
DeCipher
Algorand ABI

Application Binary Interface

DeCipher 2021

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Algorand ABI

The ABI Specification

Using with Goal

Using with the SDK

New Opcodes

ABI Specification

ARC-04

- Specification for interoperability between smart contracts and applications
- Defines standard for encoding contract calls to smart contracts.
- Includes method signatures that contain arguments and return types
- Allows wallets and other dapps to construct app calls based on a description of the interface
- SDKS support consuming a JSON file with the description

ABI Overview

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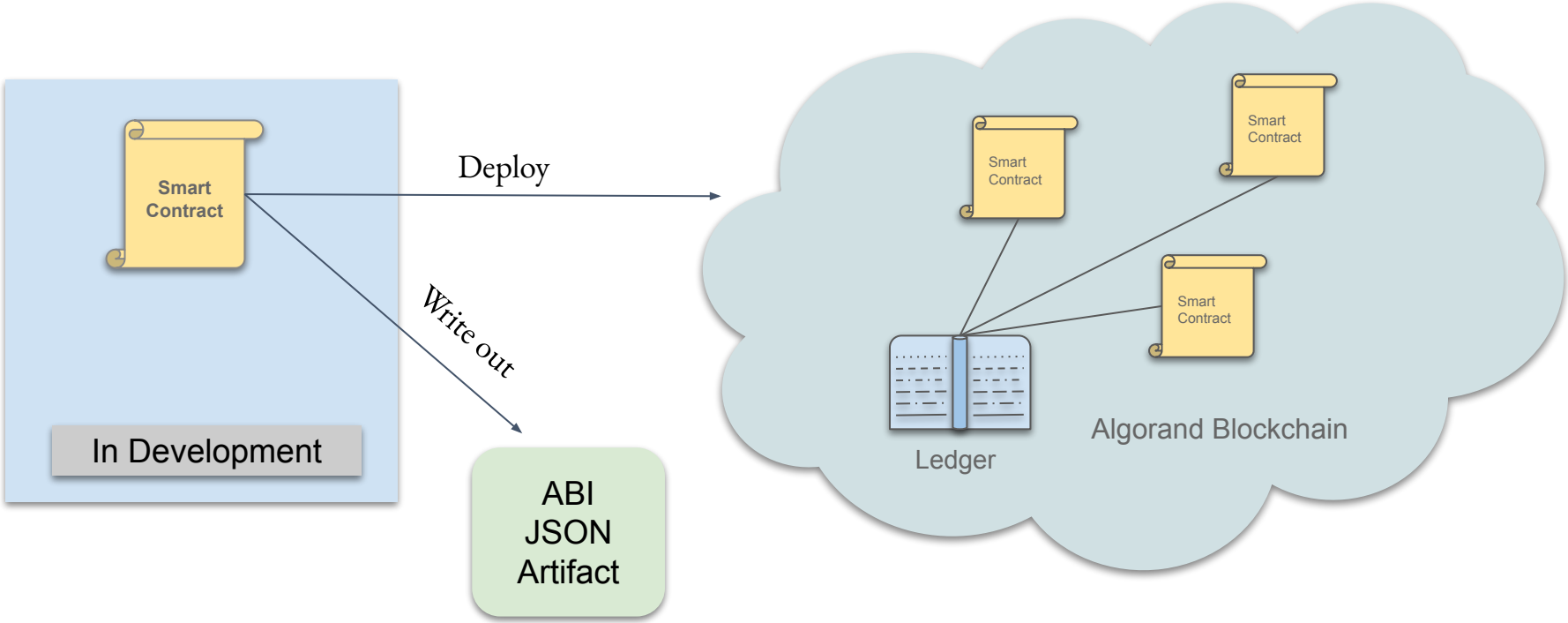

Without the JSON, dApps have no way to know how to call your contract or understand return values, without reading the code

