Case study: ClubCast and ClubClock

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K.I.S.S. Rule Co. Limited designed and built ClubCast and ClubClock: a PC app that puts any window, document or web page on every TV in a club room, a session timer readable from the back of the room, and self-managing TV units that tie them together.

At a glance

Client need	Bridge clubs run sessions with timers, results and seating that the whole room needs to see, on several TVs and projectors, run by volunteers
Solution	ClubCast (show any window, document or web page on every TV), ClubClock (a session timer readable across the room) and self-managing TV units based on Raspberry Pi 5
Delivered	Two Windows apps, a TV receiver, one-command TV provisioning, offline licensing, remote support, installers and Microsoft Store packaging
Proven	A 25-hour unattended soak test on three TVs; full club rebuilds from blank SD cards, following a printed runbook
Model	Annual licence per club, with TV units supplied preconfigured by K.I.S.S. Rule Co. Limited

The challenge

A bridge session runs on information the whole room needs to see: the round clock, the move, results and seating. The director's PC holds it all, but the players sit across a large room, often with several TVs and an ageing projector.

The usual options didn't fit:

- **HDMI cables and splitters** tie TVs to the PC and show one picture everywhere.

- **Consumer casting** (Chromecast, Miracast) shows one screen at a time, drops connections, and needs fiddling at the start of every session.
- **Digital signage systems** are built for loops of slides, not live windows, and are priced for businesses.

The people running the sessions are volunteers. Whatever replaced these had to start reliably every time, recover from power cuts and dropped Wi-Fi without anyone touching it, and be simple enough that nobody needed to understand how it worked. It also had to be supportable remotely, and priced for clubs.

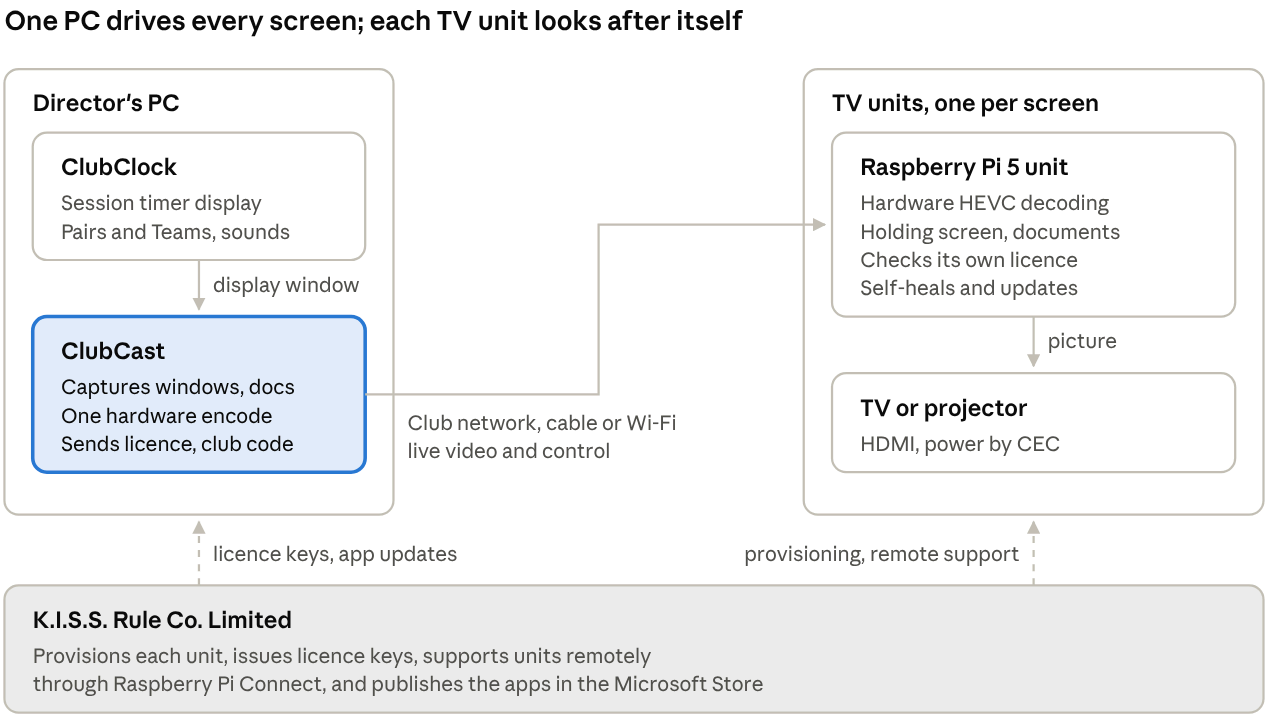
Our approach

We ran the work as a product-led sequence of small, proven steps, each tested on real club hardware before the next began.

