PARK SHARK

Operational & Business Architecture

Competitive landscape, resolved and open strategic questions, and the business and operations model

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Companion to: System Architecture v7, Power Breakdown v7, Circuit Design & Production Notes v6, Full Network BOM & Budget v1

1. Purpose of This Document

Park Shark already has a technical architecture: five hardware classes (Guardian Sensor, Lane Sensor, Gate Sensor, LF Tool, WiFi Unit) documented in detail across System Architecture v7, Power Breakdown v7, Circuit Design & Production Notes v6, and the Full Network BOM & Budget v1. What has not existed until now is a single document that lays out the business and operational side with the same rigor — who we compete with, who we can work alongside, who we remain in real conflict with, what we have actually resolved about how this business runs versus what is still open, and what ideas we tried and rejected along the way.

This document is the output of an extended strategy session in which every claim was pushed on, re-argued, and in several cases corrected. Where a position changed during that process, both the discarded version and the reasoning for discarding it are recorded here — not because the discarded version was a mistake to hide, but because the reasoning is itself part of the case for the current position, and because an investor or reviewer who sees a rejected idea will trust the surviving idea more than one that arrived unchallenged.

A note on honesty throughout: this document distinguishes clearly between what is confirmed (existing hardware capability, filed facts, sourced third-party data), what is a reasoned estimate, and what is genuinely still an open question. Overclaiming any of these categories as another would be a bigger risk to Park Shark than admitting the gap directly — particularly because two of the specific NC IDEA reviewers who raised the "why now" and innovation concerns addressed in Section 11 may read this material again.

2. Executive Summary

Park Shark is a ceiling- and wall-mounted parking sensor network that reports live, per-spot occupancy plus vehicle identity (via passive TPMS RF signature, not persistent camera surveillance) at a fraction of the installed cost of a camera-based or wired ground-sensor system. The company is not building a reservations app (that is SpotHero/Arrive's business) and not becoming a lot operator (that is AirGarage/Metropolis's business). Park Shark is building the physical data layer underneath both categories — the layer that a Google, an Uber, a Metropolis, or an Arrive would each have a distinct reason to eventually license or acquire rather than build themselves.

The business plan follows a staged sequence, referred to internally as the "metamorphosis" model, deliberately built so that Park Shark never needs an incumbent's permission or cooperation to survive the next stage — only to grow faster than it otherwise would:

- **Stage 1 — Unencumbered deployment.** Sensors go into lots with no existing exclusive vendor contract standing in the way: campuses, municipal and government lots, and independent private lots. Revenue here is B2G/B2B (data, analytics, and municipal contracts), not dependent on driver-side payment volume.
- **Stage 2 — Reference dataset and government revenue.** Live occupancy data and a track record of accuracy are built where Park Shark faces no gatekeeper, creating the evidence base needed for any later distribution conversation and a standalone revenue stream that does not require Google, Apple, or any incumbent app to say yes to anything.
- **Stage 3 — Encumbered lots, sold to the incumbent, not around it.** Where a lot already has a management/payment relationship (an Arrive-brand app, a traditional management firm, or a camera-based operator), Park Shark approaches the incumbent with the data layer as a complementary upgrade rather than trying to go around them to the property owner.
- **Stage 4 — Google/Apple Maps distribution.** Only after Stages 1–3 produce a defensible, evidenced dataset does Park Shark pursue a Maps-native presence — modeled first on Google's existing Popular Times precedent (a live data overlay, not a payment relationship) and, if warranted later, a visible-but-not-fully-integrated card similar to how SpotHero already appears in Google Maps today.

The company's revenue model blends three streams: B2G (direct municipal/campus contracts), B2B (a subscription tier for actionable analytics — never for an operator's own raw occupancy data, which stays free to avoid disincentivizing deployment), and eventually B2C (a small, driver-paid surcharge captured through split payments once a Maps-native or direct payment channel exists). The full logic for each is in Section 7.

The single most important strategic correction that came out of this process is a change in how Park Shark describes its dependence on other companies. Park Shark does not depend on any other company's financial success to survive — it depends on two much narrower things: permission (a lot operator's agreement to let hardware go up) and distribution (a platform's willingness to expose the data it produces). That distinction, worked out in Section 5, changes how every partner and competitor conversation in this document is framed.

3. The Competitive Landscape

Early framing of this space used a single, vague category — "competitors." That framing collapsed under scrutiny because the companies in parking touch completely different layers of the problem: some own the physical asset, some own the software/payment relationship, some own both. The landscape below replaces that single category with four tiers, plus one adjacent category of point-hardware competitors. Each tier has a different relationship to Park Shark — mostly indifferent, structurally non-competing, a soft-power/lobbying risk, or a direct product conflict — and each gets a different plan in Section 4.

3.1 Tier 1 — Lot and Property Owners

Universities, municipalities, hospitals, mixed-use developments, and independent lot owners are the parties who actually control whether Park Shark hardware goes up. They are mostly indifferent-to-positive toward Park Shark: the sensor network makes their asset more visible and more monetizable and, unlike a camera-based system, requires no electrician, no wiring, and minutes of install time per unit. This tier is not a competitor in any sense — it is the customer and the gatekeeper simultaneously, which is why deployment sequencing (Section 7.3) treats "who controls the lot" as the primary variable, not "who else is nearby."

3.2 Tier 2 — Software, Data, and Payment-Only Companies (the Arrive family)

In 2024, EasyPark Group unified its portfolio of previously separate consumer brands — including ParkMobile, Flowbird, RingGo, Yellowbrick, Parkopedia, YourParkingSpace, and Parkimeter — under a single corporate parent, Arrive, while keeping each brand as a distinct consumer-facing app rather than merging them into one product. [18]

None of these companies own or manage a physical lot. Their business is the payment and reservation transaction layer, licensed into lots that someone else owns and controls. That structurally limits how they can compete with Park Shark: they cannot deny Park Shark a deployment the way a lot operator could, and their only real levers are (a) lobbying an existing lot-operator relationship to keep Park Shark out, or (b) building or acquiring comparable hardware themselves.

