Demanding data - Transactional data for demand-responsive transportation

Thursday, April 16, 2020
2:00-3:30 PM ET

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Learning Objectives

At the end of this webinar, you will be able to:

- Define demand-responsive transportation and identify data needed
- Describe specifications in USA and Denmark
- Identify challenges and potential solutions

Transactional Data Specifications for Demand Responsive Transportation: TCRP Report 210

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Demand Responsive Transportation: The Original "New Mobility" Form of Public Transportation

- "Dial-A-Ride" was the first new shared use technology-enabled public transportation service when devised in early 1970's
- Dial-A-Ride services proliferated in late 1970's and 1980's, more than 500 for general public by late 1980's, most in small cities and suburbs
- BUT … DRT services never embraced by mainstream public transit industry
- AND … 1980's DRT services used very little computerized technology
- FURTHER … Advent of ADA paratransit 30 years ago led to transit industry shunning general public DRT almost completely—only changing now

Legacy of DRT Development Path: Technology Applications in Silos

- ADA paratransit interrupted DRT industry evolution from 1980's technology
- Instead--few technology providers, one became dominant, tiny second tier
- Proprietary solutions AND only one ADA paratransit system per region
- Virtually no investment in technological innovation for "regular" DRT—were small city services which couldn't afford technology of the times
- No DRT technology industry per se, transit agency customers rarely saw reason for inter-operability (ADA service not part of perceived core mission)
- Result—technology in silos, proprietary and one-off approaches

What is the Actual Problem? What is the Need?

- Inability of core applications to inter-operate across service providers
- Analogy—HP printer works with HP computer, Brand X printer works with Dell computer but requires $500 piece of software to work with HP computer
- Barrier to integrating multiple service providers into larger regional programs for coordinating/delivering DRT service for public transport or human services
- Mobility Management programs and One Call/One Click systems have to work very hard to achieve one-off solutions for service coordination
- Result: no well-defined pathway for integrating technology systems together to achieve larger scale/scope solutions—new challenge EVERY TIME

Benefits of Technology Inter-Operability for DRT

- Increased service availability
  - Can increase effective capacity and responsiveness without adding to own service
- Improved cost-effectiveness via economies of scale/scope
  - Can use another organization's services if you can plug into them—don't need to replicate service delivery infrastructure for small number of trips
  - Improved capacity utilization for service providers if can share capacity with others
- Better service quality
  - Lead time for service delivery reduced from days to potentially hours or even minutes with more capacity

What is Needed to Unlock these Benefits? Transactional Data Specifications

- A “language” with syntax that enables software applications to communicate with each other to accomplish service delivery
- Data messages need to encompass the following:
  - Requests for a transaction—e.g., book a flight, accept a trip request
  - Requests for information—e.g., how many seats are left, where is this vehicle
  - Responses to requests—e.g., reservation request accepted, vehicle arrives in 5 min.
- Objective is to enable entities to transact—to enable something purposeful to occur, not merely to access static information

Relevant Transportation Examples

- Airline industry—passenger records exchanged in standard industry format to support inter-lined trips on 2 or more airlines (since 1960's)
- Uber/Lyft data interaction functionality—proprietary specifications
  - Each have well-documented APIs that provide external systems with ability to book and manage trips on TNC platform
  - Includes data on fare, vehicle/driver assigned, pick up and delivery times, vehicle location
- FlexDanmark—DRT specifications based on SUTI standard
  - Data specifications make possible nationwide eco-system of participating service providers controlled by core technology platform

Key Project Objectives

- **Create set of specifications that are functionally complete** and will support most of the likely transaction scenarios
- **Develop feasible approach to technical implementation** of specifications in action (i.e., how they are actualized in data communication flows)
- **Engage key sector participants**—technology providers, transportation service providers, public transportation/taxi/TNC industries, planning consultants—in process of specification development and dissemination
- **Devise approaches**—including governance suggestions—**to move proposed specifications towards implementation** by sector participants

Challenges to Achieving Specification Implementation

- No existing industry forum for specification process
- Diverse set of actors—technology companies, public agencies, private contractors, taxi companies, TNCs, consultants, etc.
- Lack of any dominant industry player that encompasses entire sector
- Lack of any prior organizational structure or convening process, contrast to GTFS situation
- Difficult role for government as standards organizer in American system, contrast to SUTI process in Sweden and Scandinavia
- Multiple technology paths forward, but resource-dependent
- Can a recommended specification catalyze forward motion?

