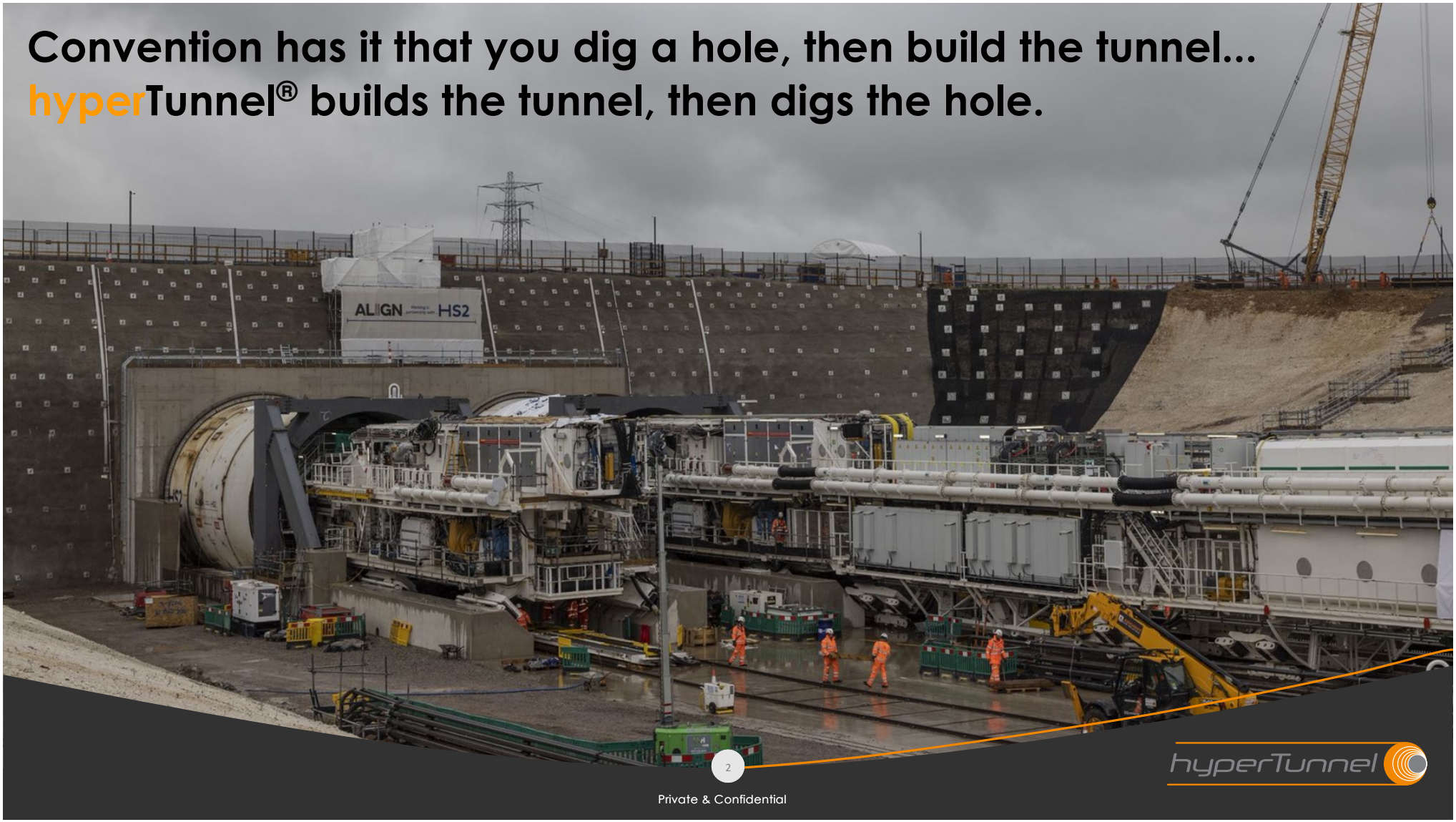
Technology Overview

September 2023

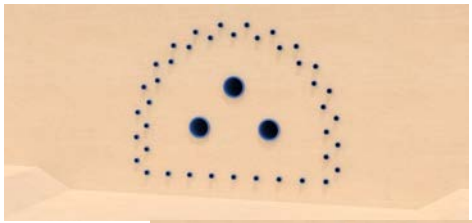
Convention has it that you dig a hole, then build the tunnel...
hyperTunnel® builds the tunnel, then digs the hole.