The second lever is not hypothetical — Arrive already acquired Flowbird, which does make physical parking hardware (meters and related terminals), rather than building that capability internally. That fact matters because it undercuts an easy but wrong argument (discarded, see Section 6) that "software companies won't build hardware." The more accurate read is that Arrive-style companies acquire proven hardware rather than build it from scratch — which is actually a point in Park Shark's favor for the exit thesis in Section 9, not evidence that they will out-build Park Shark on a competitive timeline.

The sharpest point of direct conflict inside this tier is specifically ParkMobile, on driver-side transaction fees. ParkMobile is the incumbent payment method at many U.S. municipal and campus lots — the exact segment Park Shark is targeting first. Since ParkMobile and Parkopedia both now sit under the same Arrive parent as of the 2024 restructuring, that overlap needs to be tracked deliberately, since a channel conflict with ParkMobile's payment business could, in principle, complicate a future Parkopedia-mediated Apple Maps conversation even though the two are nominally separate products.

3.3 Tier 3 — Traditional, Non-Tech Management Firms

Firms like Lanier Parking, ACE Parking, and Propark Mobility manage large lot portfolios under contract with property owners but do not have a competing live-occupancy or payment product of their own — they

operate largely on legacy equipment, kiosks, and manual enforcement. This tier is the best near-term "we make your service better, not obsolete" target: Park Shark's pitch to them is a data and enforcement upgrade layered on top of a contract they already hold, not a threat to the contract itself.

3.4 Tier 4 — Tech-Enabled, Camera-Based Lot Operators

AirGarage and Metropolis are the hardest category, because they combine both gatekeeper power (they directly manage the lots they operate) and a competing product: camera-based license-plate recognition (LPR) tied to automatic payment at entry and exit. [7]

An earlier version of this analysis (corrected mid-conversation, see Section 6) incorrectly assumed AirGarage was software-only with no proprietary hardware. That was wrong — AirGarage has publicly documented its own LPR camera hardware, which already performs the same core function Park Shark was originally pitching as differentiated: tying a specific vehicle to a payment. The corrected differentiation against this tier is narrower and more defensible (see 3.6 below), and this tier is explicitly deprioritized to the latest stage of the go-to-market sequence in Section 7.3, since it is the one category where Park Shark is asking an operator to let a partial competitor onto their own asset.

Metropolis, the larger of the two, raised roughly $1.6 billion in late 2025 to expand beyond its original AI-powered, camera-based parking-payment product — a signal of both the capital intensity of this category and of how much runway an incumbent in this tier now has. [11]

3.5 Adjacent — Simple Ground-Occupancy Sensor Makers

Companies like Nwave, Libelium, and JAPA sell single-spot, wired or battery ground sensors that report binary occupied/vacant status per space, typically priced above $150 per spot. They are not a strategic threat so much as a pricing and functionality floor Park Shark needs to clear decisively: Park Shark's ceiling-mounted units cover 10–15 spots per unit at a target unit cost of roughly $65 (see Full Network BOM & Budget v1), install in minutes with no per-spot wiring, and add vehicle identity and payment capability these products structurally lack.

3.6 The Corrected Differentiation Claim

Because AirGarage and Metropolis already combine vehicle ID with payment, Park Shark's differentiation against that tier cannot rest on "we uniquely combine identity and payment" (an earlier, overbroad claim — discarded, see Section 6). The differentiation that survives scrutiny has three real components, verified independently against each competitor tier rather than asserted once for all of them:

- **Spot-level granularity.** Entry/exit cameras see a vehicle cross a gate line; they do not see which specific interior spot is open. This is the same "resolution gap" Google's own Popular Times feature has always had at the venue level rather than the seat or spot level — Park Shark closes that gap at the level of an individual parking space.
- **Installed cost and speed.** Park Shark's ceiling units run roughly $65 per unit covering 10–15 spots and stick to a ceiling in minutes with no electrician. A comparable camera installation (the Apex pilot referenced in Park Shark's own pitch deck) runs $1,500–2,000 per unit covering 15–20 spots, requires wiring, and needs a bucket truck for maintenance.
- **No added camera surveillance for occupancy.** Park Shark determines occupancy and vehicle identity primarily via radar and passive/active TPMS RF signature, not persistent video capture — the Gate Sensor camera exists for brief plate correlation at entry/exit only, not continuous recording. This is a genuine privacy differentiator against an always-on LPR camera network, not just a cost one.

4. Direct Competitors, Partners, and Points of Conflict

The table below translates the four-tier landscape into a concrete stance and plan for each named company or category. "Work with" does not mean a signed partnership exists today — it means the structural relationship supports one and the current plan assumes it as the target outcome.

Company / Category	Stance	Why	Plan
Lot & property owners (campuses, cities, private lots)	Partner / customer	They control deployment access and benefit from more visible, more monetizable assets at effectively no cost.	Primary Stage 1–2 sales target; free occupancy dashboard, paid analytics tier only for actionable features (Section 7.2).
ParkMobile (Arrive)	Direct conflict (driver-side fee), otherwise coexist	Incumbent payment method at many of the exact municipal/campus lots Park Shark targets first; overlaps precisely on transaction-fee revenue.	Decoupled deployment (Section 5.2): deploy sensors and show live occupancy everywhere, but only enable Park Shark's own payment button where no competing live payment channel exists or the operator agrees.
Parkopedia (Arrive)	Cautious partner track	Existing Apple Maps data relationship since 2016; potential channel into Apple's ecosystem — but now under the same parent as ParkMobile.	Treat as a possible long-term data-licensing partner (Section 8), but track the ParkMobile overlap explicitly so a fee conflict there doesn't poison this relationship.
Other Arrive brands (Flowbird, RingGo, YourParkingSpace, Yellowbrick, Parkimeter)	Largely non-competing	No direct U.S. footprint overlap with Park Shark's near-term targets in most cases; no lot control.	Monitor; no active outreach needed until Stage 3.
Traditional management firms (Lanier, ACE, Propark)	Partner	Hold lot contracts but no competing data/payment product — clean "upgrade their service" pitch.	Direct B2B sales target for Stage 3 encumbered-lot expansion; sell to the firm, not around it.
AirGarage	Direct conflict + potential later partner	Owns proprietary LPR hardware that already ties vehicle ID to payment — the hardest category, both gatekeeper and product competitor.	Deprioritized to latest stage; approach as an invitation into a larger data network (their lots gain Maps-scale exposure) rather than a replacement pitch.
Metropolis	Direct conflict + potential later partner	Same dual role as AirGarage, at much larger scale and capital base (~$1.6B raised late 2025).	Same approach as AirGarage; not a near-term target. Possible long-term acquirer under the exit thesis (Section 9).
Nwave / Libelium / JAPA (simple ground sensors)	Displaces on price/function	Occupancy-only, no vehicle ID, no payment, higher per-spot cost.	No direct engagement needed; differentiation argument (3.6) is sufficient in any head-to-head.