ABI Overview

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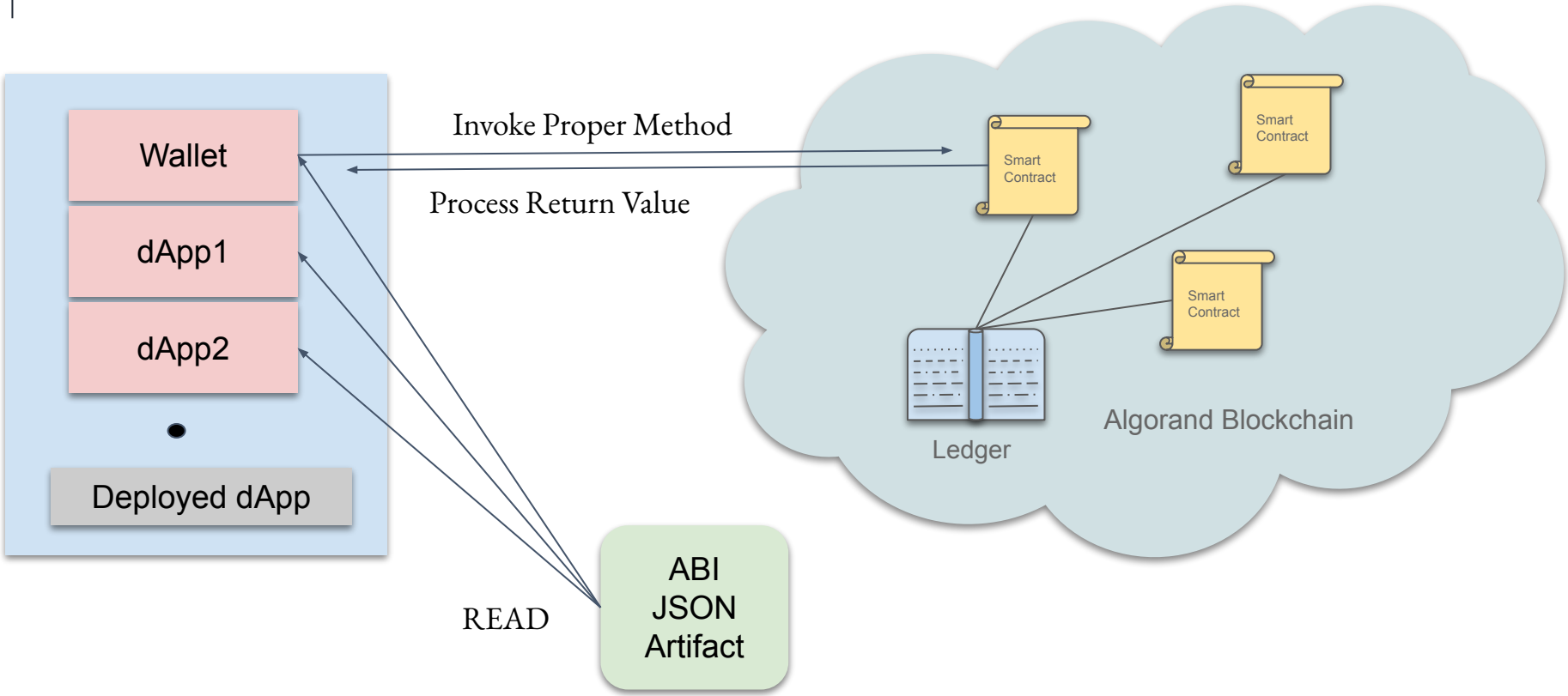

ABI Overview - Specification

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- Defines the JSON Artifact formatting
- Defines the Method invocation rules
- Specifies the argument and return types allowed
- Defines encoding rules Goal and the SDKs use encode and decode method names, arguments and return values
- Defines Three Top Level JSON artifacts
    - Method
    - Interface
    - Class
- Not Mandatory, but **highly** recommended

ABI
JSON
Artifact

ABI Overview - Method JSON

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```
interface Method {
  name: string,
  desc?: string,
  args: Array<{ name?: string, type: string, desc?: string }>,
  returns: { type: string, desc?: string }
}
```