Diverse Set of Actors

- Technology companies—DRT booking/scheduling, taxi dispatching, in-vehicle systems, MaaS providers, etc.
- Public transit agencies
- Private transportation contractors—ADA paratransit, small city DRT, NEMT, human service transportation are all target markets
- Taxi companies—large variation in capabilities
- TNCs—Uber, Lyft, Via, others
- Consultants—advisors to cities, transit agencies
- Think tanks—”public service” orientation (e.g., data issues)

Additional Challenges

- Fragmented market of paratransit service providers, technology firms, transit agencies and other actors
- Local, state and federal regulations affect service provisions and requirements
  - No single set of rules
- No dominant firm (e.g. Google for GTFS)
- Little incentive to adopt specifications voluntarily
  - Costs passed on to providers for bespoke systems

The Advisory Panel Process

- What we did to convene key organizations and solicit their inputs and perspectives
  - Transit agency managers
  - Private transportation operators
  - Transportation network companies
  - Technology providers
  - Researchers in demand responsive transportation and/or transit/DRT data systems
- Interviews with each panel member
  - Summarize state of the industry
  - Discuss benefits and costs of common data specification
- Panel meeting by phone every three months

The Advisory Panel Process--2

- Panelists generally agreed that
- 1) standardized specifications would be desirable
- 2) such specifications lack an obvious governing body or champion
  - Many private service providers work with multiple technology providers
  - Some technology firms have limited internal systems for working across platforms, tends to be ad hoc rather than planned
  - Multiple pilot projects are underway with little effort to coordinate specifications
  - Public agencies are keen to develop systems that can incorporate new, flexible services (including ridehailing) to reduce costs
- Specifications need to be managed as market and uses change

Perceived Benefits

- Potential cost reductions for software development and service provision
- Facilitate data sharing between public agencies and demand response providers
- Standardized specifications for transactional data can help with more flexible services in the future
- Simpler mobile applications for easier use
- None of benefits perceived to be very large
- More in vein of “nice to have” and “useful”

Identified Challenges

- Differences in business rules and operational policies
- No financial incentive to standardize specifications (e.g. “walled gardens” can be protected from competition)
- Switching costs
- Potential medical data issues (privacy)
- Identifying the appropriate scope of the specification

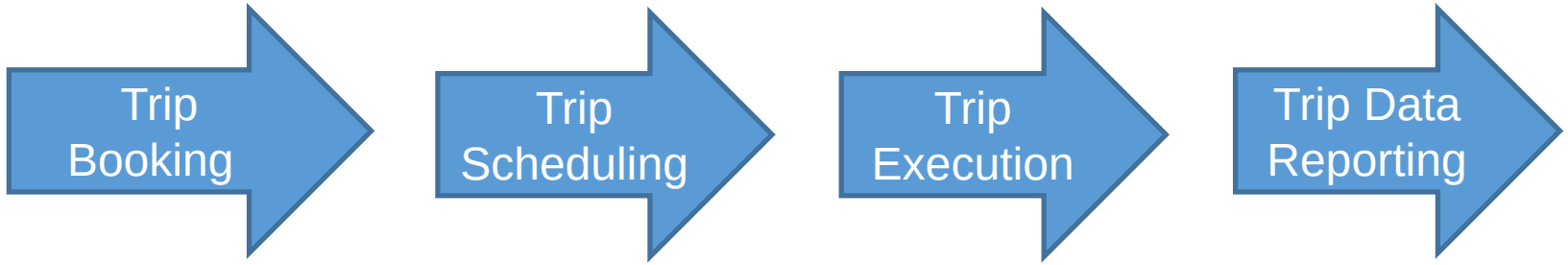
We Know DRT Transactional Data Specifications Are Effective: SUTI and the Case of FlexDanmark

- SUTI standards developed in Sweden beginning in mid-1990's and spread to all of Scandinavia
- Comprehensive set of DRT data specifications, enable end to end transactions
- Enable service sponsors to engage multiple service providers with different technology systems
- Objective is to prevent vendor lock in and ensure that funding agencies have choices among technology providers
- SUTI standards required for use by all of FlexDanmark service providers

FlexDanmark Success Strongly Connected to SUTI

- More than 500 service providers using thousands of vehicles
- All data communication within FlexDanmark system is SUTI-compliant
- FlexDanmark assigns and schedules trips to service providers
- Providers do final scheduling/dispatching and handle service execution
- Data flows must be standardized to keep core FlexDanmark system and provider systems connected in real time
- Specification adherence is only realistic way to accomplish this with many diverse provider technology systems

Functional Requirements: The DRT Trip Lifecycle



- DRT trips go through a cycle (process)—all elements of this cycle must be supported by a data specification
- At each stage of cycle, sufficient data must be advanced to next stage to enable the system that is responsible for that stage to accomplish its function
- This defines the core functional requirements for transactional data flow