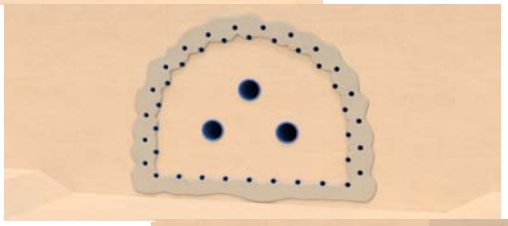
hyperTunnel Overview

So what is hyperTunnel?

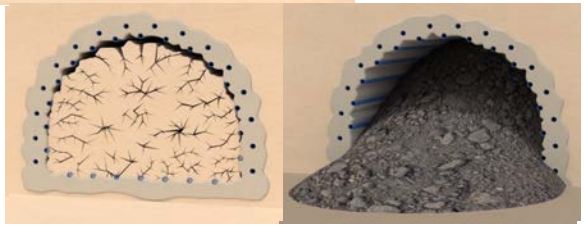
Convention would have it that you dig a hole, then build the tunnel...
hyperTunnel® builds the tunnel, then digs the hole.



First, we drill bores around the periphery of the tunnel using established, off the shelf, horizontal directional drilling (HDD) technology.

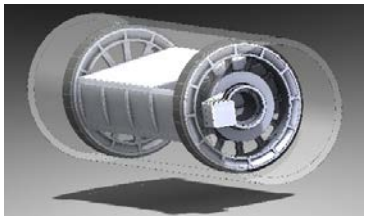


Then we deploy chemistry from the bores into the surrounding geology to create a strong tunnel structure – *this is the really clever bit*.



Then remove the material inside the tunnel in complete safety using simple earthmoving equipment and finally spray concrete a smooth lining, if required.

The really clever bit....
3D printing a tunnel structure in the geology



To begin with we send robots (we call them bots) into the bores to inspect the geology (using, for example, ground penetrating radar). Together with the core samples already taken we develop an almost perfect understanding of the geology along the entire tunnel length.

Then we use our chemical expert partners to design the optimum treatment to turn the geology into a sound structure – we use this to develop a 3D model of the tunnel structure; the digital twin.

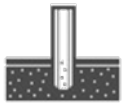
Different, quite simple, bots then drill from the bores into the geology and further bots arrive and deploy the chemistry – we then inspect again to ensure the chemical spread matches the digital twin.

Thousands of bots will be used, all controlled using swarm technology. Basically, we 3D print the tunnel in much the same way that thousands of bees build a hive or termites build a mound.

hyperTunnel's four phased platform approach summary

1. Preparation

- Core sampling and advanced geophysical surveying techniques to populate digital twin and initiate machine learning