Company / Category	Stance	Why	Plan
Google	Long-term distribution partner (not yet)	Owns the default map surface most drivers already use; Popular Times precedent shows Google will surface live occupancy-style data from a third party.	No near-term ask. Build reference dataset first (Section 8); approach only with evidence, modeled on the Popular Times precedent, not a payment-cut ask.
Apple	Long-term distribution partner (not yet),	Existing Parkopedia relationship since 2016 shows Apple is willing to license third-party parking data into Maps.	Same evidence-first approach as Google; Parkopedia may be the practical entry channel.
Uber (via SpotHero, Feb 2026 acquisition)	Monitor	Uber's acquisition of SpotHero folds a consumer reservations product into a much larger mobility platform — changes SpotHero's strategic weight and possible future direction (consumer vs. fleet/driver-efficiency tool).	No near-term interaction; revisit once Uber's integration direction for SpotHero is clearer, since a fleet/driver-efficiency pivot could open a B2B angle rather than a competitive one.

5. Challenges — What Has Been Resolved and What Has Not

This section is organized by challenge, not by chronology. Each subsection states the problem as it was originally raised, how it was resolved (or why it remains open), and is explicitly tagged so a reader can see at a glance which parts of Park Shark's plan are load-bearing and settled versus still under active work.

5.1 Payment Mechanics and Revenue Capture

The original question: how does Park Shark actually get paid without becoming a payment intermediary, and without disrupting the lot operator's existing economics?

[RESOLVED] Split payments via a Stripe Connect-style structure ("separate charges and transfers" / destination charges).

The driver pays a single amount through the standard payment flow — the base rate the lot already charges, plus a small surge captured by Park Shark. The base fare routes directly to the lot operator; Park Shark's cut is deducted automatically as part of the transfer, and Park Shark never takes custody of the operator's funds first. This is the same mechanical pattern Stripe documents for marketplace platforms that need to split a single charge between a platform fee and a connected account, and it is what avoids Park Shark being treated as a money transmitter or payment intermediary standing between the driver and the operator. [19]

Worked example, as discussed: a $6.00 spot becomes $6.18–$6.30 to the driver; the lot operator still receives the full $6.00 it would have received anyway; Park Shark's $0.18–$0.30 is captured automatically in the same transaction, not billed separately or reconciled after the fact.

[UNRESOLVED] Whether Apple/Google take their own platform cut of payments processed "through" a Maps-native flow for a real-world service.

The working assumption is that Apple's and Google's in-app purchase commissions (typically 15–30%) apply to digital goods and services consumed inside an app, not to payment for a real-world physical service like parking — the same general carve-out that applies to ride-hailing, food delivery, and hotel bookings paid through similar flows. This is a well-established general rule in mobile platform economics, but it has not been freshly, directly re-verified against Apple's and Google's current published guidelines for this specific document, and it should be confirmed directly before it is used as a load-bearing assumption in any formal financial model or investor deck.

5.2 Double Payment / Channel Conflict at Lots With an Existing App

The original question: if Park Shark and an incumbent app (ParkMobile, a kiosk system, etc.) are both live at the same lot, how does Park Shark avoid drivers being charged twice or lot operators being stuck reconciling two payment systems?

[RESOLVED] Decoupled deployment: sensor deployment and payment-enablement are two independent switches, set per lot.

Park Shark can deploy hardware and show live occupancy at any lot, redirecting drivers to whatever existing payment app is already present where one exists. Park Shark's own in-app payment button is enabled only where no competing live payment channel exists, or where the operator explicitly agrees to make Park Shark the primary channel. This was a deliberate design change: an earlier version of this plan (see Section 6) handled the conflict reactively, with a refund process after a double payment occurred. The decoupled

model instead makes double payment structurally impossible rather than something to clean up afterward, which also removes a support burden from the lot operator that would have undercut Park Shark's "zero hassle to the operator" pitch.

5.3 Deployment Sequencing and the Encumbered/Unencumbered Problem

The original question: Park Shark eventually needs to be in lots that already have a management or payment relationship in place — "start with underserved lots" doesn't resolve that, it only delays it.

[RESOLVED] A two-category deployment model, entered in sequence, not a vague "underserved" label.

- **Unencumbered lots** — no existing exclusive vendor, management, or payment contract stands between Park Shark and a deployment decision: campuses, municipal/government lots, and independent private lots. This is Stage 1–2.
- **Encumbered lots** — an existing management, payment, or hardware relationship is already in place. Park Shark enters these later, by selling the data layer as an upgrade to the incumbent operator or management firm itself (Tier 2 and Tier 3 companies above), not by trying to go around them to the property owner. This is Stage 3.

[UNRESOLVED] The specific terms, pricing, and legal structure of an "incumbent upgrade" sale have not been worked out — this is a Stage 3 problem, not a Stage 1 one, and is intentionally left open until the reference dataset from Stage 1–2 exists to sell against.

5.4 Privacy and Consent

The original question: an early description of "automatic" registration of a driver's license plate to a Google/Apple account the moment they pull into a lot with Maps open sounded like silent enrollment, in tension with Park Shark's existing privacy-by-design architecture.

[RESOLVED] "We retain a specific, disclosed, opt-in payment-linkage record and purge everything else," reconciled with per-transaction biometric payment approval.

Every payment is approved by the driver through the standard Apple Pay / Google Pay per-transaction confirmation flow (Face ID, Touch ID, or device PIN) — there is no silent auto-enrollment, because the driver affirmatively approves each charge. This resolves the consent concern without needing a separate Park Shark-specific opt-in step, and it sits on top of the privacy-minimization architecture already documented in System Architecture v7: vehicle identity inside the sensor network is based on TPMS RF signature, not persistent camera tracking; a license plate is captured only briefly at the Gate Sensor, correlated to the TPMS signature for that vehicle, and then purged once the vehicle exits.

