# Common Mechanism in a Box: point-of-synthesis DNA screening

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Scan to give feedback

## Background

DNA synthesis machines are required for modern biotechnology, academic research, and medical diagnostics, but the same machine can print the sequences of regulated pathogens. Synthesis screening is the countermeasure: every ordered sequence is checked against reference databases, and the order is refused when that sequence appears to encode a pathogen or a toxin.

Voluntary adoption has largely failed: much synthesised DNA is never screened, and unregulated fragments can be ordered separately and assembled to bypass the screens that do run [1]. Regulation is catching up, with rules passed in some jurisdictions and drafted in others. AI design tools raise the stakes further: genome language models have already generated working bacteriophages [2].

The Common Mechanism [3], from the International Biosecurity and Biosafety Initiative for Science (IBBIS), screens orders offline at the point of synthesis, so no sequence ever leaves the provider.

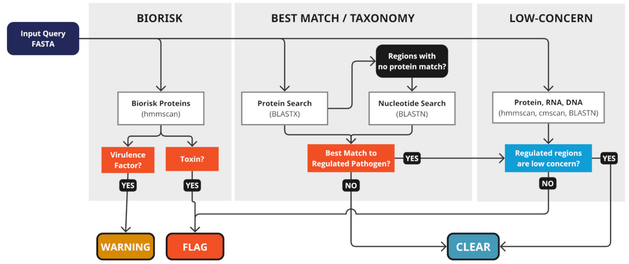



**Figure 1.** The Common Mechanism screens every query three ways: biorisk proteins, taxonomic best match, and low-concern exemptions. It then returns a flag, a warning, or a clear.

Three things block adoption: providers have no technical staff to install and drive a command-line tool, no local compute to run it on, and import and export controls that stop a configured workstation being shipped to them.

## Methods

commec-in-a-box is an ordinary business-class mini-PC, a one-litre Lenovo ThinkCentre of about 1.2 kg, that arrives pre-imaged and screens entirely offline. commec-gui wraps the screening engine in a local web page: paste a sequence, upload a FASTA, point at a file on the box, or paste spreadsheet rows. No command line, and nothing leaves the machine.

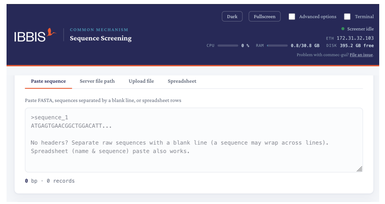




**Figure 2.** The appliance, shown beside an apple for scale, and its interface. Any hardware clearing a minimum spec works, so providers buy locally instead of importing.

## Distribution

Provisioning drives are built by a reproducible pipeline: it spins up a virtual machine, builds the exact disc image, wraps it with Clonezilla and flashes the result to a USB drive. Boot any compatible computer from that drive and it becomes a commec box.

We provide three routes, for different levels of export control.

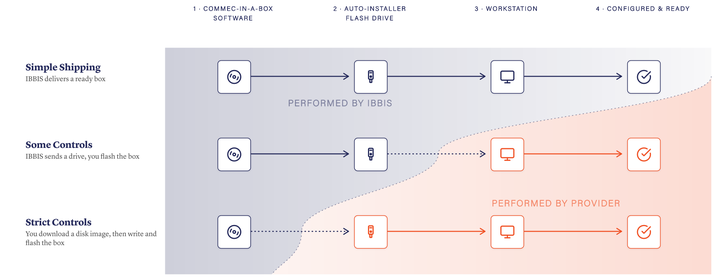



**Figure 3.** Three distribution models. Navy marks the stages IBBIS performs and orange those the synthesis provider performs; the handoff slides earlier as local export controls tighten.