2. Construction

- 3D printing / additive manufacturing for the pre-excavation structure

3. Excavation

- Remotely controlled excavation for a safer workforce environment

4. Completion

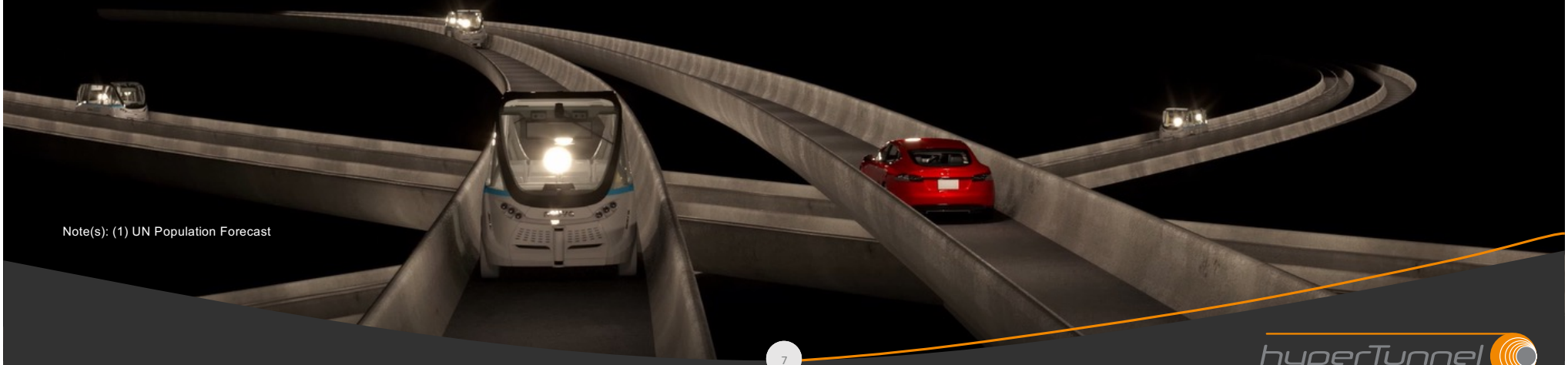