5.5 Differentiation and "Why Now" (the NC IDEA reviewer concern)

The original question, taken directly from NC IDEA reviewer feedback on a prior application round: the market looked crowded, with reviewers specifically flagging "Streetline or Nwave are exceptions, not the rule" and rating Innovation "Less than adequate."

[RESOLVED] A precise, three-tier differentiation claim, replacing one overbroad claim.

The full argument is in Section 3.6. In short: against simple ground sensors, Park Shark adds vehicle ID and payment they structurally lack, at a lower cost and faster install; against camera/LPR systems, Park Shark does not uniquely offer ID+payment (an earlier claim, corrected, see Section 6) — the real edge is spot-level granularity, lower installed cost, and no added persistent camera surveillance; against software-only apps, Park Shark provides the physical data layer they cannot produce themselves. No single sentence answers

the reviewer's concern for every competitor at once, which is precisely why the earlier one-size-fits-all claim needed to be replaced.

A second, related answer to "why now" that is not just competitive but architectural: Park Shark's enforcement and reservation-related features (Section 5.7, Section 7) can act locally and physically, at the exact moment and location of a violation, via an audible signal from hardware already in the lot. No software app and no entry/exit camera system can intervene at that specific point — they can only record or bill after the fact.

5.6 Google/Apple Maps Distribution

The original question: how does Park Shark get onto Google/Apple Maps given the existing, established partnerships those platforms already have with parking apps?

[RESOLVED] Treated as a long-term (2–3 year), evidence-gated distribution goal, not a near-term funded milestone.

The full staged model is in Section 8. The short version: there is no realistic near-term path to a Google or Apple conversation before Park Shark has a proof-of-accuracy dataset, so the near-term plan does not depend on one. The mid-term plan builds that dataset through Stage 1–2 deployment and establishes real, independent B2B/B2G revenue in the meantime, so the business does not need a Maps deal to survive while it waits for one.

[OPEN] The exact form of an eventual Maps presence — an invisible B2B2C data-licensing arrangement versus a visible, Park-Shark-branded card inside Google Maps' own UI (as in the reference mockup provided) — is a live design question, currently leaning toward the visible, branded option, closer to how SpotHero already appears in Maps today, rather than a fully invisible plumbing role.

5.7 Hardware and Technical Open Items

These are carried directly from System Architecture v7 and Power Breakdown v7's own CONFIRMED / DERIVED / ESTIMATE / OPEN / REJECTED tagging, included here because they directly affect several business claims made elsewhere in this document.

[RESOLVED] Existing enforcement signal: the Lane Sensor already has a simple audible buzzer (0.042 mAh/day in Power Breakdown v7) capable of producing a tone-based alert.

[UNRESOLVED] Voice-capable enforcement: a full voice-speaker capability (e.g., an audible spoken warning for an unauthorized handicapped or reserved-spot parking event) is a future feature, not a currently budgeted or designed component. It should not be described as existing hardware in any pitch material — only the simple tone buzzer currently exists.

[OPEN] Gate Sensor / WiFi Unit power source (battery vs. mains) is explicitly unresolved in System Architecture v7's own Open Items list, along with thermal/mounting treatment gaps, clock-drift resynchronization across the mesh, and several bench-validation gaps not yet run against real hardware.

[RESOLVED] Phone-tracking mechanism: after two rejected approaches (Generation 1, BLE Find My/Continuity signals — rejected on unconfirmed iOS persistence; Generation 2, full WiFi-probe decode — rejected after real-data analysis showed only a 6.3–10.5% catch rate against a 20 mAh/day power cost), Generation 3 (RF energy-detection correlated with radar) was adopted, with an estimated ~53% catch probability at the Guardian Sensor for a far lower power cost.

6. Ideas Considered and Discarded

Every idea below was seriously proposed at some point in this process and then dropped, replaced, or corrected. They are recorded here in full, with the specific reasoning, both because an investor benefits from seeing that the surviving plan was actually stress-tested, and because several of these are easy mistakes another founder in this space would plausibly make.

6.1 "Our business only works if theirs keeps working"

An early description framed Park Shark's dependence on incumbent parking apps and lot operators in terms of needing those businesses to keep succeeding financially. This was rejected as both inaccurate and a bad way to describe the company to investors — it reads as parasitic ("living off another company's leftovers") and is not actually true. Park Shark's dependency is narrower and different in kind: it needs permission (physical deployment access from a lot operator) and distribution (a platform's willingness to expose the data), not any incumbent's financial survival. This reframing — "permission-gated, not parasitic, not fully independent" — is now the standing description used throughout this document.

6.2 Refund-based double-payment handling

The first proposed fix for the double-payment risk at lots with an existing app was reactive: let both channels operate, rely on clear payment-method messaging, and resolve any double charges via refunds, with the lot operator given direct data access to manage disputes themselves. This was replaced by the decoupled deployment model (Section 5.2) after recognizing that a refund-based process puts a support and reconciliation burden on the lot operator, undercutting the "zero hassle to the operator" pitch that is central to getting fast deployment approval. Preventing the conflict from being possible in the first place was judged clearly better than cleaning it up after the fact.

6.3 Parkopedia as a fully invisible data-licensing channel

An early framing of the long-term Google/Apple strategy proposed a strictly binary choice: either Park Shark becomes a fully invisible B2B2C data supplier (the way Parkopedia's underlying data has historically operated inside Apple Maps, largely without independent consumer-facing branding) or it builds and owns a fully separate, standalone consumer app. This was a false dichotomy and was explicitly rejected after pushback: visibility-in-the-UI and payment-mechanism-structure are two separate, independent design axes, not one binary choice. The reference mockup the user provided — a branded "PARK SHARK: City Center Garage" card inside Google Maps' own interface — shows a real, already-precedented middle path (the same pattern SpotHero already uses inside Google Maps), and that middle path is now the working assumption, not either extreme.