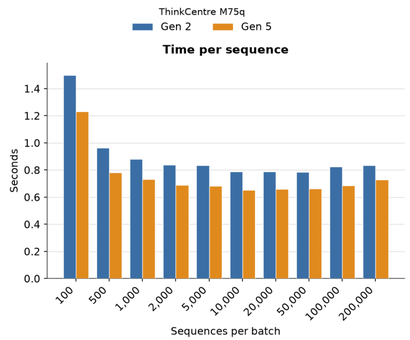
## Evaluation

Throughput was measured on two generations of ThinkCentres over batches from 100 to 200,000 sequences. Usability was tested with five pairs of fellows who had never seen the system. Each pair was given a workstation with no software on it, a provisioning drive and a printed guide, then asked to flash the machine, set it up and reach a verdict on a test order, and finally completed the System Usability Scale [4].

# Results

## Throughput

IBBIS set a target of 1,000 sequences per day, drawn from conversations with synthesis providers. The appliance can screen a sequence in roughly 0.7 s and never approaches its memory ceiling.




**12-15 min**
to screen 1,000 sequences, by generation; the target was 1,000 per day

**4.6 GB**
peak RAM of the 16 GB installed, at a 200,000-sequence batch

**Figure 4.** Time to screen one sequence, by batch size, on the two ThinkCentre generations tested.

## Usability

**83.8**
mean SUS score, against a published mean of 70.1 [5]

**5 of 5**
teams set the box up unassisted

**21 min**
mean, from bare hardware through flashing and setup to a verdict

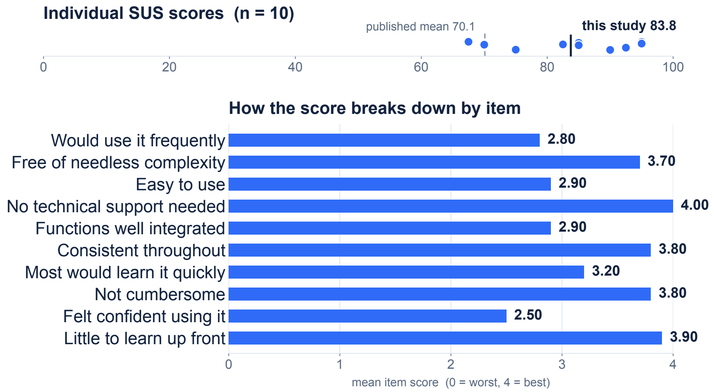



**Figure 5.** System Usability Scale, n = 10. Mean 83.8, median 85, sd 10.0. Negatively worded items are reverse-scored, so a longer bar is always better.

## Limitations

Participants were AI-safety and AI × Bio fellows rather than synthesis-provider staff, and n = 10.

Real deployments introduced additional complications. Reaching the box over a local network depends on the site's own topology, and VLANs or host isolation can block access between machines, so deployment has to be coordinated with the synthesis provider's IT staff. Serving the interface over the LAN needs a certificate no browser will trust by default. Updating an airgapped box is challenging: either the airgap is partly broken under controlled network access, or updates travel on physical media.

## Future directions

Boxes are going out to synthesis providers now. The work in progress is collecting feedback from them in ordinary use: how screening fits an existing order flow, what keeping the databases current costs a provider, and where the interface still gets in the way.

[1] Edison, R., Toner, S. & Esvelt, K. M. Assembling unregulated DNA segments bypasses synthesis screening. *Nat. Commun.* 17, 2026. [2] King, S. et al. Generative design of novel bacteriophages with genome language models. *bioRxiv*, 2025. [3] Wheeler, N. E. et al. Developing a common global baseline for nucleic acid synthesis screening. *Appl. Biosafety* 29, 71, 2024. [4] Brooke, J. SUS: a quick and dirty usability scale, 1996. [5] Bangor, A., Kortum, P. T. & Miller, J. T. An empirical evaluation of the System Usability Scale. *Int. J. Hum. Comput. Interact.* 24, 574, 2008. Thanks to Tessa Alexanian for mentorship and to the CBAI fellows who tested it.

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