- **Prove the hard part first.** Live window capture, hardware video encoding and delivery to TV units were proven in staged proofs of concept before any polish.
- **Test on the real thing.** Every change was checked on the actual PC, TVs, projector and club network, including the faults clubs really meet: power cuts, Wi-Fi drops, TVs that reset their own settings.
- **Design for volunteers.** Each feature was judged by whether a director could use it mid-session without help: one drag to show something, one click to stop.
- **Make it repeatable.** Once it worked, every step was scripted: provisioning, licensing, installers and packaging. The proof was rebuilding a whole club from blank SD cards by following a printed page.
- **Commercial from the start.** Licensing, branding, legal review and distribution were built in, not bolted on.

The solution

The director works on one PC; each TV has its own small unit that does the decoding, drawing and housekeeping itself, so nothing at the TVs needs attention.



ClubCast system · PC, club network, TV units and support

ClubCast captures what the director drags onto a TV, encodes it once in hardware and sends it over the club's own network; each unit decodes it, checks the club's licence and keeps itself running. K.I.S.S. Rule provisions, licenses and supports the units from outside the club.

ClubCast

ClubCast puts the director's PC on every TV in the room. Each TV appears on the PC as a small floating circle; dragging a window onto a circle shows it on that TV within seconds, live, while the window stays usable on the PC.

- **Any window, live:** the timer, the scoring program, a seating plan, a slide. An "All TVs" circle shows it everywhere.
- **Two windows side by side:** hold Ctrl while dropping a second window, and the TV shows both (stacked on a portrait TV). Remove either, or close it, and the other fills the screen.
- **Documents:** spreadsheets, word-processor files and PDFs dropped from File Explorer scroll smoothly on the TV, or hold still, chosen per TV.

- **Web pages:** a browser window opens on the TV itself, full screen and sharp; Shift + drop streams it as it looks on the PC instead.
- **Landscape or portrait,** per TV, with every screen laid out for its shape.
- **Screen power:** TVs switch on and off from the PC over HDMI-CEC, where the TV supports it.
- **Clear feedback:** each circle shows a live thumbnail and the TV′s state; Windows′ yellow border marks which windows are on the TVs.
- **Holding screens:** idle TVs show the club′s welcome, a large clock, the TV′s name and network address, and who it is licensed to.

ClubClock

ClubClock runs the session clock so the director doesn′t have to. It started as a feature of ClubCast and became a standalone app, so clubs can use it with or without TV units.

- **Pairs:** rounds of any number of boards at a set time per board, automatic move time, and an optional break. The next round starts by itself.
- **Teams:** one countdown for the whole playing time, of any length, with a "no more new boards" warning at a time the director chooses.
- **Sounds:** a chime as each round starts, a double chime with a minute left, spoken calls for the move and the break, from built-in voices or the club′s own recordings.
- **A display built for the room:** bright yellow seven-segment digits on black, the round, the time of day and the estimated finish. Full screen on a projector, or on every TV through ClubCast.
- **The director stays in control:** pause, plus or minus a minute and next round, from the setup window, on-screen controls that appear only when the mouse moves, or the keyboard.
- **Presets:** each kind of session saved once and started with one click.

Engineering challenges solved

Most of the effort went into the problems a club room actually throws at a system like this.

Challenge	What we found	How we solved it
Capturing modern Windows apps	Older screen-capture methods show modern apps as black	Windows Graphics Capture, which captures a window even when it's covered
Smooth video on modest hardware	Software encoding loads a club PC heavily	Automatic choice of the PC's hardware encoder (Intel, NVIDIA or AMD), with a fallback; one encode shared by every TV
Latency drift	A stream slowly falls behind the PC	The TV speeds up slightly when behind, and restarts the stream if it falls too far behind
Sound over Wi-Fi	Audio drifted out of sync and froze the picture	Picture-only streaming; the PC plays sounds directly
TVs resetting themselves	A TV woke from standby in a 4K, 30 Hz mode the units can't play smoothly	Each unit checks its screen mode every 30 seconds and corrects it
Wi-Fi drop-outs	Wi-Fi power saving interrupted live video	Power saving turned off on every unit; units re-announce themselves when their address changes
Finding the TVs	Network announcements are easily lost on Wi-Fi	The PC remembers its TVs, connects directly, and looks again every minute for any that are missing
Unattended recovery	Players freeze, connections drop, PCs crash	A watchdog on each unit restarts a frozen player; the PC returns orphaned TVs to their holding screen
Portrait TVs	Rotating the screen left the page and player at the old shape	Rotation applied by the unit itself, which redraws everything at the new shape

Challenge	What we found	How we solved it
Running for hours	The PC must stay awake and keep capturing	The PC stays awake while projecting, and warns when a projected window is minimised

Licensing and the commercial model

Both apps are licensed per club, per year, with a licence system designed to need no server and collect no data.