6.4 The Street View region-by-region analogy, taken too literally

An early analogy compared Park Shark's coverage expansion to Google Street View's region-by-region rollout, with sparse coverage filled in by inference for uncovered lots, eventually leading to Park Shark owning the full data/payment/network relationship "much like Apple Maps has handed off to Parkopedia." This framing was useful for internal thinking about staged coverage but was flagged as something that cannot be presented to investors as-is, since it implicitly describes a company that could get "stuck in limbo" indefinitely between stages — a structure nobody wants to invest in. The analogy survives only as an internal mental model for staged rollout, not as investor-facing language, and is superseded by the concrete Stage 1–4 sequence in Section 7.3.

6.5 "Underserved lots" as a deployment strategy

"Start with underserved lots" was an early, vaguer version of the deployment plan. It was replaced by the more precise unencumbered/encumbered classification (Section 5.3) after recognizing that "underserved" doesn't actually resolve the hard problem — eventually Park Shark must deploy into lots that already have a vendor relationship, and "underserved" gives no plan for that transition. The encumbered/unencumbered framing does, by defining the transition explicitly as "sell to the incumbent, not around them."

6.6 Silent automatic license-plate-to-account registration

An early description of onboarding had a driver's license plate "automatically" registered to their Google/Apple account the moment they pulled into a lot with Maps open. This created a real internal tension with Park Shark's own stated privacy design (opt-in payment-linkage, purge-on-exit) because it sounded like silent enrollment without an affirmative action. It was resolved, not simply dropped: every payment is still approved through the standard Apple/Google Pay per-transaction biometric confirmation flow, which supplies the missing affirmative consent step without requiring a separate, additional opt-in flow specific to Park Shark.

6.7 "Software companies won't build hardware" as a competitive defense

An early argument for why Arrive-family companies (ParkMobile, Parkopedia, etc.) wouldn't become direct hardware competitors rested on the idea that they are "essentially software companies" and therefore unlikely to build physical sensor networks. This was weak on its face and directly contradicted by Arrive's acquisition of Flowbird, which does make physical parking hardware. The claim was replaced with a more accurate and more useful one: large software/payment platforms tend to acquire proven hardware capability rather than build it from first principles — which is not a defense against competition, but is actually supporting evidence for Park Shark's own acquisition-based exit thesis (Section 9).

6.8 "We uniquely combine vehicle ID and payment" as the core differentiation claim

Park Shark's original headline differentiation claim was that it uniquely combines vehicle identity with seamless payment. Direct research into AirGarage disproved this for one entire competitor tier: AirGarage's own LPR camera hardware already ties a specific vehicle to an automatic payment. Continuing to lead with this claim risked a credible, informed reviewer or investor catching the gap and discounting the rest of the pitch. It was replaced with the tier-specific differentiation claim in Section 3.6, which makes a narrower but defensible claim against each competitor category rather than one broad claim that only holds against some of them.

6.9 Early Google-patent attribution

A parking-occupancy-monitoring patent was initially, incorrectly attributed to Google in internal discussion of prior art / competitive IP landscape. Direct verification found the patent was actually assigned to Xerox Corporation, not Google. This was caught and corrected before being used as evidence in any external-facing claim; it is recorded here only as a reminder that IP/prior-art claims in this space need direct verification before they appear in investor or reviewer-facing material, and that no such patent claim should be repeated as "Google's" in future material.

7. Business and Operations Model

7.1 Revenue Streams

- **B2G (government / municipal).** Direct contracts with cities and municipalities for live occupancy data, enforcement support, and analytics at public lots and on-street parking. This is the earliest and most independent revenue stream — it requires no cooperation from any private incumbent and no Maps integration.
- **B2B (lot operators, property owners, management firms).** Free live-occupancy dashboard for any lot with Park Shark hardware (this is never paywalled — see 7.2), plus a paid subscription tier for genuinely actionable features: cross-lot and regional competitive benchmarking, dynamic-pricing automation, programmatic API/data-export access, enforced reservation guarantees, and gamification/loyalty tooling (see 7.2 for the full list and reasoning).
- **B2C (drivers).** A small per-transaction surcharge (the "surge," worked example in Section 5.1) captured through split payments, activated only once a payment channel exists — either Park Shark's own button at an unencumbered/government lot, or eventually a Maps-native payment flow. This stream deliberately does not exist at Stage 1 for most private lots, to avoid opening a driver-side payment fight before Park Shark has the leverage or evidence to win it.

7.2 The Paywall Principle

The governing rule, arrived at directly in response to a specific concern raised during this process, is: never charge a lot operator for their own lot's raw occupancy data. Charging for the basic data a lot generates would give operators a direct financial incentive to deny deployment in the first place, which would undermine the entire land-grab logic of Stage 1–2. What is chargeable is a genuine, actionable service that would otherwise require hiring an independent contractor or building custom tooling:

- **Cross-lot / regional benchmarking —** the most structurally defensible paid feature, because a single lot operator cannot replicate it without seeing competitor lots' data, which only Park Shark, sitting across many lots, can aggregate.
- **Dynamic-pricing automation —** an actionable service that saves an operator from paying a contractor or staff time to manually adjust rates.
- **API / programmatic data-export access —** the standard SaaS pattern of a free dashboard with a paid API tier for operators who want to pipe live data into their own systems.
- **Enforced spot reservation —** requires live ground-truth occupancy to actually guarantee and enforce a reservation, which a simple booking app cannot do on its own without a physical sensing layer underneath it.
- **Post-Maps-integration gamification/loyalty layer —** in mixed-use developments (the Empire Properties example discussed), a lot manager and an adjacent merchant can advertise their own parking-linked incentive (for example, $1 off at a restaurant for parking in that lot). Park Shark hosts the data and display layer only; the lot manager and the merchant own the deal itself, self-serve, not brokered by Park Shark. This mirrors the real, existing precedent of Google Business Profile "Offer Posts," which lets a business self-serve promotional offers directly onto its own Google listing.

This is also the concrete answer to "what should be paywalled" and "how does private-lot deployment become a standalone viable revenue stream" rather than only a bridge to eventual driver-side revenue: the B2B tier above is designed to work, and to be worth paying for, independent of whether a Maps integration ever happens.