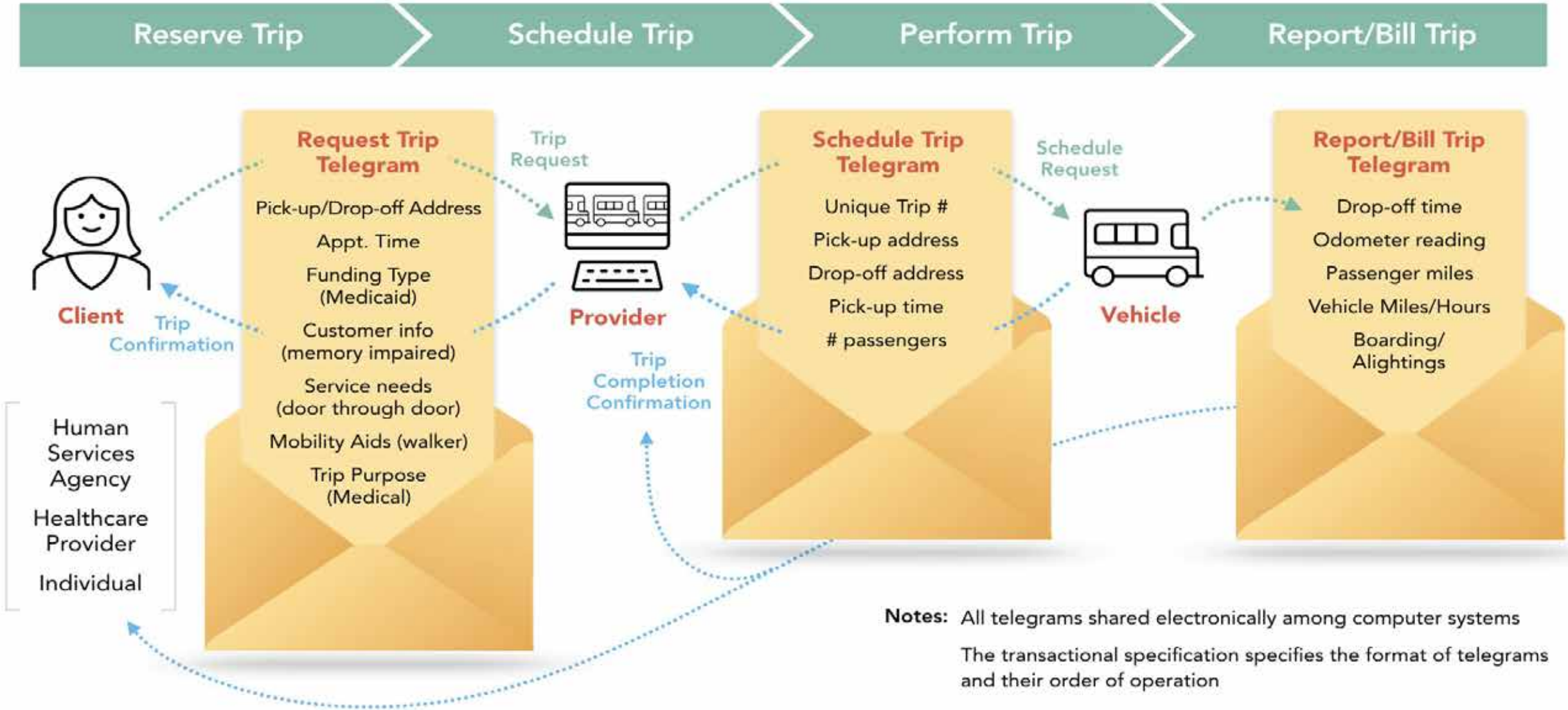
Overview of the Recommended Data Specifications

- Data telegram concept—standard data messages to advance transactions
- Similar approach to SUTI, but many fewer messages
- Only the fundamental steps in the process—11 messages (SUTI has 70+)
- Required and (many) optional data elements
  - Enable parties involved in any specific situation to tailor data messages to needs
  - Specific needs for disabled riders can be put in tailored messages
  - Can be used to maintain data flows in existing One Click and Mobility Mgmt projects
- Specification language is XML or JSON, standard data languages
- Includes recommended data communication approach to validate messages

Telegram Roles in Trip Lifecycle Data Flow

Trip Lifecycle Stage	Task Accomplished and Flow of Data	Telegram
Plan/Book Trip	Request Trip—client/rider to service provider	Telegram 1-A
	Confirm Trip Request--service provider to client/rider	Telegram 1-B
Engage/Schedule Trip with Service Provider	Confirm Order--client/rider to service provider	Telegram 2A
	Rider Details (optional)--client/rider to service provider	Telegram 2A1
	Confirm Trip Scheduled--service provider to client/rider	Telegram 2B
	Confirm Vehicle (optional)--service provider to client/rider	Telegram 2BB
Perform Trip (Dispatch Vehicle)	Route/Trip Task Information--service provider to vehicle	Telegram 3A
	Confirm Route/Trip Task--vehicle to service provider	Telegram 3B
Report/Bill	Completed Job Data--service provider to client/rider	Telegram 4A
	Completed Job Confirmation--service provider to client/rider	Telegram 4B
	Vehicle Performance Information--vehicle to service provider	Telegram 5