- **Signed keys, checked offline.** Each key names the product, the club and the expiry date, and is signed with ECDSA P-256. The apps check it without contacting anyone, and a key can't be altered or forged.
- **Tied to the club's TVs.** A ClubCast key lists the serial numbers of the club's TV units, and each unit checks it for itself, so a key shared with another club does nothing on their TVs.
- **A visible, gentle nudge.** Unlicensed, everything still works; the display and TVs show a faint "UNLICENSED COPY" strip, readable on any background. Licensed TVs show "Licensed to" and the club's name.
- **Renewals that are fair.** A renewal runs on from the end of the previous licence. The apps remind the club in the last 30 days, and a single command lists every club due for renewal.
- **Built to extend.** The same key format, tooling and register serve future K.I.S.S. Rule products.

Deployment, updates and support

A club receives TV units that work on arrival, and K.I.S.S. Rule can support them from anywhere.

- **One-command provisioning.** A freshly flashed SD card becomes a finished TV unit in 10 to 20 minutes with one command: software installed, named to a standard (licensee plus TV number), the club's Wi-Fi saved, the unit recorded for the club's licence, and remote support linked.
- **Self-maintaining units.** Each unit installs software updates weekly at a quiet hour and restarts, and remembers several Wi-Fi networks, joining whichever is in range.

- **Remote support.** Every unit is reachable through Raspberry Pi Connect, with remote shell and screen sharing in a browser, with no ports opened on the club's network.
- **Licensed-codec decoding only.** Video is decoded solely by the Raspberry Pi 5's licensed hardware HEVC decoder, with software fallback switched off and logged.
- **Clean PC installs.** Installers bundle .NET and fetch an LGPL build of FFmpeg from its publisher rather than redistributing it. The apps are also packaged as MSIX for the Microsoft Store, giving warning-free installs and automatic updates.
- **A printed runbook.** The whole process, from blank SD cards to a licensed club, is a step-by-step document with a troubleshooting table drawn from real faults.

Delivery stages

The product was built in eight stages, each proven on real hardware before the next.

1. **Proof of concept:** live window capture, hardware encoding and delivery to Raspberry Pi 5 TV units, tested in stages.
2. **Reliability:** self-healing players and connections, screen-mode and Wi-Fi fixes, proven by a 25-hour unattended soak test on three TVs.
3. **Club features:** documents, web pages, screen power, holding screens, then scrolling control, portrait TVs and two windows side by side.
4. **ClubClock:** a built-in timer, then a standalone app with Pairs and Teams, sounds and a full-screen display with director controls.
5. **Productisation:** installers, versioning, one-command provisioning and a printed deployment runbook.
6. **Commercial:** signed licence keys, watermarks, unit-bound keys, renewals and a licence register.
7. **Support at scale:** remote access, weekly self-updates, multiple Wi-Fi networks and hardware-only decoding.
8. **Brand and distribution:** the ClubCast and ClubClock names, Microsoft Store packaging, listings and a privacy policy.

Results

The result is a system a volunteer can run with one drag, which K.I.S.S. Rule can deploy, license and support at scale.

Measure	Result
Unattended running	25+ hours across three TVs; the PC app's memory stayed steady (136 MB to 176 MB over 6 hours), and every Wi-Fi drop recovered by itself
PC load	Three TVs from one hardware encode: about 13 to 20% CPU at about 6.8 Mbit/s, on a laptop-class Intel processor
Setting up a TV	One command, 10 to 20 minutes per unit, from a blank SD card
Setting up a club	Rebuilt end to end from blank SD cards by following the printed runbook word for word
First run of ClubCast	Video components fetched and ready in about 16 seconds
Decoding	100% in the Raspberry Pi 5's licensed hardware decoder, confirmed on every unit
Licensing	Keys bound to each club's units; a shared key does nothing on another club's TVs

Technology

Area	Technology
PC apps	C# and WPF on .NET 10, for Windows 10 and 11
Capture and encoding	Windows Graphics Capture; FFmpeg (LGPL) with hardware HEVC encoding via Intel Quick Sync, NVIDIA NVENC or AMD AMF
Streaming	SRT over the club's local network, one encode shared by every TV
TV units	Raspberry Pi 5, Raspberry Pi OS; Python receiver; mpv with hardware HEVC decoding; Chromium for holding screens, documents and web pages

Area	Technology
Discovery and control	mDNS service announcement; WebSocket control with a shared club code
TV power	HDMI-CEC
Documents	LibreOffice and Poppler conversion on the unit; openpyxl for spreadsheets
Licensing	ECDSA P-256 signed keys, verified offline in .NET and Python
Remote support	Raspberry Pi Connect
Distribution	Inno Setup installers; MSIX packages for the Microsoft Store