7.3 Go-to-Market Sequencing (the "Metamorphosis" Model)

Internally, staged growth has been described using a worm-to-butterfly metaphor — useful for thinking about the transition between stages, but explicitly not something to present to investors in that form, since it can read as a company that might get permanently "stuck in limbo" between forms. The investor-facing version is the concrete four-stage sequence from the Executive Summary, repeated here with the operational detail for each stage:

Stage	What happens	What it depends on
1. Unencumbered deployment	Sensors installed at campus, municipal, and independent private lots with no existing vendor contract in the way.	Nothing outside Park Shark's control — a direct sale to the lot owner/operator.
2. Reference dataset + government revenue	Live accuracy data accumulates; direct B2G contracts generate real revenue independent of any platform partner.	Stage 1 hardware being live and accurate; no external permission needed beyond the individual lot/government contracts already won.
3. Encumbered lots	Data layer sold as an upgrade to the incumbent management firm or operator already at a lot, not around them to the property owner.	A credible, evidenced dataset from Stage 1–2 to sell against; incumbent willingness to add a complementary layer.
4. Google/Apple Maps distribution	A Maps-native presence, modeled first on the Popular Times precedent (data overlay) and potentially evolving toward a visible, branded card similar to SpotHero's existing placement.	Evidence from Stages 1–3; Google/Apple willingness to expose third-party live data — explicitly not assumed or required for the business to survive Stages 1–3.

7.4 Cost Structure and Unit Economics

Per the Full Network BOM & Budget v1, the target installed cost is roughly $65 per hardware unit across the Guardian, Gate, LF Tool, and WiFi Unit classes, with each ceiling-mounted unit covering 10–15 parking spots. Major components include the IWRL6432AOP radar module (~$11.65), SX1262 LoRaWAN transceivers ($8.53–$12.08), and SX1302-based gateway hardware at Gate Sensor locations (targeting ~$30 at scale versus $69–$119 at current module pricing).

Several component choices were made purely on cost rather than functional preference — for example, the Gate Sensor's guardian-facing LoRaWAN gateway uses the SX1302/SX1250 combination over the SX1308 despite the SX1308 being, by the Circuit Design & Production Notes v6 team's own assessment, a better functional fit; the SX1302 path was chosen purely on price. This is disclosed here because unit-economics claims in this document rest on the current BOM, and that BOM reflects deliberate cost-driven trade-offs, not the theoretically optimal component set.

7.5 Team and Capacity

Park Shark is currently a three-person, part-time team: Ishan Joshi (founder; Physics/Data Science, UNC; transitioning to full-time after graduation in December 2026, effective roughly January 2027), Parshant Kumar (Business/Economics, UNC Kenan-Flagler; business development), and Laaraib Abro (Computer Science, NC State; software). The company has received a $4,000 SURF grant and has had approximately $1,000 in personal founder spend toward the MVP to date, with no equity investment raised as of this document's date. The current ask is $50,000 in non-dilutive funding, framed around the NC IDEA MICRO grant.

7.6 Intellectual Property Status

[UNRESOLVED] Provisional patent applications are in preparation, targeted for filing in November 2026. As of this document's date (August 27, 2026), no patent application has been filed. This must be stated plainly in any investor or reviewer material — the NC IDEA reviewer feedback in Section 11 specifically flagged the earlier absence of any patent mention, and overstating current IP status would be a worse outcome than being clear about the timeline.

8. Google and Apple Maps Integration Strategy

This section exists because the single hardest question raised throughout this process was some version of: "How does Park Shark actually get onto Google or Apple Maps, given the partnerships those platforms already have with SpotHero, Parkopedia, and ParkMobile?" The honest answer is that there is no near-term path, and the plan does not pretend otherwise — it treats Maps distribution as a long-term, evidence-gated goal that the rest of the business does not depend on reaching.

8.1 Why Near-Term Is Not Realistic

Google and Apple already have functioning, revenue-generating relationships with established parking-payment platforms. Neither company has an incentive to entertain an unproven, pre-funding startup for a live-data or payment relationship before that startup can demonstrate accuracy at meaningful scale. Treating this as a near-term milestone would have been dishonest in any pitch material and was explicitly rejected for that reason.

8.2 The Realistic First Ask: Popular Times, Not a Payment Cut

Google's Popular Times feature already shows that Google is willing to surface live, crowdsourced or third-party-derived busyness data on top of its own Maps product without that data source owning a payment relationship. That is a closer, more realistic model for Park Shark's first ask than the harder, unprecedented request of directly capturing a slice of a Maps-native payment flow. [9]

8.3 Existing Precedents Studied

Google formally partnered with SpotHero in October 2024 to let users find and reserve parking directly through Google Maps and Google Search — the clearest existing example of a third-party parking company achieving a genuine, transaction-capable Google Maps integration, and the closest real precedent for what a later-stage Park Shark deal could look like. [1]

In February 2026, Uber announced its acquisition of SpotHero, folding a standalone consumer parking-reservation product into a much larger ride-hailing and mobility platform. This changes SpotHero's strategic position and its likely future direction — it is now a moving target for how a large mobility platform incorporates a parking product, worth monitoring for how Uber chooses to build on it, whether toward a broader consumer parking play or a narrower professional/fleet-driver tool. [2]

Apple has had a parking-data partnership with Parkopedia since 2016, when Apple Maps began surfacing detailed, Parkopedia-sourced information on parking garages and lots — the longest-running example of Apple licensing third-party parking data rather than building its own, and the basis for treating Parkopedia cautiously as a possible long-term entry channel into Apple's data ecosystem (Section 4). [4]

Google's Hotel Ads program historically ran a commission-based booking model, in which Google took a cut of completed hotel bookings made through its own interface; Google has since moved away from that commission-based bidding structure. This is included as a cautionary, not encouraging, precedent — it shows a major platform is willing to experiment with taking a direct commission on a real-world booking category, but also shows that structure was not permanent, which argues for Park Shark not designing its entire long-term model around assuming a specific platform-commission structure will exist indefinitely. [15]

Coord, a Sidewalk Labs-backed company, built an open data platform for curb and parking-regulation information aimed at cities and mobility companies. It is referenced here as a structurally similar, though not identical, prior attempt at a city-facing physical/regulatory data layer — useful as a comparison point for the B2G data-licensing model in Section 7.1, with the honest caveat that Coord's own trajectory and current status were not independently re-verified for this document and should not be treated as a fully validated precedent without further research. [17]

8.4 The Long-Term Design Question

Once a Maps relationship becomes realistic, the specific form it should take is still an open design question, not yet a resolved one. It is deliberately framed as a choice along two independent axes rather than one binary decision (see Section 6.3 for the discarded false-binary version of this question): how visible Park Shark is in the consumer-facing UI, and how the underlying payment/data relationship is structured. The current working assumption — based directly on the reference mockup showing a branded "PARK SHARK: City Center Garage" card inside Google Maps — leans toward a visible, attributed presence similar to how SpotHero already appears in Google Maps today, rather than a fully invisible, Parkopedia-style plumbing role.