Trip Cycle Supported by Data Specification



Notes: All telegrams shared electronically among computer systems

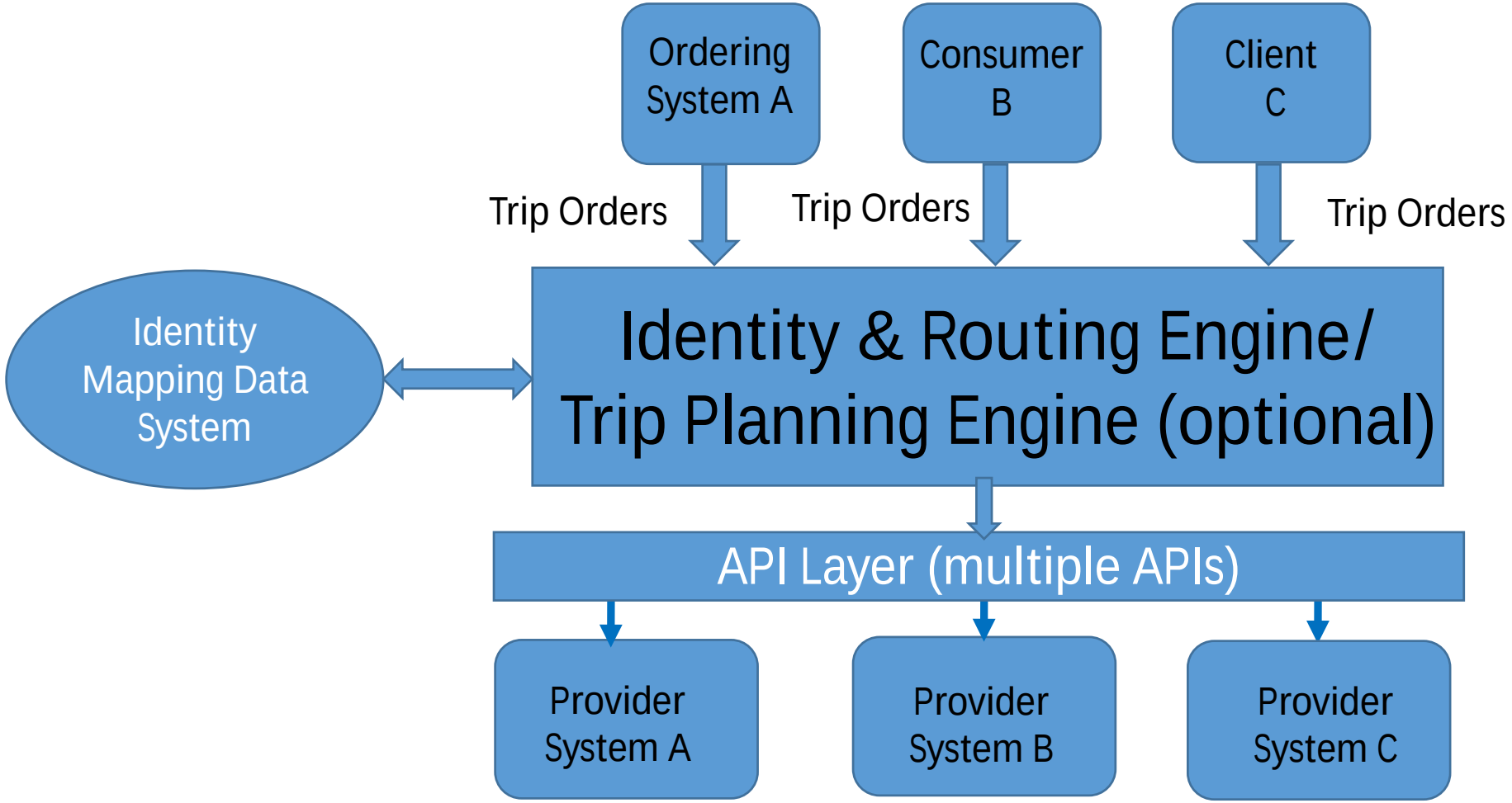
The transactional specification specifies the format of telegrams and their order of operation

Multiple “Coordination” Models for DRT Services Can Be Supported with Transactional Specifications

- Models all involve making resources available for use by more than one organization and its clients/customers
- Models enable organizations (and sometimes individuals) to transact for services without having exclusive control of the service
- Models involve end to end processes which include the entire trip lifecycle
- Different circumstances will favor one model or another
- No model is likely to be successful without some form of data specifications