- Custom lining for the tunnel and post-construction opportunities

Why now?

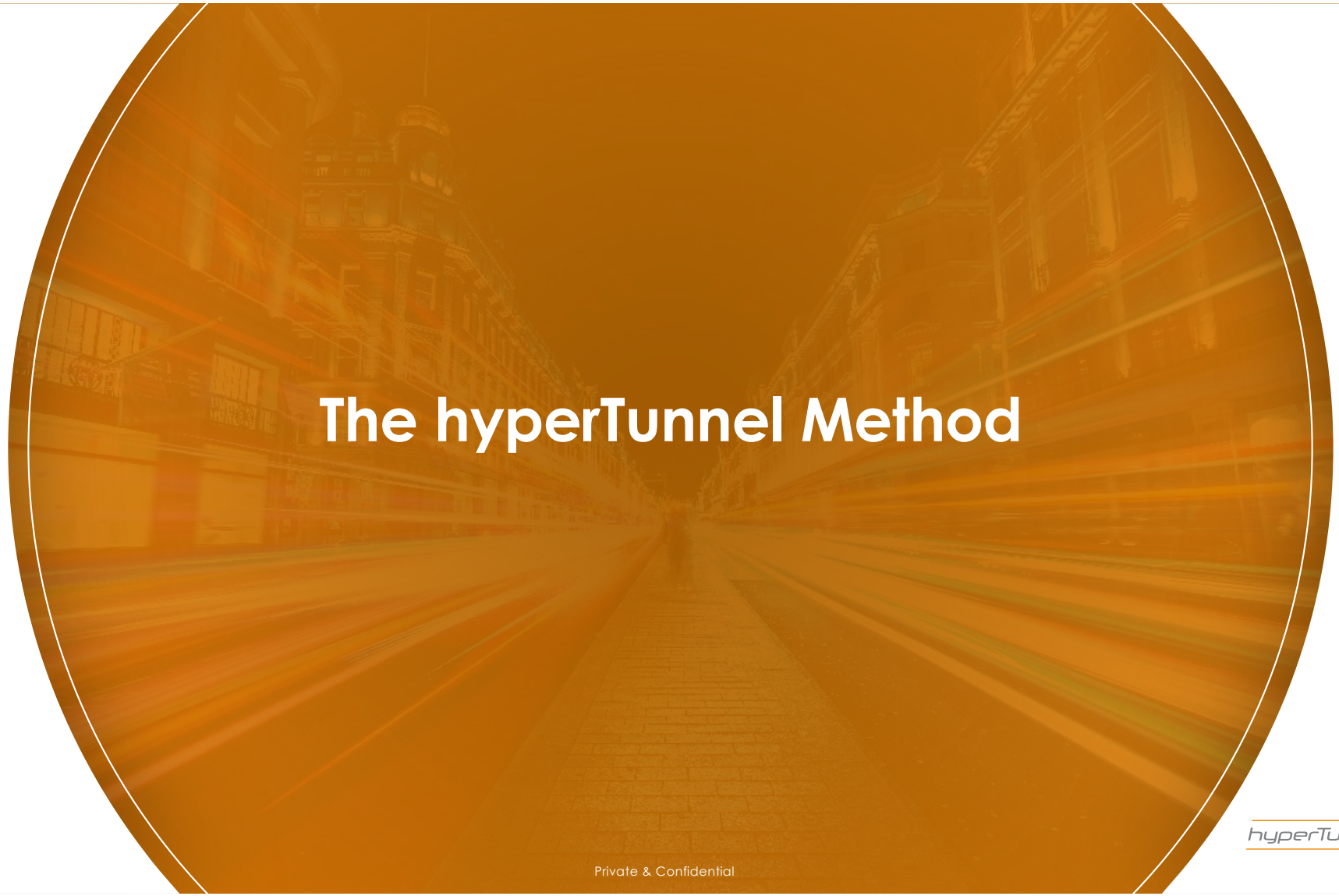
The global population is expected to increase to 9.2 billion in 2040[1], with urgent need for underground infrastructure.