9. Exit Strategy

Park Shark is deliberately not positioned as a reservations app competing with SpotHero, and not positioned as a lot operator competing with Premier Parking, SP Plus, AirGarage, or Metropolis. It is positioned as the physical occupancy-sensing and vehicle-identity data layer underneath all of those categories — a component that a Metropolis, an Uber, a Google, or an Arrive would each have a distinct, different reason to want to acquire or license, rather than a platform trying to become the one dominant platform itself.

The clearest direct precedent is Streetline, the most frequently cited prior "success story" in smart-parking hardware, which was acquired by Kapsch TrafficCom in 2015 — even the industry's own acknowledged success case ended in acquisition by a larger transportation-technology company, not independent scale as a standalone platform. [5]

This is reinforced by Arrive's own demonstrated playbook: rather than building ParkMobile, Flowbird, and Parkopedia in-house, Arrive's predecessor (EasyPark Group) acquired each of them. A company in exactly this market has already shown it prefers to acquire capability — including, via Flowbird, physical hardware capability — over building it from scratch. That is direct evidence supporting an acquisition-based exit thesis for Park Shark, not just an assumption.

Each named acquirer category has a distinct, legible reason to want this specific layer: Metropolis or AirGarage would gain spot-level granularity they currently lack; Uber (via SpotHero) or Arrive would gain a physical data source their software-only model cannot produce internally; Google or Apple would gain a proven, evidenced live-occupancy dataset without having to build and maintain physical hardware themselves. This multi-buyer structure — several different, non-mutually-exclusive reasons to acquire — is itself part of the strategic case, not just the existence of any single potential acquirer.

10. Market Sizing

Industry estimates place total U.S. parking spaces in the range of roughly 1 to 2 billion, depending on methodology and what counts as a distinct "space" (on-street, surface lot, and structured spaces are counted differently across sources). [8]

ParkMobile, the largest single incumbent in the driver-side payment layer, has reported reaching roughly 50 million registered users, spanning a large but still partial footprint of U.S. cities and locations. [12]

Taken together, these figures support a directional white-space argument — even the largest existing driver-side payment platform covers a minority of total U.S. parking capacity, and no single company (including Arrive's combined brand portfolio) has close to full market penetration on the payment layer, let alone on the physical occupancy-sensing layer underneath it, which is largely unaddressed outside of the point-hardware players in Section 3.5. This figure should be treated as directional, not precise: the two source figures come from different measurement methodologies (total physical spaces versus registered payment-app users), and a rigorous, apples-to-apples market-size calculation — ideally validated against a primary industry source such as the National Parking Association's own market-size research — is still a piece of unfinished analytical work, not a fully resolved number.

11. NC IDEA Reviewer Feedback — Addressed Directly

This section responds point-by-point to feedback received from two NC IDEA reviewers on a prior grant application round, since at least one of those reviewers may see this material again.

Reviewer concern: crowded market / differentiation skepticism

Addressed in Section 3.6 with a tier-specific differentiation claim, replacing the earlier single overbroad claim (Section 6.8).

Reviewer concern: risk of customer-discovery de-biasing (leading interview subjects toward desired answers)

Acknowledged directly: the existing 35 customer-discovery interviews should be re-examined for leading-question risk before being cited again as validation, and future interview rounds should be structured with this concern in mind. This document does not claim that concern has been resolved — only that it is understood and being taken seriously going into any next round of customer discovery.

Reviewer concern: skepticism that lot owners would pay per-spot ground-sensor pricing

Addressed structurally, not just rhetorically: the paywall principle in Section 7.2 never charges a lot operator for their own raw occupancy data — only for genuinely actionable paid features. This sidesteps the reviewer's concern rather than arguing the market will simply tolerate ground-sensor-style pricing after all.

Reviewer concern: damage and maintenance

[UNRESOLVED] This document does not contain a resolved maintenance/damage-liability plan. It should be treated as an open item for the next revision of this material, not silently dropped.

Reviewer concern: "Streetline or Nwave are exceptions, not the rule — why now"

Addressed in two parts: the differentiation argument in Section 3.6 (why Park Shark's bundle differs from both Streetline-era hardware and Nwave-style point sensors), and the exit-strategy argument in Section 9, which reframes Streetline's 2015 acquisition not as evidence the category doesn't work, but as the expected outcome for a hardware layer in this market — acquisition by a larger platform, which is exactly the outcome Park Shark is designed around rather than treating as a failure case.

Reviewer concern: Innovation rating 'Less than adequate'

Addressed by the same tier-specific differentiation work in Section 3.6, plus the "local and physical" enforcement argument in Section 5.5, which identifies a capability (real-time, in-lot physical intervention) that no software-only or camera-only competitor can replicate by design, not just by current product choice.

Second reviewer concern: no patent mention

Addressed directly and honestly in Section 7.6: provisional patents are in preparation, targeted for filing November 2026, not yet filed as of this document's date.

Second reviewer concern: need for more segmented customer interviews

[UNRESOLVED] Not yet completed. Flagged here as a concrete next step: future customer discovery should be explicitly segmented by the tiers in Section 3 (property owners, traditional management firms, government/municipal buyers) rather than treated as one undifferentiated "customer" group.

12. Privacy and Consent Architecture

Park Shark's privacy design predates this business-strategy discussion and is documented in full in System Architecture v7; it is summarized and reconciled with the business model here because payment mechanics and consent are business-facing questions as much as technical ones.