One Click Type System: Mediated Transactions

Focus: Personal & Organizational Identity of Booking Entity

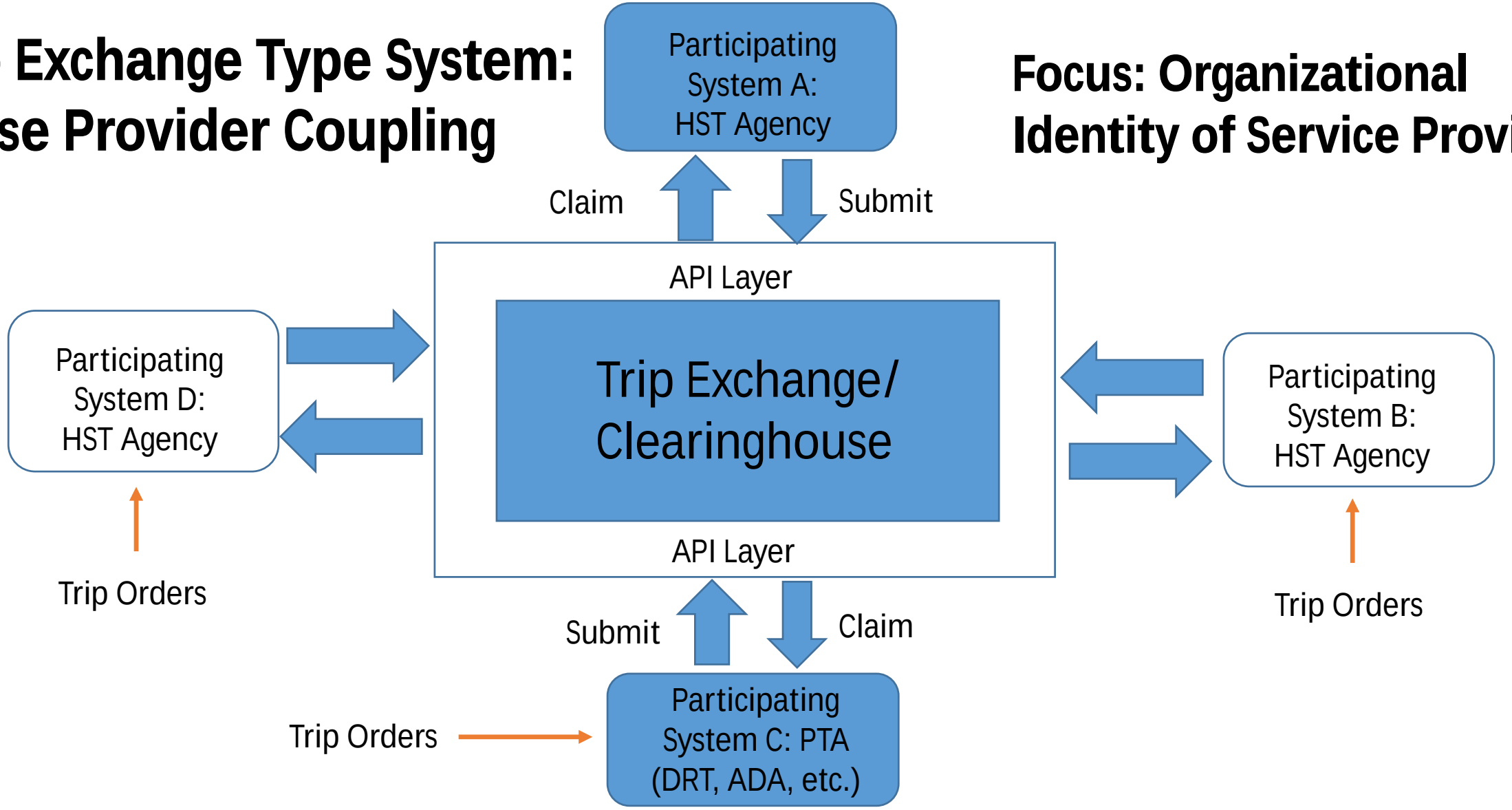


Key Features

- **Who Organizes:** Regional Entity/Autonomous service providers
- **Booking Entities:** Customers book directly (agency access)
- **Scheduling Entities:** Trips scheduled in service provider system
- **Payors:** Agencies pay service providers for trips on their behalf with fare payment by customers retained as desired
- **Service Providers:** Public sector/PNP service providers who operate/contract own services
- **Data Specifications:** Limited, based on individual service provider requirements, no cross-provider data exchange

