SSL System T

Fully Networked Broadcast Audio Production

Tom Knowles, Product Manager - Broadcast Systems

Solid State Logic
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System T *is a truly new broadcast audio production environment bringing I/O, routing, innovative control, and audio processing together in a flexible, fully networked, large-scale system.*

Each System T ecosystem is based around three elements; a new networked implementation of the proven ***SSL Tempest processing engine****, a variety of* ***networked control interface options*** *offering versatile, distributed, multi-operator control, and* ***Dante network based audio routing and I/O****.*

With every part of the System T infrastructure networked, broadcast production facilities can benefit from several key advantages:

- All three networked aspects - I/O, control, and processing engine are flexible, scalable resources that can be deployed and distributed as required.
- Multiple control interfaces can address a single 800 path audio engine simultaneously, so multi-user systems, technical 'over-control', and control redundancy can be built into System T implementations.
- I/O is sharable between any processing core and control interface, even if a console core is taken offline.
- I/O is movable and discoverable so named inputs and outputs will always be available and easily accessed wherever they are plugged into the network.
- Routing information is distributed across network providing resilience and control interfacing from any location.
- Routing and I/O management using the defined Dante API allows seamless echoing of cross points across system T's own routing GUI and 3rd party control systems.
- Network, Control, and Processing redundancy can extend to separate rooms and separate physical fire zones.

More Information: **The SSL Team** bring decades of broadcast console design experience to the challenges of leveraging networked technology for broadcast. Email sales@solidstatelogic.com for help and advice.

solidstatelogic.com/SystemT

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Networked I/O & Routing

The audio network technology that underpins System T is Audinate's Dante - a well defined, widely supported, high capacity, and low latency Audio-Over-IP technology standard. Dante devices, including System T, can also deliver AES67 AoIP transport, for audio exchange with non Dante AoIP technologies supporting AES67.

Complete Technology

Dante technology incorporates device naming, configuration and discoverability so that any Dante enabled device from any manufacturer added to the network will automatically give System T access to that I/O. This can be routed immediately using the System T GUI, both to and from System T or any other Dante device on the network. Routing includes signal naming, so a 'split' audio feed can now incorporate named inputs and outputs. This information is stored in the devices so there is zero reconfiguration needed if a device is moved to a different port on the network. For example a Stagebox moved from one side of a studio to the other, or even a different room, will instantly function as before.

From an operational perspective you don't need to be a network engineer to route audio using System T and Dante. Routing is presented as you would have expected with a traditional non-AoIP system. Without any operational intrusion, automatic management of channel per flow ('packets') ensures plenty of system capacity with flexible routing. A high channel count, real-time, distributed routing system is well within the capability of even modest network port speeds. The implementation of the IEEE 1588 Precision Time Protocol (PTP) means that a single network master clock will give sample and phase accurate synchronization across the network

Distributed hardware and software

The Dante network effectively absorbs traditional routing function into its component parts. Routing is no longer limited by the complexity and cost of large-scale central routing hardware and central software management. Audio routing is stored within devices, and once configured devices communicate directly via the network, so control software does not have to be present on a network for the system to operate. Whole sections can be taken offline without affecting routing and control elsewhere on the network, and redundancy can easily be achieved.

All Dante control software is passive and reports the routing state as a direct tally from each endpoint device. Multiple control systems can co-exist accessing the same I/O and sharing routing data without additional complex protocols and configuration. For example; if a mic input is routed to an intercom input using the System T routing GUI, this route is also shown on any other routing GUI or control system using the Dante API. This allows workflows where each operator in the facility uses a suitable GUI or physical panel but instantly knows what other staff members have configured. Dante's strict routing protocol plus the control and monitoring API (ConMon) ensures any Dante hardware or software will be seamlessly compatible with System T.

I/O Devices

SSL's Dante enabled Network I/O product line (which includes Mic/Line Stageboxes, MADI, AES and SDI interfaces) can be remote controlled directly from System T consoles or network connected computers. The separate SSL Stagebox Remote Control Application offers full device control from a standalone software application. Devices configured to be used with System T can easily be used for other jobs when required, for example a truck's flight case stagebox could become a mobile recording rig.

Networked Processing Engine

System T's processing power is provided by the Tempest Processor Engine, including OCP™ technology already being leveraged in SSL's Live consoles. With System T one Engine is capable of running 800 processing paths, 192 mix busses and routing over 3000 audio inputs and outputs. Unique resource allocation provides 'on the fly' channel and bus configuration, with no audio dropout, enabling adding channels or busses during a live production.