Governments are pledging €billions toward infrastructure and require cost effective, sustainable solutions.

The €130 billion industry is slow to adopt innovations such as digital twins, 3D geotechnical layering, AI and robotics, which creates a **disruption opportunity.**



Note(s): (1) UN Population Forecast

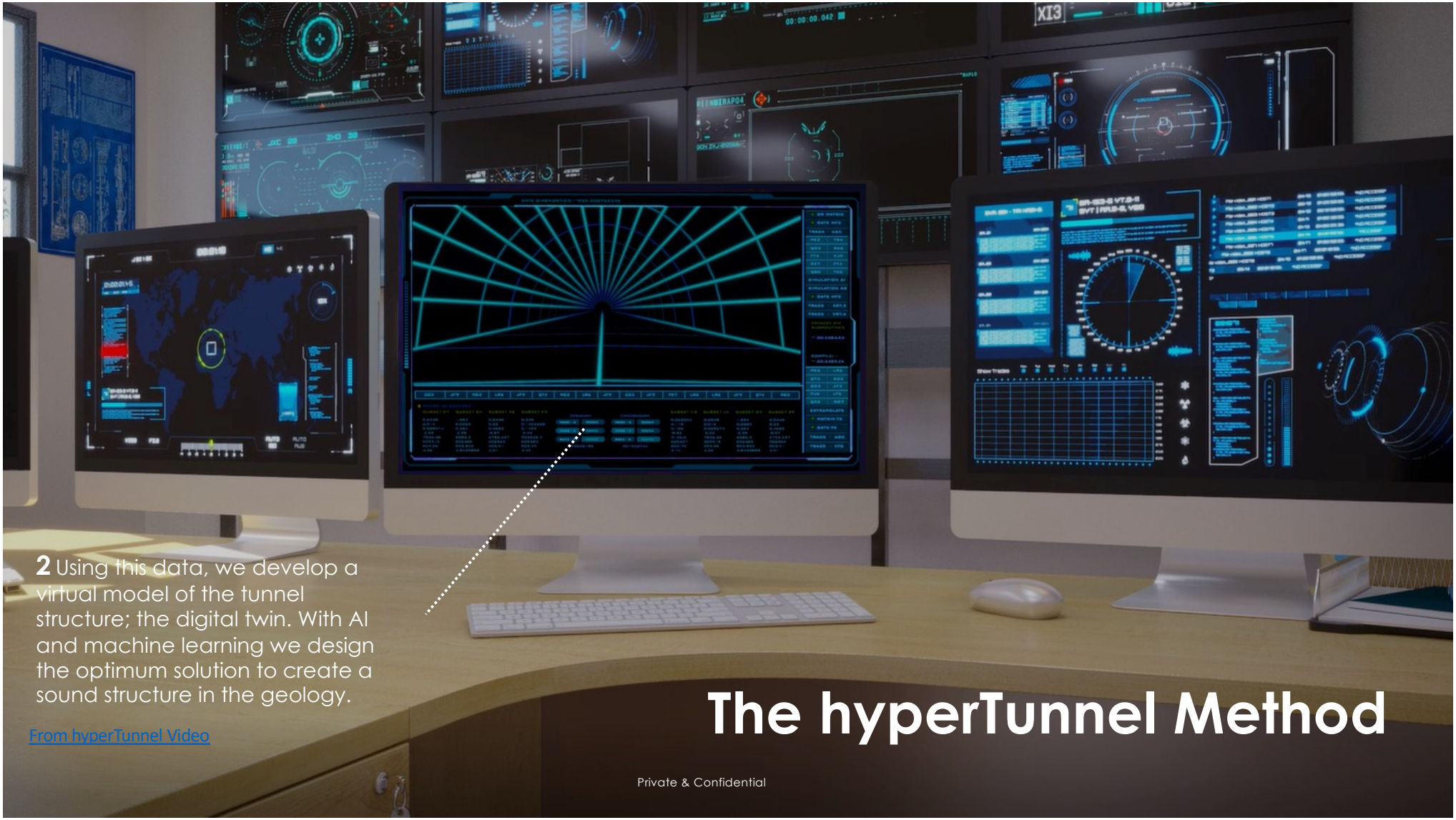


The hyperTunnel Method

The hyperTunnel Method

1 We drill and line pilot bores and send robots inside to inspect the geology taking core samples and scanning using ground penetrating radar.
Result: A near perfect understanding of the entire tunnel length's geology.