Trip Exchange Type System: Loose Provider Coupling

Focus: Organizational Identity of Service Provider

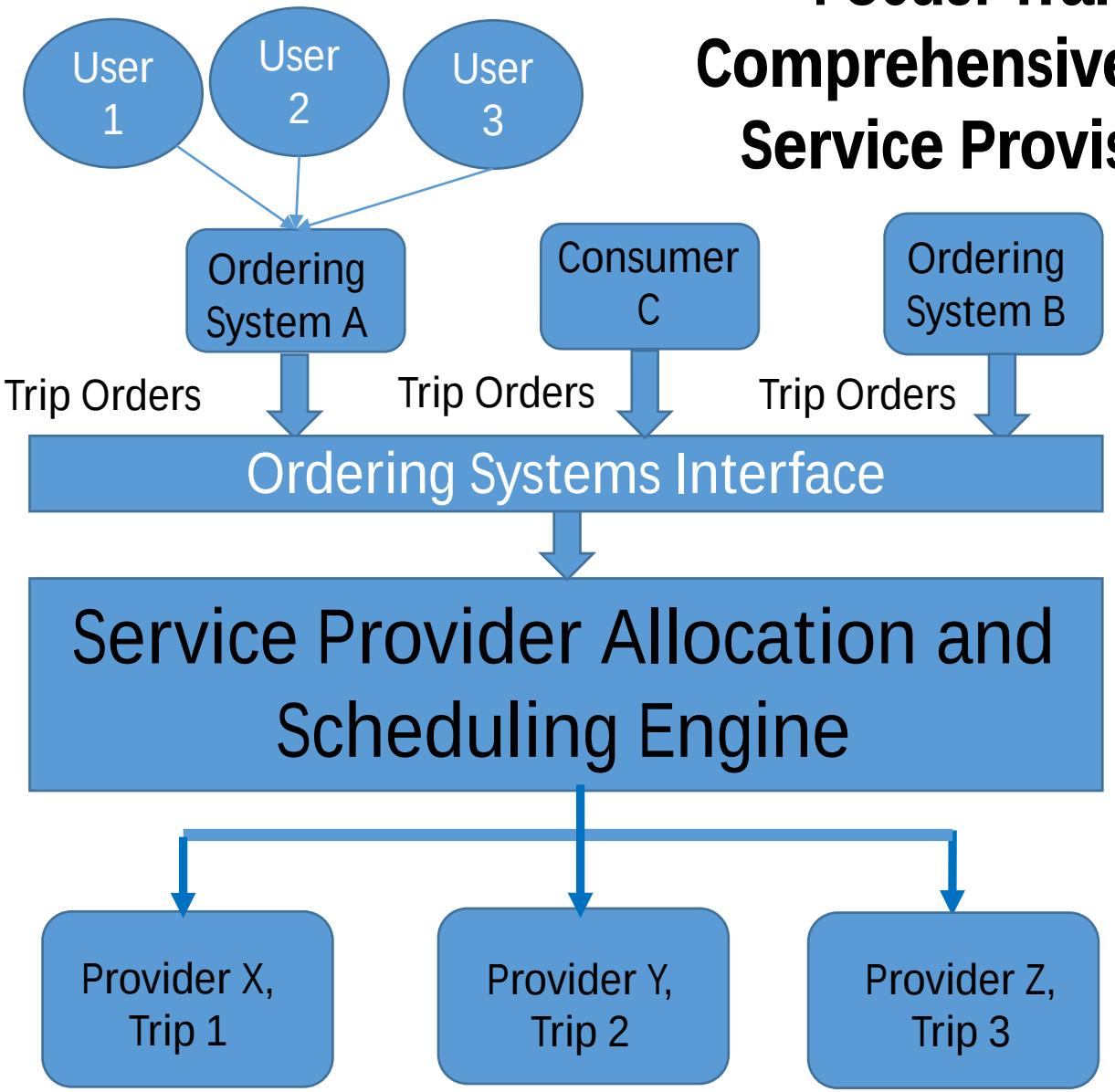


Key Features

- **Who Organizes:** Collaborating service providers/agencies
- **Booking Entities:** Trips booked at service provider level
- **Scheduling Entities:** Trips scheduled at service provider level
- **Payors:** Agencies pay service providers for claimed trips on their behalf, fare payment for customers is nominally retained
- **Service Providers:** Agencies or public sector providers who operate (or contract) services for own customers (could be GP)
- **Data Specifications:** Apply only to Trip Exchange data, limited number of mandatory data items, bilateral for optional spec data

Federated Integration: End to End Transactional System

Focus: Transactional Comprehensiveness without Service Provision Borders



Key Features

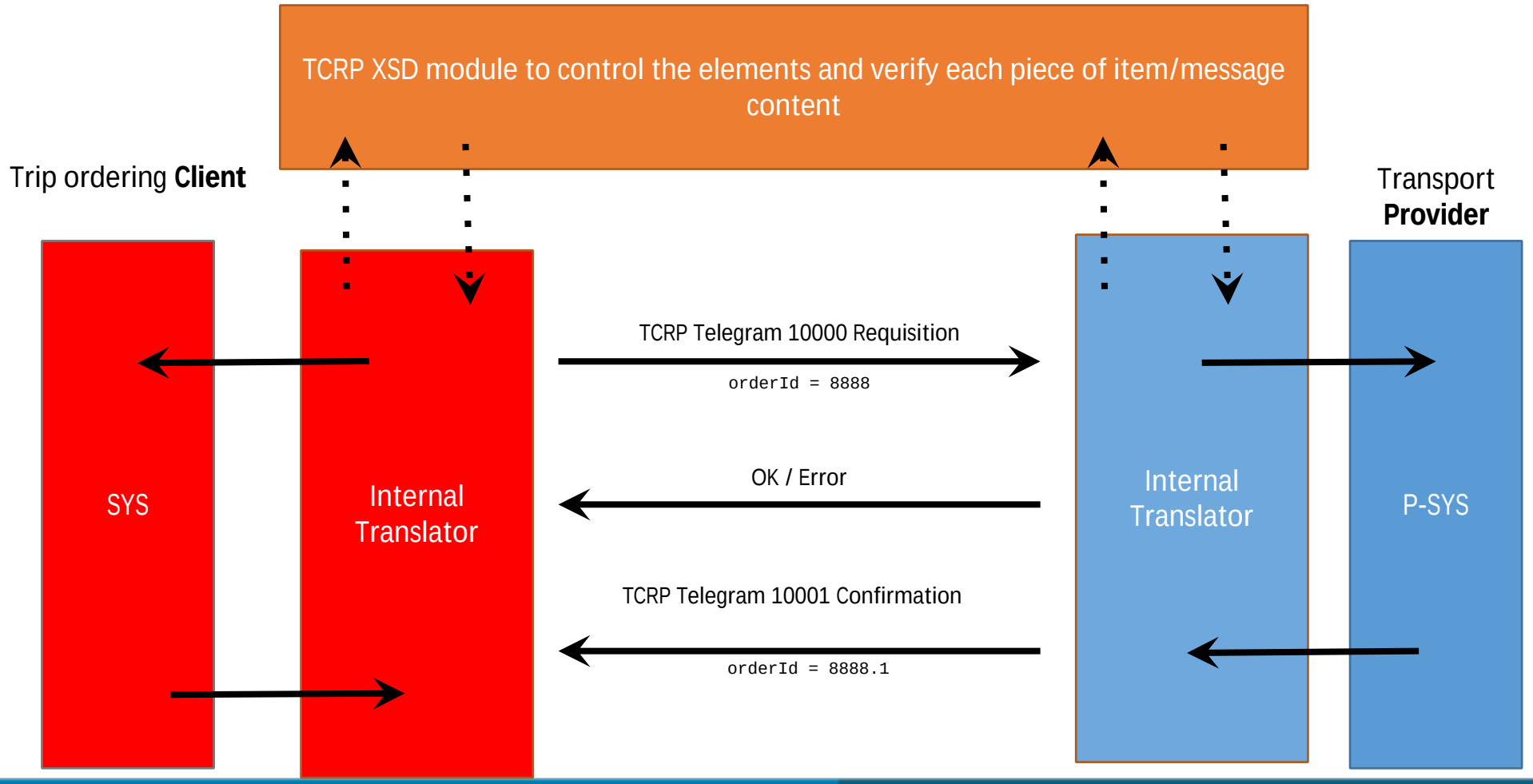
- **Who Organizes:** Central entity (e.g., Flex Danmark)
- **Booking Entities:** Customers, Agencies on behalf of clients
- **Scheduling Entities:** Central system assigns trips and schedules, service providers directly control vehicles
- **Payors:** Agencies, individuals pay user fares for service
- **Service Providers:** Private or public service providers under contract
- **Data Specifications:** Imposed by central entity, mandatory for ordering systems and service providers