Each Processor Engine connects to the Dante Network via SSL's Network I/O HC cards, which can each handle up to 512 inputs and 512 outputs. Each Engine or redundant pair of Engines has capacity for up to six HC connections. The system has full-mirrored redundancy from the Engine chassis dual power supplies through to the redundant networks. The HC Bridging configuration allows redundant Engines to be located in separate physical fire zones within a facility if required. Multiple Engines can share a network, along with multiple Control Clients and multiple I/O, so several System T based production teams (with shared I/O) can coexist on a redundant pair of networks for large facility installations.

Technology

The Tempest Processor Engine runs on industrial grade multi-core CPU devices. In addition to the RTOS (Real Time Operating System) the Engines include SSL's patented OPC™ (Optimal Core Processing) technology. OCP guarantees real time and deterministic allocation of resources across the CPU, enabling multiple 64-bit floating-point operations with high precision and ultra low latency. Uniquely, processing and mixing are all done inside the cores, no additional FPGA or DSP is required, reducing buffering and decreasing latency. All this provides an extremely stable, but tremendously flexible DSP like architecture, with capacities only previously possible with FPGAs. Tempest's processing power is completely transparent to the console operator allowing seamless real time configuration, routing and processing allocation.

Processing architecture

The massive 800 paths of processing can be user configured, with 192 of paths available for use as busses. Bus types include:

- Main busses – often used for PGM feeds
- Stem busses – group busses that can also feed other busses
- Auxiliary busses – sends with individual level control per channel
- Mix Minus busses – simple to set up clean feed busses for return signals to IFBs and remote locations
- Track busses – utility busses for quick sends to recorders or pre routed outputs

All path types have full processing capability, 8 Automix groups can cope with 400 mono paths, plus a full FX engine provides inbuilt Reverbs, Delays, De-Nosiers, Signal analysers, Signal generators, Up-mixers and Down-mixers as well as additional Dynamics and EQ.

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Control Interfaces

The System T control surface is modular and can be configured to suit specific requirements. The core elements include:

- Multi gesture Channel View touch screens – direct, intuitive, control and configuration
- Fader Tiles – 16 faders and 16 encoders, with displays, metering and layer switching for control of any channel or bus
- A Master Tile – main and focus fader plus monitor controls, scene automation controls and user keys
- A Channel Tile – touch screen and physical hardware controls of all parameters of the selected focus channel

Further additions allow custom surface configuration, these additions include intelligently switched bays including an overview screen, a meter bridge and dual fader bays. The System-T control software T-SOLSA can be run on a network connected PC for additional control locations. Remote fader tiles can be used to extend control into production galleries and other locations in the Audio control room or OB vehicle.

Layering

System T's layer manager provides intuitive drag and drop functionality for configuring any channel or bus, to be accessed by any physical fader on the surface. Layers and banks on each fader tile can recalled independently, allowing access to lower paths while retaining access to key faders. Each 16 fader tile includes 15 layers each with 4 banks, providing up to 60 individual layouts per tile. That's 960 control faders, if necessary a single tile can access all console paths and VCAs. Flexibility really is unlimited, but the user is only presented with the configured layers and banks keeping operation simple.

Metering

With up to 800 paths of processing across multiple surface layers, audio metering on a mixing console has been rethought. The overview screen can show all configured busses or banks of 256 formatted channel paths, providing a huge amount of data including signal level, fader position. Signal overloads or issues across the huge capacity can be quickly identified, touching any path on the overview screen instantly assigns this path to the focus fader and channel tile, for any issues to be immediately resolved.

The optional meter bridge provides a meter configurator; each of the 17 vertical strips can be configured to have full, half or quarter height meters permanently displayed. Allowing up to 68 metering slots per screen, again providing indication of what may be happening on multiple fader layers simultaneously. The metering is identical to the path metering on the channel view and displays a rich amount of data including, signal level, path name, path colour flag, dynamics reduction, gate activity, fader position and automix activity.

