at the node; clicking on it shows its probing neighbors, one-way delay metrics and more detailed visualizations pertaining to the node.

2.5 Manage Subscription

The Clockwork subscription page also provides a way to manage your subscription. Click on the “Manage subscription” button to navigate to a management UI to make changes to your subscription or unsubscribe.



The management UI displays the current subscription plan and seat count. You can click on the “Change subscription” button to modify the subscription plan and/or seat count. You can click on the “Unsubscribe” button to unsubscribe from the current plan. These buttons are not available if your subscription has any pending changes that are currently in progress; instead you will see a list of the pending changes.

Tick Tock Clock Sync & Monitoring Subscription

Subscription plan	Free
Seat count <small>(Max. number of Agents)</small>	10

[Change subscription](#) [Unsubscribe](#)

Change subscription

Subscription plan	<input checked="" type="radio"/> Free <input type="radio"/> Pro <input type="radio"/> Enterprise
Seat count <small>(Max. number of Agents)</small>	<input type="text" value="10"/>

[Close](#) [Apply changes](#)

3. License

This software is developed and owned by Clockwork Systems, Inc. All rights are reserved by Clockwork Systems, Inc. Unauthorized usage or copying of this software, in whole or part, via any medium is strictly prohibited.

4. Technical Support

If you have questions about installation and other technical matters, please email support@clockwork.io.

5. Troubleshooting

If you do not see an agent on the TTCS dashboard, check the agent status using `ttcs-agentq` and consult the agent log file at `/var/opt/ttcs/log/ttcs-agent.log` for any errors. Below we list a few common errors and possible resolutions to fix them.

- **Command error: systemctl ...**
 - Failed to connect to bus: No such file or directory

This error can arise when running a system command on the agent's host e.g. `systemctl disable ntp` to disable NTP. Although the error message is cryptic, the most likely cause of this is the lack of elevated privileges for your user account. To fix this, run such commands with `sudo` e.g. `sudo systemctl disable ntp`.

- **Command error: wget .../download/pkg/...**
 - HTTP request sent, awaiting response... 302 Found
 - Saving to: 'index.html'

This error can arise when attempting to download a TTCS Agent package or TTCS user manual from the command line. As noted earlier, these resources are password-protected and cannot be downloaded without an authenticated session. In particular, you cannot download them directly on a host using `wget` or `curl`. The recommended method is to download these files from the browser on to your working instance and then push these files to the agent hosts.

- **TTCS Agent error**
 - Unable to parse config file `/etc/opt/ttcs/ttcs-agent.cfg`
 - Error parsing text-format `clocksync.AgentConfig`

A possible cause could be incorrect formatting in the config file. Make sure strings (e.g. IP addresses) have surrounding double quotes. For example, the values of the fields `management_address` and `probe_address` need to have double quotes around them e.g. `"10.1.10.20"`.

- **TTCS Agent error**
 - Conflicting process(es) disciplining clock: ntpd

This happens when the agent's host is running another synchronization process (e.g. NTP) that is disciplining its clock. If the TTCS Agent is configured to correct the clock (using `correct_clock: true`), it refuses to start in this scenario. Turn off and disable the conflicting process, and restart the TTCS Agent.

- **TTCS Agent error**
 - Failed to create agent server

This happens when the TTCS Agent is unable to initialize its services. The most likely cause of this is its inability to bind to the IP address given in `management_address`. For Azure hosts, processes can only bind to its private IP address, and NOT its public IP address. Make sure you are using private IP address in the field `management_address` in the config file.

- **TTCS Agent error**
 - Failed to fetch interface for probe IP ...

This happens when the TTCS Agent is unable to fetch the network interface for the given probe IP. The most likely cause of this is an incorrect IP address for `probe_address`. Make sure that the value for `probe_address` field in the config file is the private IP address of your Azure host. Public addresses are not tied to any network interface on the host and cannot be used for probing.

- **TTCS Agent error**
 - Failed to subscribe to coordinator ...

This happens when the TTCS Agent is unable to reach the TTCS Coordinator managed service. This is usually due to an invalid `coordinator_address` IP address in the agent config file. Make sure you have the most recent version of the agent config file since you started your subscription. If not, follow the instructions in Section 2.3 to download and update the agent config file.