```
{
   "name":"add",
   "desc":"Add 2 integers",
   "args":[ { "type":"uint64","name":"parm1", "desc":"first parameter" }, { "type":"uint64" } ],
   "returns": {"type":"uint64"}
}
```

- Method names should start with a letter followed by any number of characters that are either letters,numbers or underscores.
- Camel case is preferred
- Optional data can be used by wallets and dApps for display and understanding purposes

ABI Overview - Method Signatures

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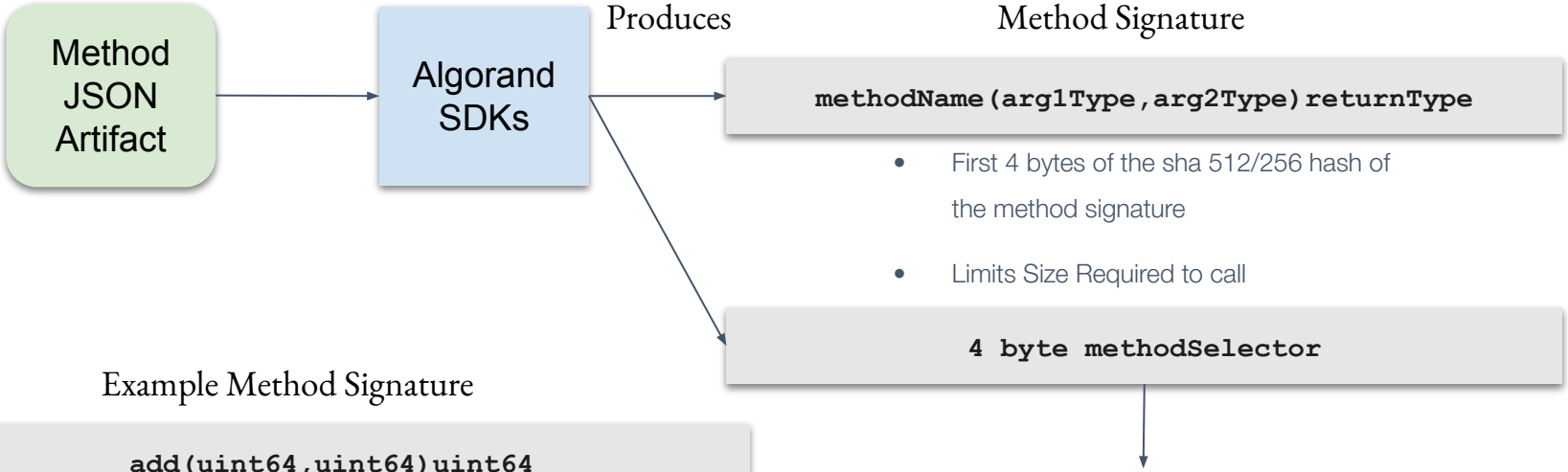

Example Method Signature

```
add(uint64,uint64)uint64
```

Example Method Selector

```
hash (hex): 8aa3b61f0f1965c3a1cbfa91d46b24e54c67270184ff89dc114e877b1753254a

Selector:

8aa3b61f
```

ABI Overview - Interface JSON

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```
interface Interface {
  name: string,
  methods: Array<Method>
}
```

```
{
   "name":"my interface",
   "methods":[
       {
           "name":"add",
           "args":[{"type":"uint32"},{"type":"uint32"}],
           "returns":{"type":"uint32"}
       }]
}
```

- Logical collection of methods
- Each method must generate a unique method selector
- A smart contract implements an interface if it supports all methods

ABI Overview - Contract JSON

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```
interface Contract {
  name: string,
  appId: number
  methods: Array<Method>
}
```