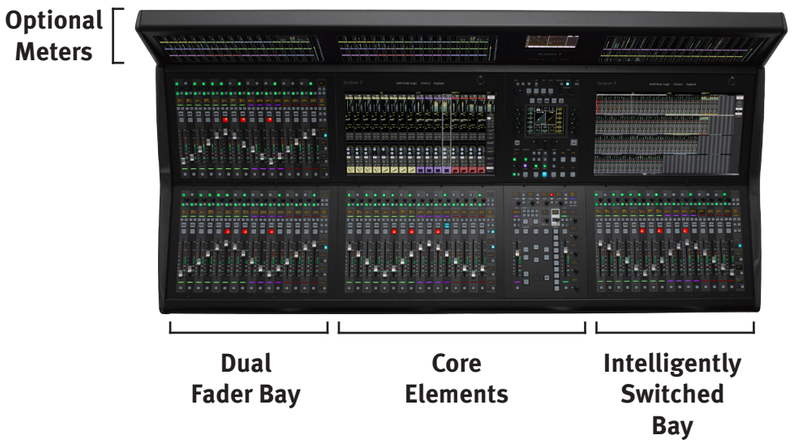
Control Clients

A traditional multi-user broadcast system would require multiple instances of a complete 'console', i.e. a DSP and control combination deployed for one purpose, normally restricted to one location. With System T however, you can deploy multiple Control Clients anywhere on the network with simultaneous control over shared Tempest Processor Engine resource. A single System T Control Client can be considered as an instance of the System T Channel View touchscreen, either within a hardware surface or a T-SOLSA online control computer.

System T currently allows three simultaneous IP-addressed Control Clients per Engine (or redundant Engine pair), the main surface and up to two remote clients. Where more than three Control Clients exist on a network they can be easily assigned to different main surfaces as required. Each Processor Engine supports two complete monitoring systems; each with individual AFL and PFL busses, multiple monitor selections and external source selections. There are four additional studio/remote monitor paths per Engine to provide zoned remote monitor level control. Multiple Engines and their associated Control Clients can coexist on a single network. In this way extremely powerful and flexible multi-zone, multi-operator systems can be specified.

Control where you need it

The 'screen call' and 'swap' functions allow a user to select what tile is displayed on the channel view or swap any fader tile to the 'hot' position in front of the channel view. In doing so the operator can always sit in the same place and access any fader or parameter required. Surfaces with multiple touch screens are segmented into screen groups with the fader tiles around a particular screen associated with that screen. An inbuilt KVM provides intelligently switched bays, where the channel view and overview screen exchange places so the channel view is always by the faders being used, bringing the channel view control to where the user needs it. Additionally this KVM has 3 external inputs, 2 with touch screen control so computer and other video feeds can be brought right to where needed.



Each of these three possible configurations would be considered a single Control Client.

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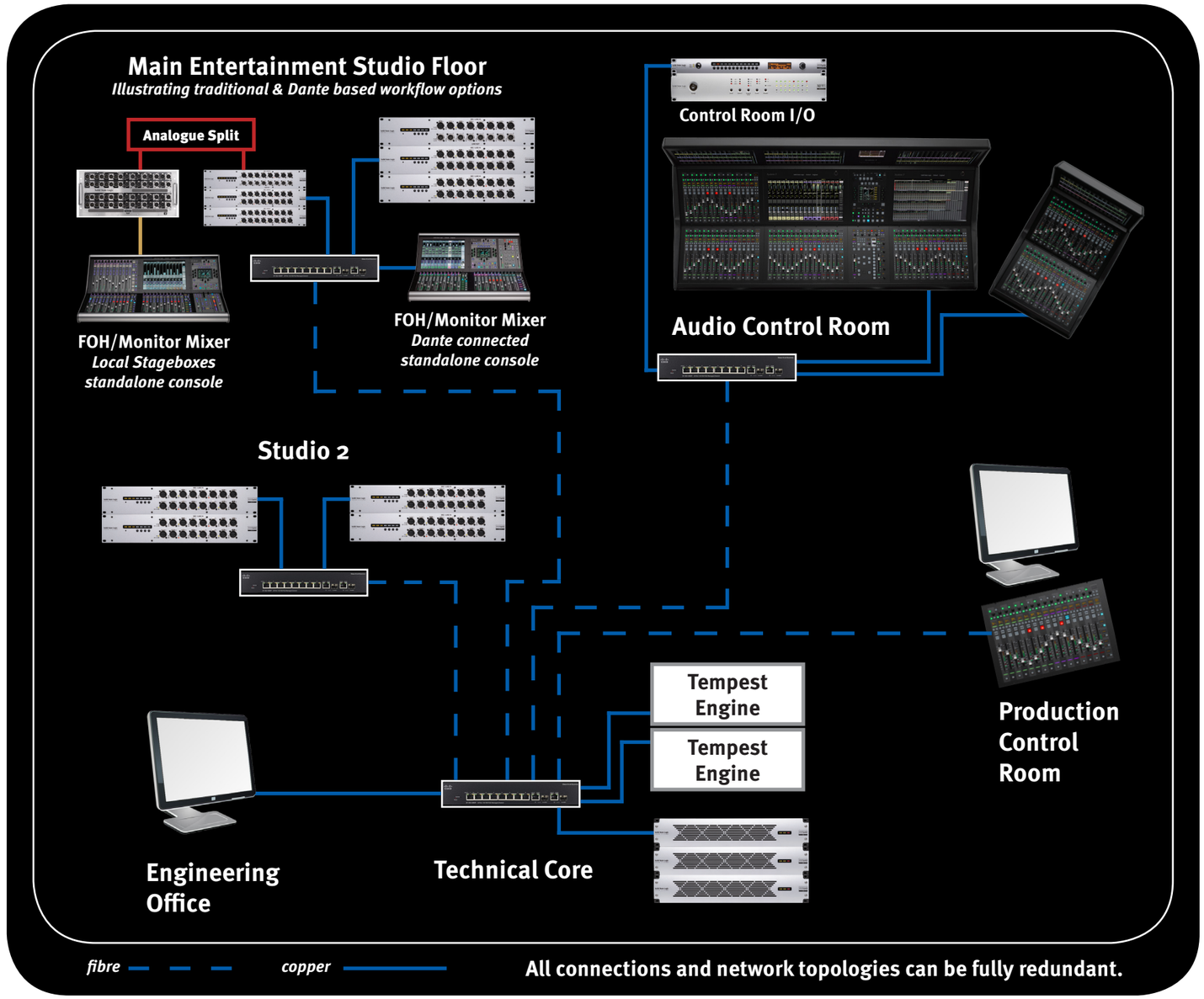
Entertainment Show Configuration