Transactional Model	Advantage
One Click Type System: Mediated Transactions	Insure the validation of data and ability to book trips on diverse DRT systems- with focus on the rider data for trip booking
Trip Exchange Type System: Loose Provider Coupling	Creates the opportunity for providers to use resources of other providers, create more efficient use of resources at “regional” level
Federated Integration: End to End Transactional System	Creates an open market for transport for trip purchasers with many sourcing options and secures equitable competition between large and small providers

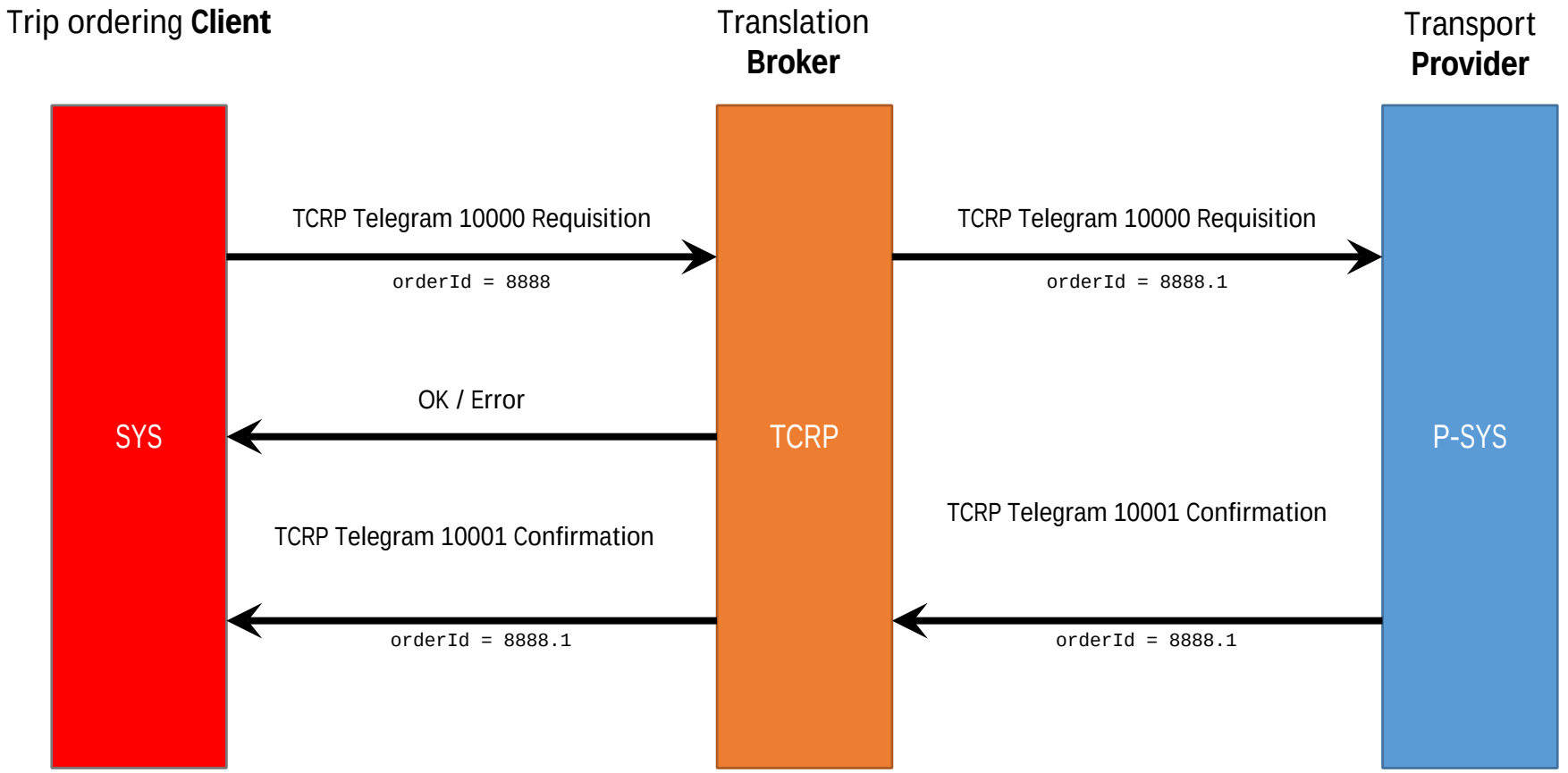
2 Different Potential Logical Set-ups for Data Communication for Specification

