Find the Constraint First: Designing Wi-Fi for Any Environment



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Nine buildings, nine different problems, and one question that should come before every design.

Over the last nine articles, this series has walked through nine very different environments.

A school. A hotel. A hospital. A warehouse. A stadium. A multi-tenant building. A heritage building. A retail chain. An event.

On the surface, they had very little in common.

Different users. Different devices. Different construction. Different budgets. Different risks.

But underneath, the same thing happened every time.

One constraint dominated the environment.

And once that constraint was understood, most of the important design decisions followed from it.

That is the idea this final article is about.

Before you choose an access point, a channel width or a mounting position, find the constraint first.

Nine buildings, nine constraints

It is worth putting them side by side.

Schools: synchronised demand.

The timetable moves everyone at once. Devices connect and become active together, and the network has to cope with the bell, not just the average.

Hotels: consistency.

Hundreds of rooms, each with its own walls and its own guests, all expected to deliver a consistent experience.

Hospitals: criticality.

A network where an outage can affect patient care, supporting critical devices and clinical workflows.

Warehouses: change.

The building changes shape with the stock. The RF environment on the day of the survey is not necessarily the one the network lives in.

Stadiums: density without separation.

A space with no walls between seating sections, where the crowd itself becomes part of the RF design.

Multi-tenant buildings: ownership.

You control your network, but not the RF environment it lives in.

Heritage buildings: permission.

You design for where you are allowed to put the access points, not simply where the RF wants them.

Retail chains: repetition.

Every decision is copied, good or bad, across the estate.

Events: time.

The network is built quickly, used intensively and removed. It has to work the first time.

None of those constraints replaced good wireless design.

Coverage, capacity, roaming, security and validation mattered in every one of them.

What the constraint changed was the order of priority. It decided which trade-offs mattered most, where the effort went and what had to be proven before the network could be called finished.

How to find the constraint

The dominant constraint is not always obvious, and the customer will rarely describe it in those terms.

They will tell you how many users there are, how big the building is and when they need it installed.

The constraint is usually hiding in the answers to a different set of questions.

What happens if this network fails?

If the answer involves patient care, safety, lost revenue or a queue of people watching, criticality may be the constraint.

What changes, and how quickly?

Stock levels. Tenants. Stands. Seasons. Timetables. If the environment changes, the design has to account for that change.

When does demand arrive?

Steadily through the day, or all at once? A design built only for the average can fail at the peak.

Who controls the building, the spectrum and the installation?

Neighbours, landlords, conservation officers, exhibitors and stand builders can all limit what you are able to do.

How many times will this design be built?

Once, or five hundred times? Repetition changes the cost of every decision.

What opportunity is there to test and correct problems before the network is needed?

Can you run a representative pilot, or is the first realistic test the morning everyone arrives?

What are the least capable, most important devices?

A ten-year-old scanner, a clinical device or a payment terminal can define the design more than the newest smartphone.

Ask those questions before the design starts.

The answers will usually point to one constraint that matters more than the others.

Most buildings have more than one

Real buildings rarely fit neatly into a single article.

Consider a hotel in a listed country house that hosts weddings and conferences.

Consistency matters, because every guest room should deliver a reliable experience.

Permission matters, because the building limits where the access points and cables can go.

Time matters, because the conference suite has to work on the first morning of every event.

That does not mean all three constraints are equal.

On a refurbishment project, permission may decide the design, because nothing else is possible until the access point locations are approved.

On an event weekend, time may become the dominant constraint for that one space.

So identify the dominant constraint, then identify the secondary ones.

Write them down.

Make the trade-offs visible, so that everyone involved understands why a decision was made, rather than discovering the competing constraint after installation.

The constraint can change over time

The constraint that dominates the design is not always the one that dominates operation.

A warehouse may be designed around stock and racking, then operated around the reliability of automated vehicles.

A retail estate may be designed around repetition, then operated around change management and outlier stores.

A multi-tenant building may be stable on handover day and dominated by new neighbours a year later.

That is why design documentation matters.

Record the constraint the design was built around, the assumptions that were made and the baseline that existed at the time.

When the building changes, the next engineer can see whether the original constraint still applies or whether a new one has taken its place.

Validate against the constraint

Every network needs validation.

But the most important test is usually the one that challenges the dominant constraint directly.

In a school, test when the bell goes and the devices move.

In a warehouse, test with the racking full and representative stock in place.

In a stadium, test with people in the seats where possible, and account explicitly for what an empty bowl cannot tell you.

In a hospital, validate the clinical workflows and critical devices with the teams responsible for them.

In a retail chain, test the template in representative stores before it is copied.

At an event, test registration with the stands powered and the surrounding infrastructure running, not just in a quiet hall the evening before.

A survey report full of good signal measurements can still miss the one condition that defines success.

If the constraint is time, test the first hour.

If the constraint is change, test after the change.

If the constraint is criticality, validate failure and recovery under controlled conditions.

The mistakes that repeat across every building

Looking back across the series, the same mistakes appear in different forms.

Copying a design from the wrong environment.

A flagship store template rolled out to buildings it does not represent. A best practice from one environment applied to another without asking what still depends on the old behaviour.

Designing for the drawing instead of the building.

The empty hall. The empty warehouse. The empty stadium. The floor plan with no walls marked. The heritage drawing that says nothing about what is inside the stone.

Designing for the average instead of the moment that matters.

The steady state looks fine. The bell, the kick-off, the registration rush and the break between sessions do not.

Treating the network as finished.

New tenants. New stock. New stands. New firmware. New devices. Every environment in this series changed after handover in some way.

Forgetting the device that matters most.

The scanner, the clinical device, the payment terminal, the handheld in the stockroom. Good coverage for a laptop does not guarantee a working service for those devices.

Each of those mistakes points back to the same question.

Was the constraint understood and carried through the design?

What does not change

The fundamentals still apply in every building.

Gather requirements properly. Understand the client devices. Survey and validate on site. Plan channels and capacity. Secure the network. Document the decisions. Monitor what changes.

The constraint tells you where those activities need the most attention, which compromises are acceptable and which ones are not.

That is the difference between a design that is technically correct and a design that works in the building it was built for.

Final Thoughts

Every environment in this series looked like a different problem.

In practice, each one brought us back to the same question.

What dominates this environment?

Synchronised demand. Consistency. Criticality. Change. Density. Ownership. Permission. Repetition. Time.

Find it before the design starts.

Identify the secondary constraints and make the trade-offs visible. Validate against the condition that defines success, not just the conditions that are easiest to measure.

And write the constraint down, because the building will change long after the design has been handed over.

Good wireless design does not start with the access point.

It starts with understanding what the building will not let you ignore.

This is the final part of a series on designing wireless for real environments, where the constraint that dominates the environment influences the design.

Jarryd De Oliveira, CWNE #594

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