This system shows the infrastructure for a typical Entertainment Show production using a single System T ecosystem. There are two console frame based Control Clients in a main Audio Control Room, and SOLSA computer based Control Clients in a Production Gallery and in the Engineering Office. A maximum of three of these Control Clients could be used simultaneously. There is remote mic/line I/O in two studio floors, plus SDI, AES and MADI bridging to the Dante network in the technical core.

The system is based around a dual-redundant network, with two redundant Tempest Processor Engines that can, if required, be located in separate physical fire zones. Single switches and network cables are illustrated to keep the diagram simple to read but all network layouts and redundancy topologies are supported.

The **Audio Control Room** shows two console frame based Control Clients which could be used to facilitate two different approaches to production; **Split Control** - where each of the two Control Clients has access to its own audio channels that are mixed together at the output, as might traditionally be done with two mixing consoles. **Parallel Control** - where two Control Clients have access to the same audio channels and busses, but each operator has different tasks, a workflow that is not easily achieveable with multiple consoles. High density Audio Control Room monitoring is provided with a combination of a Dante-MADI bridge unit and an SSL Alpha-Link Live-R.

The diagram illustrates two different potential approaches to integration of FOH and Monitoring consoles on the **main entertainment studio floor**. In both approaches the local live FOH/Monitor console(s) have independent processing power, they do not share the System T Engines. The more traditional approach of using an analogue split to feed the Stageboxes of FOH/Mon console(s) whilst also feeding the broadcast system is shown. An alternative approach places Dante Stageboxes on the show floor and shares line level audio across the network to both FOH/Mon and broadcast systems simultaneously.