From hyperTunnel Video

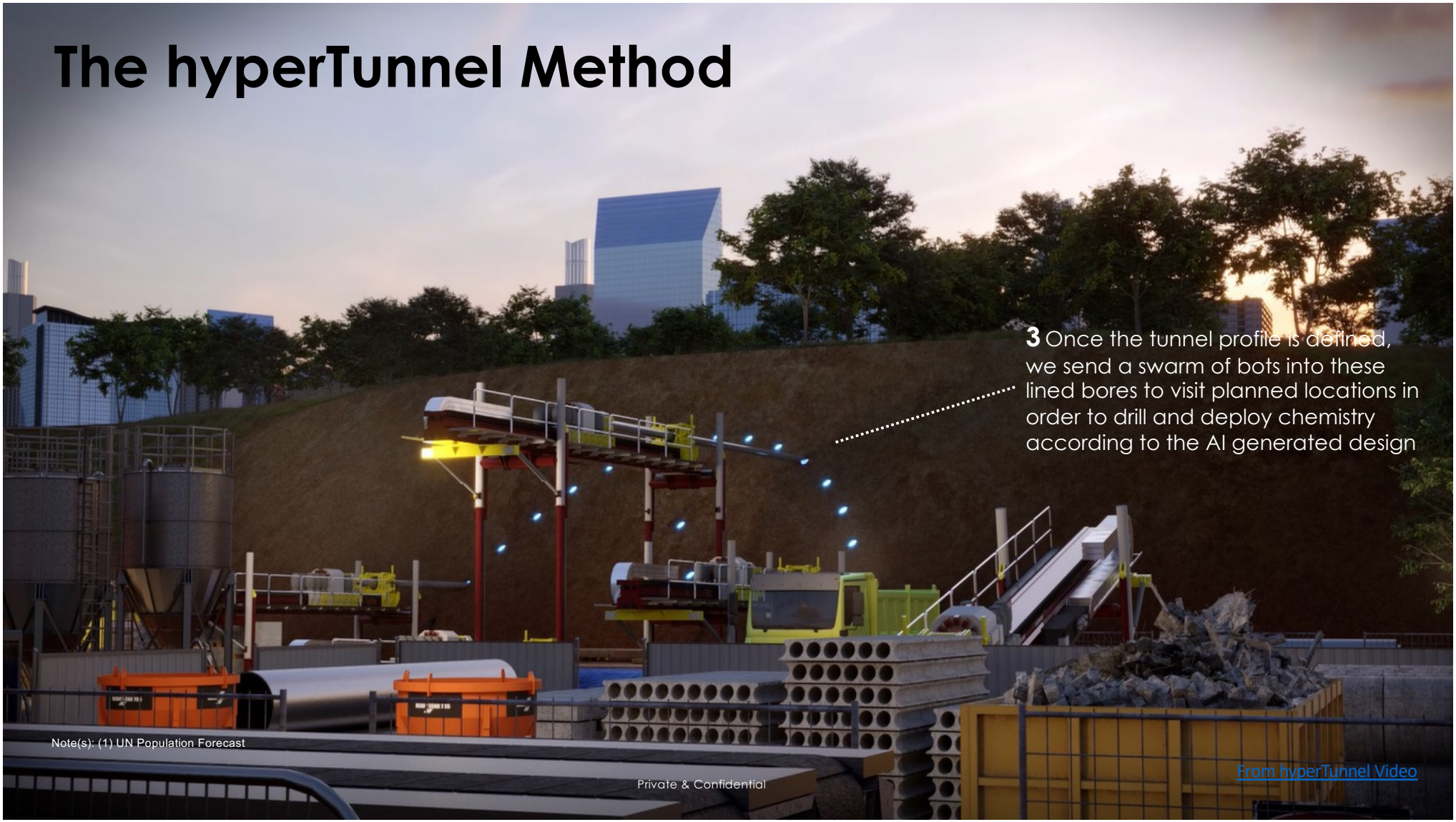


2 Using this data, we develop a virtual model of the tunnel structure; the digital twin. With AI and machine learning we design the optimum solution to create a sound structure in the geology.

From hyperTunnel Video

The hyperTunnel Method

The hyperTunnel Method

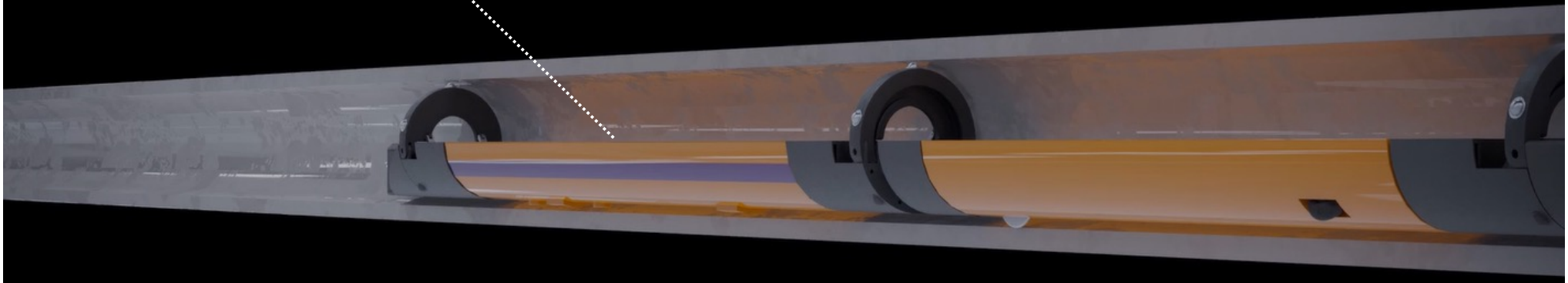


3 Once the tunnel profile is defined, we send a swarm of bots into these lined bores to visit planned locations in order to drill and deploy chemistry according to the AI generated design

Note(s): (1) UN Population Forecast

From hyperTunnel Video

4 Thousands of robots will be used, all controlled using swarm technology to 3D print the tunnel in the same way that bees build a hive or termites build a mound.