- **Vehicle identity** is established primarily via passive and active TPMS RF signature correlation, not persistent camera-based tracking.
- **License plate capture** happens only briefly, at the Gate Sensor, to correlate a plate to a TPMS signature at entry/exit — it is not continuously recorded, and is purged once the vehicle exits the monitored area.
- **Payment-linked data retention** is limited to a specific, disclosed, opt-in payment-linkage record; everything else is purged. This framing directly replaced an earlier, ambiguous description of "automatic" license-plate-to-account registration (Section 6.6).
- **Consent** is supplied by the standard Apple Pay / Google Pay per-transaction biometric or PIN confirmation flow required for every charge — there is no silent, automatic enrollment step.

TPMS itself is not a Park Shark design choice but a federally mandated feature on virtually all U.S. passenger vehicles, following the TREAD Act and the resulting Federal Motor Vehicle Safety Standard for tire pressure monitoring systems — which is part of why a TPMS-based signature is a durable, broadly available signal to build vehicle identification around, rather than a proprietary or fragile one. [20]

13. Risk Register Summary

A consolidated view of every item tagged UNRESOLVED or OPEN elsewhere in this document, gathered in one place for quick reference.

Open Item	Where It's Discussed
Direct confirmation of Apple/Google IAP commission carve-out for real-world services	Section 5.1
Terms, pricing, and legal structure of the "encumbered lot / incumbent upgrade" sale	Section 5.3
Exact form of eventual Maps presence (visible branded card vs. invisible data licensing)	Section 5.6, Section 8.4
Gate Sensor / WiFi Unit power source (battery vs. mains) and related thermal/mounting/clock-drift items	Section 5.7
Voice-capable enforcement speaker — not yet designed or budgeted	Section 5.7
Provisional patent filings — in preparation, not yet filed	Section 7.6
Damage and maintenance liability plan	Section 11
Re-examination of existing customer interviews for leading-question bias; further segmented customer discovery	Section 11
Rigorous, apples-to-apples total addressable market calculation	Section 10

14. References and Sources

External sources cited in this document, in order of first appearance:

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[2] Uber Acquiring SpotHero — CNBC, February 2026. https://www.cnbc.com/2026/02/23/uber-acquiring-spothero.html

[3] Uber to Acquire Parking App SpotHero — Uber Investor Relations, 2026. https://investor.uber.com/news-events/news/press-release-details/2026/Uber-to-Acquire-Parking-App-SpotHero/default.aspx

[4] Apple Partners With Parkopedia to Bring In-Depth Parking Data to Apple Maps — MacRumors, July 2016. https://www.macrumors.com/2016/07/27/apple-parkopedia-apple-maps/

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[7] How AirGarage Uses License Plate Recognition to Increase Parking Revenue — AirGarage, company website. https://www.airgarage.com/resources/how-airgarage-uses-license-plate-recognition-to-increase-parking-revenue

[8] How Many Parking Spots Are in the US? — A Coffee Break Read — Oobeo. https://www.oobeo.com/how-many-parking-spots-are-in-the-us-a-coffee-break-read/

[9] Behind the Scenes: Popular Times and Live Busyness Information — Google (blog.google), Maps 101 series. https://blog.google/products/maps/maps101-popular-times-and-live-busyness-information/

[10] License Plate Recognition — AirGarage, capability page. https://www.airgarage.com/capabilities/license-plate-recognition

[11] AI-Based Parking Lot Payment Startup Metropolis Raises $1.6 Billion — CNBC, November 2025. https://www.cnbc.com/2025/11/06/ai-based-parking-lot-payment-startup-metropolis-raises-1point6-billion.html

[12] ParkMobile Hits New Record With 50 Million Users — ParkMobile Newsroom. https://parkmobile.io/about-us/newsroom/articles/parkmobile-hits-new-record-with-50-million-users

[13] Economic Contributions of the US Parking Industry — National Parking Association. https://cdn.ymaws.com/weareparking.org/resource/resmgr/research/NPA_Economic_Impact_Report_2.pdf

[14] Parking Market Size — National Parking Association. https://weareparking.org/page/Market_Size

[15] Google's Commission-Based Hotel Ads Are Gone: What This Means for Your Hotel — Hospitality Net, 2025. https://www.hospitalitynet.org/opinion/4126546/googles-commission-based-hotel-ads-are-gone-what-this-means-for-your-hotel

[16] Commission-Based Bid Strategies in Hotel Ads to Sunset — Google Ads Help. https://support.google.com/google-ads/answer/14280291?hl=en

[17] Coord Announces Open Data Platform for Curbs — Smart Cities Dive. https://www.smartcitiesdive.com/news/coord-curbs-open-data-platform/551989/

[18] EasyPark Group Unifies Under 'Arrive' to Build the World's Leading Global Mobility Platform — Arrive Newsroom, 2024. https://arrive.com/en/newsroom/news/easypark-group-unifies-under-arrive-to-build-the-world-s-leading-global-mobility-platform

[19] Understand How Charges Work in a Connect Integration (Separate Charges and Transfers) — Stripe Documentation. https://docs.stripe.com/connect/marketplace/tasks/accept-payment/separate-charges-and-transfers

[20] Federal Motor Vehicle Safety Standards; Tire Pressure Monitoring Systems — Federal Register / NHTSA, 2005. https://www.federalregister.gov/documents/2005/09/07/05-17661/federal-motor-vehicle-safety-standards-tire-pressure-monitoring-systems

Internal sources

- Park Shark System Architecture v7 — full hardware-class architecture, communication design, and Open Items list.
- Park Shark Power Breakdown v7 — per-component power budgets, battery life targets, and CONFIRMED/DERIVED/ESTIMATE/OPEN/REJECTED tagging.
- Park Shark Circuit Design & Production Notes v6 — component selection history, including rejected components and reasoning.
- Park Shark Full Network BOM & Budget v1 — per-unit component costs and sourcing.
- Park Shark NC IDEA MICRO grant application and reviewer feedback (prior round).
- Park Shark ConvergeSouth 2026 Pitch Deck — market-size figures, business-model slide, competitive cost comparison, and FAQ material.