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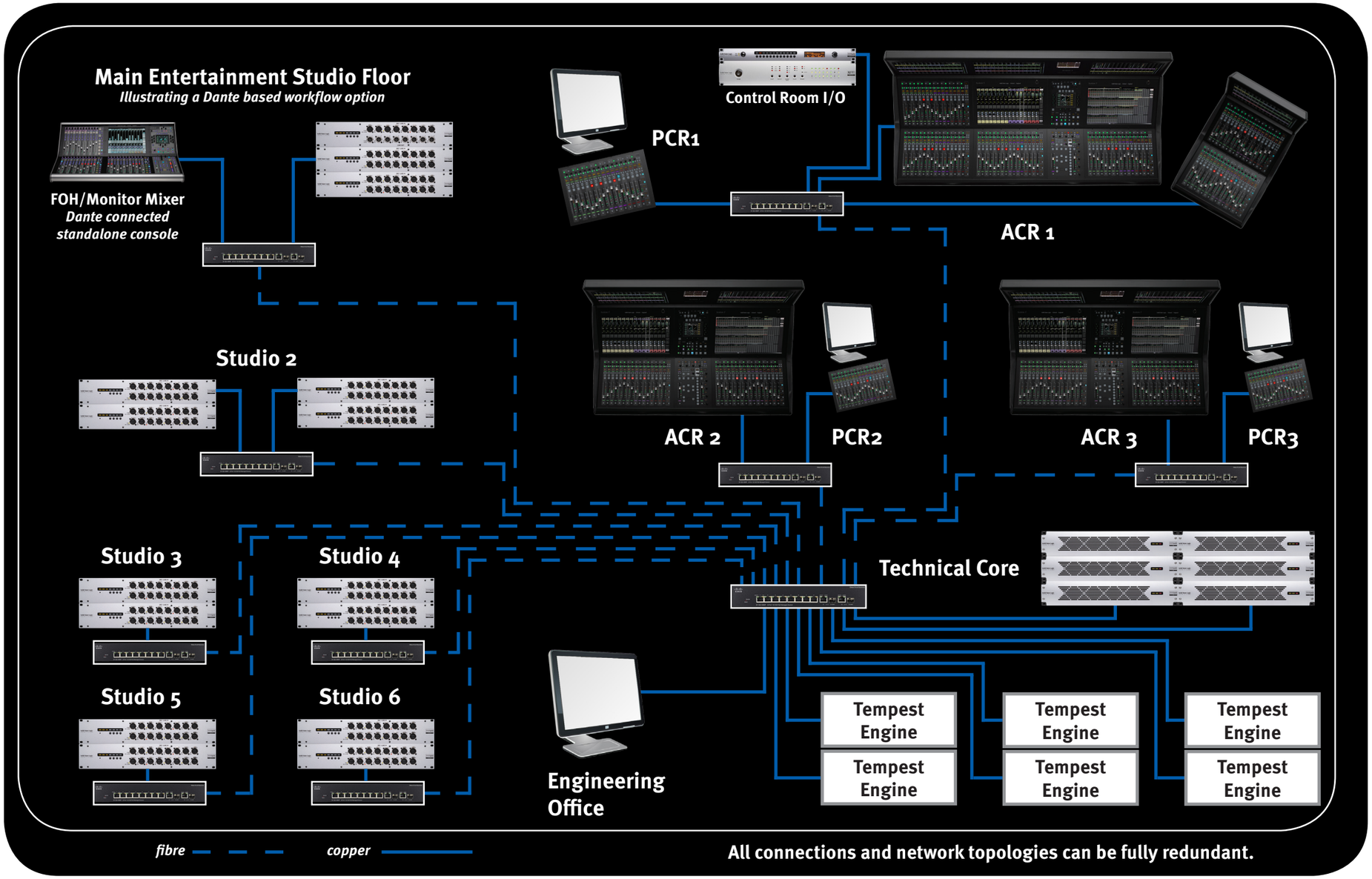
Large Scale Installation

This diagram illustrates just one of many ways System T can be used to create versatile scalable infrastructure for a large scale broadcast facility with multiple studio floors and control rooms and a single technical core.

There are two console frame based Control Clients (which could be used for Split or Parallel Control) in a main Audio Control Room, mid size console style Control Clients in ACR1 and ACR2 and SOLSA computer based Control Clients in three Production Galleries and in the Engineering Office. There is spare capacity to add temporary Control Clients.

There is a main entertainment studio floor with an illustration of how a Dante based approach to integration of local FOH/Monitor consoles can be achieved. There is remote mic/line I/O in five further studio floors, plus SDI, AES and MADI bridging to the Dante network in the technical core. High density Audio Control Room monitoring is illustrated with a combination of a Dante-MADI bridge unit and an SSL ALpha-Link Live-R.

The system is based around a dual-redundant network, with three redundant Tempest Processor Engine pairs that can, if required, be located in separate physical fire zones. Dotted lines represent the use of fibre for longer cable runs from the technical core. Single switches and network cables are illustrated to keep the diagram simple to read but all network layouts and redundancy topologies are supported.



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OB/Truck Configuration

This system shows the infrastructure for a typical Outside Broadcast production using a single System T ecosystem within OB1. There is a console frame based Control Client in a main Audio Control Room, and a SOLSA computer based Control Client in the Production Gallery.

There is Control Room I/O in the Audio Control Room, plus SDI, AES and MADI bridging to the Dante network in the technical core, and rear panel I/O within OB1. An OB Stagebox is deployed in the arena, with a Stagebox in the commentary area - a fibre based Dante connection runs back to OB1. The OB Stagebox is shown connected to a permanently installed Dante network within the arena (it would be straightforward for the truck to deploy its own arena network connected to the OB Stagebox if required).

The system is based around a dual-redundant network, with two redundant Tempest Processor Engines. Single switches and network cables are illustrated to keep the diagram simple to read but all network layouts and redundancy topologies are supported.

The Audio Control Room shows a single console frame based Control Client that provides 80 faders in a frame under 2m wide. A second System T equipped vehicle (OB2) is shown to illustrate how assets could be easily shared by two or more vehicles.