The hyperTunnel Method

From hyperTunnel Video

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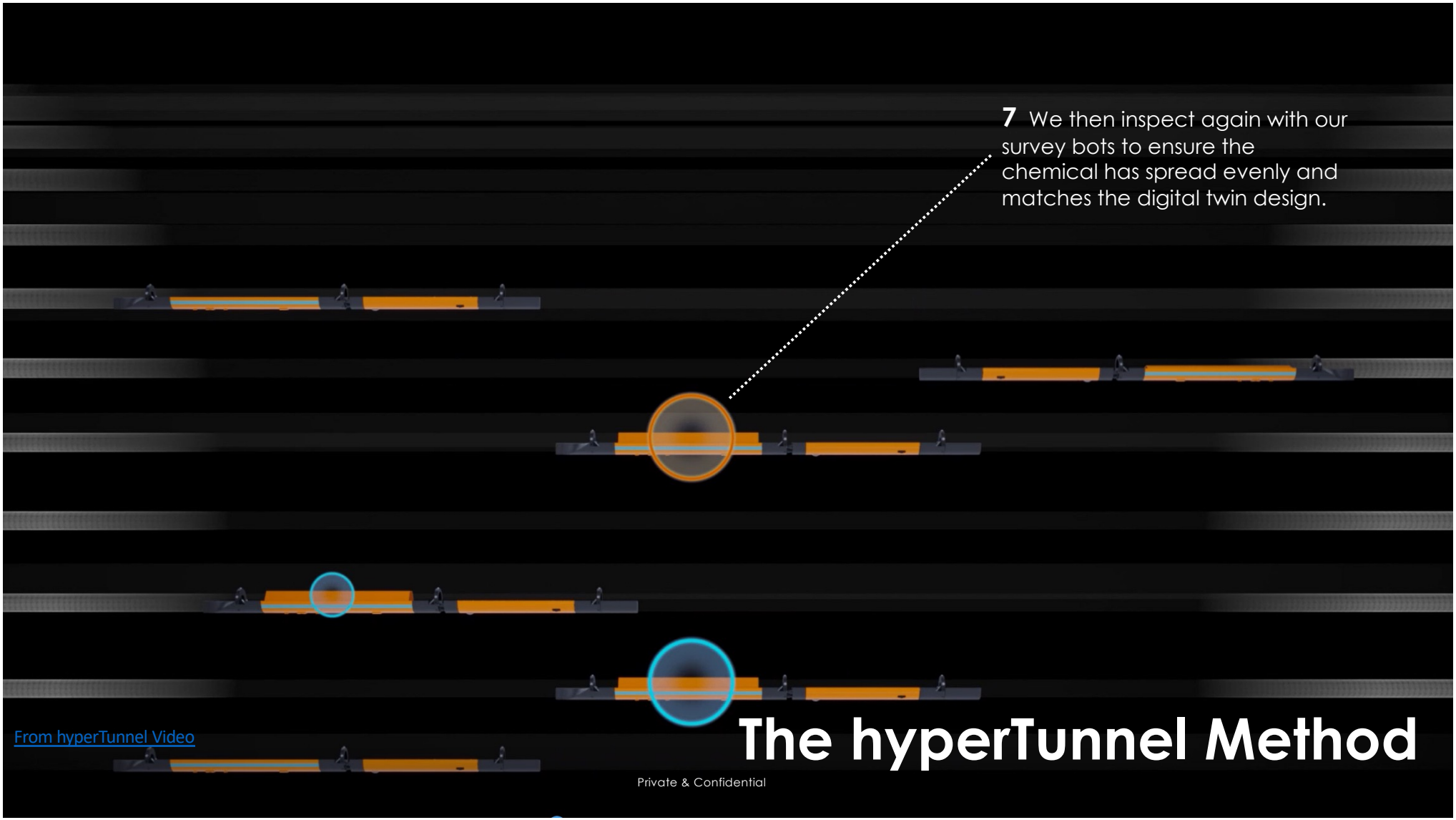
The hyperTunnel Method