- 1--Internal translator with external validation
- 2--Translation Broker
- Project team has recommended first approach
- Major reason for recommendation: Can be implemented without major additional resources or creation of formal governance structure
- But requires more work on part of software providers to implement and places full responsibility on them for satisfactory operation

Point to point via internal translator and external control



Translation Broker Control



Data Communication Model Approaches

- The specification is a means of creating a common data model that can be used to translate between different systems.
- Implementation must support the specific need - it can be in transaction speed or in security of transaction documentation
- Internal translator with external validation - can be very fast but doesn’t have 3rd party validation or creation of transaction log
- Translation Broker - can have 3rd party validation and a transaction log, but adds to cost—both initial and on-going—and transaction time

Trade-Offs Between Preferred Approaches

- Telegram approach imposes more structure on interactions
  - Imposes dialog model on system to system interactions
  - API-based approaches typically have looser request-response paradigms, albeit with certain mandated requirements
- API is just a way to send a message
  - The focus needs to be on the contents
  - Need to agree on the variables - to understand the contents
  - Need to align the transaction flows to reply on the right questions

Trade-Offs Between Preferred Approaches

- Burden on software providers
  - Internal translation/external validation approach requires software providers to implement both message structures and data mappings to specification requirements
  - SUTI has 71 telegram messages, recommended specification has opted for only 11 to reduce burden
  - Translation broker approach requires messaging functionality for software vendor, but broker software can handle data translations and other functions

Trade-Offs Between Preferred Approaches

- Resource requirements and governance considerations
  - Internal translation/external validation approach can be implemented with little additional work by specification “governors” and on case by case basis
  - Software providers would need to create new modules for their systems in order to achieve the task of internal translation—not a trivial effort
  - Translation broker approach is more compatible with current technical preferences
  - BUT ….. Requires significant additional resources to develop APIs and backend functionality that implements translation for arbitrary software systems
  - AND ….. Requires sector-approved governance structure to ensure that key participants are in alignment with details of technical approach

Governance Considerations and Potential Paths Forward

Key Governance Questions

- Who should manage the transactional specification?
- How to finance the specification implementation?
- How to participate as a service provider?
- Why will organizations want to participate?

No Existing Industry/Sector Forum

- No existing industry group for standards or specifications
- APTA, TLPA, CTAA have never initiated or led such efforts
- Specifications are typically set by:
  - Historical precedence—standards organization exists
  - Industry self-governing initiatives—often customer-encouraged
  - Software provider preferences/leadership—engineering driven
- No equivalent (or even close) to the Internet Engineering Task Force (IETF) in this situation

Authority Structures Limited in USA Context

- Federal government needs justification to intervene, no compelling reason in this situation
- State, local government have no mandate or interest to reach beyond jurisdictional bounds
- Standards are almost always set by industry groups or dominant players in an industry sector
- Swedish government role in SUTI situation has limited foundation in USA

Possible Models for Specification Governance

1. The federal government mandates a specification (very unlikely)
2. A professional organization manages the specification
3. An industry organization (e.g., APTA) manages the specification.
4. One or more large local agencies agree on a specification and it incrementally spreads across the industry
5. A large company puts forth a specification that becomes the basis for an industry-wide approach
6. A consortium of different parties (e.g., private companies) agree on a specification.
7. The specification is developed as an open source project.

Where Do We Go From Here?

- Who Provides the Leadership?
- Who Provides the Resources?
- How Does the “Industry” Get Convened and Actualized?
- Who Benefits Enough to Care about Specifications?

Today's Panelists

- Roger Teal, DemandTrans Solutions, roger.teal@demandtrans.com
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