6 The cast in situ blocks interlock to create a permanent structure, block by block.

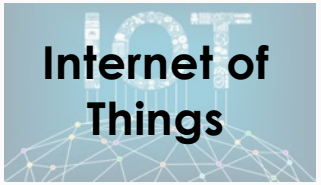


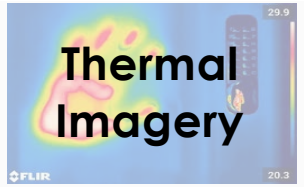
The hyperTunnel Method

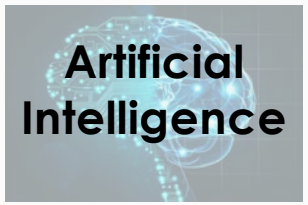
8 The tunnel walls are prepared for final use, leaving a **smart** structure that can be monitored and maintained throughout its life.

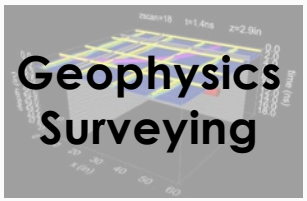
From hyperTunnel Video

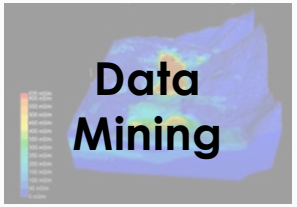
hyperTunnel® leverages existing technologies

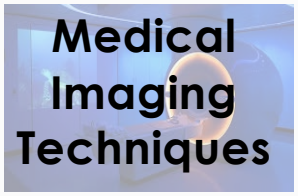


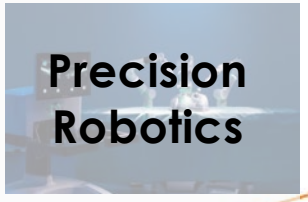




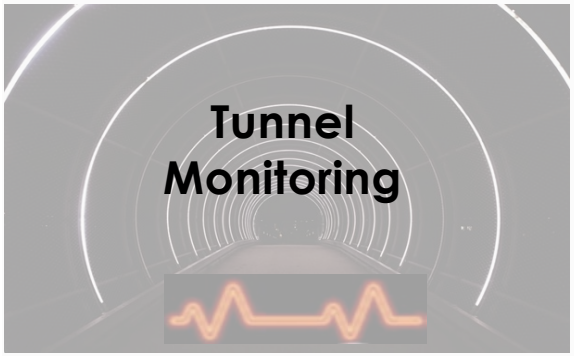


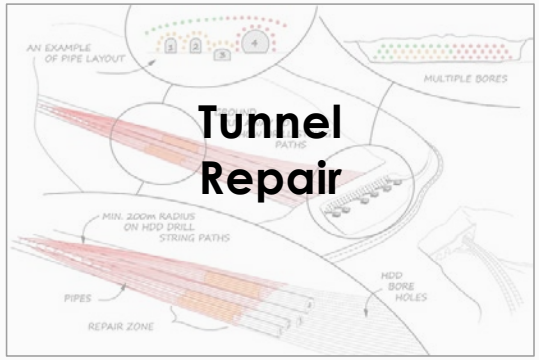


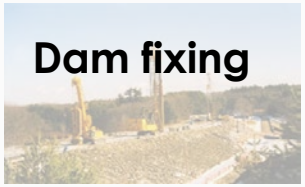


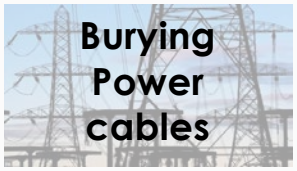


hyperTunnel® applications









Target industry sectors

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