```
{
   "name":"contract",
   "appId":123,
   "methods":  [{"name":"add",
               "args":[{"type":"uint32"},{"type":"uint32"}],
               "returns":{"type":"uint32"}}
               ]
}
```

- Similar to an interface, but represents a concrete deployed contract
- Each method must generate a unique method selector
- Complete set of methods a contract implements
- May be said that it implements an Interface with possible additional methods
- Contract may contain special `_optIn` and `_closeOut` methods
- If not used and local state is used in a call, developer may set for method
    - onComplete: algosdk.OnApplicationComplete.OptInOC
    - onComplete: algosdk.OnApplicationComplete.CloseOutOC,
    - If not set and local state is used, call will fail

ABI Types - Method Signatures

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Types
uint<N> - N-> 8-512
byte
bool
address
string
ufixed<N>x<M>
<type>[]
<type>[<N>]
(T1,T2,....TN) - Tuple

N bit unsigned fixed decimal point with M precision

Foreign Types
account
asset
application

Only in arguments, not in tuples or arrays

Special Types
txn -any txn
pay
keyreg
acfg
axfer
afrz
aapl

Used to specify additional Txes that method needs

Dynamic Types
[]

Will most likely require extract*

opcodes to process in Teal

Method Invocation

Standard Format

- First app transaction parameter should be method selector
  - Accessed in Teal as `txna ApplicationArgs 0`
  - SDKS and Goal handle
- Next forteen parameters are method parameters
- The fifteen parameter can contain a tuple of additional parameters
  - SDKs do this automatically
  - PyTeal will handle in future
  - TEAL programs need to use extract for the tuple
- Return value is returned using unique log with 4 byte prefix
  - prefix hash of the word return
  - Last log in the transaction with this prefix

App Developer Description

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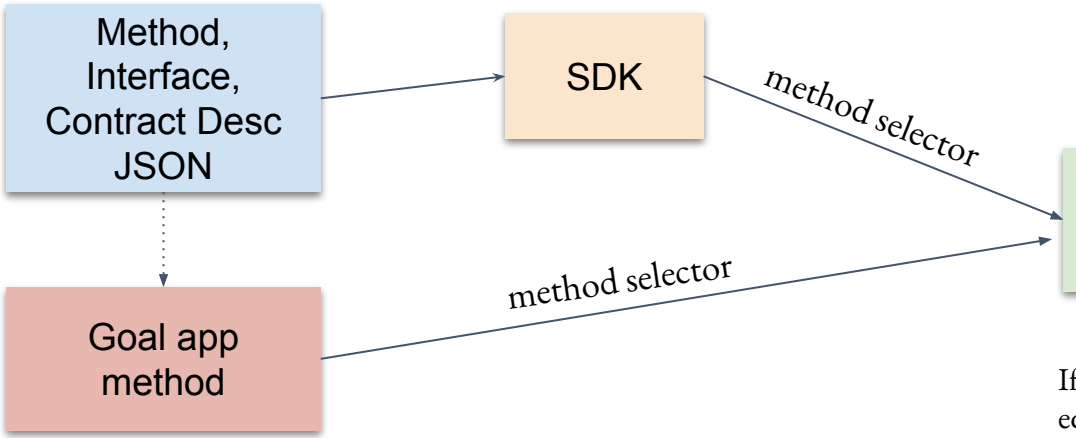

If SDK Method Selector is not equal to the TEAL selector the method will never be called

- Switch on selector using method opcode
- Return values with log opcode and 4 byte prefix

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Demo

Goal method call

SDK JSON Descriptions

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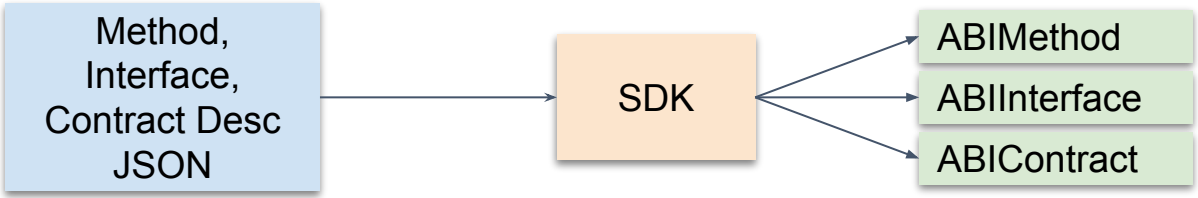

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Demo

JSON to JS SDK

SDK New Atomic Builder

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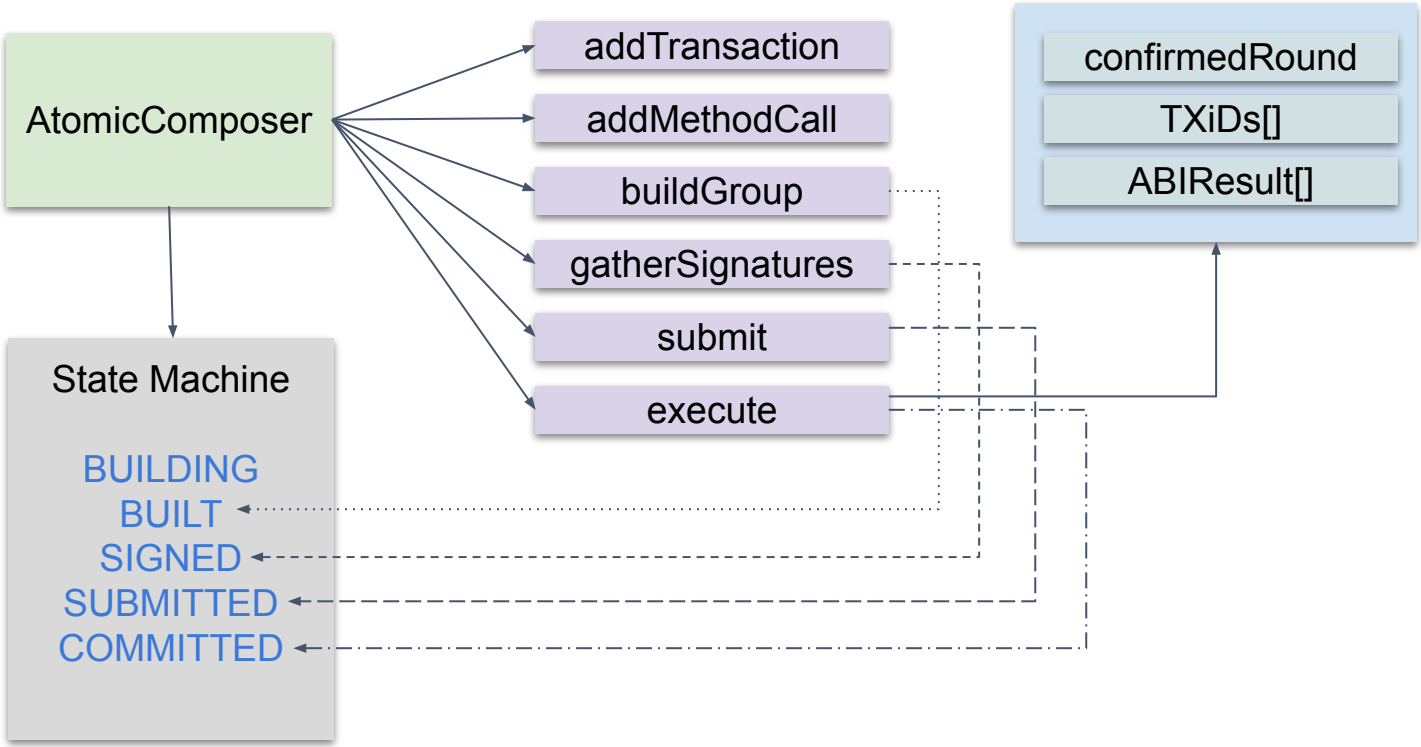
- One or More Transactions
- For any transaction
- Enforces ABI



SDK New Atomic Builder addTransaction

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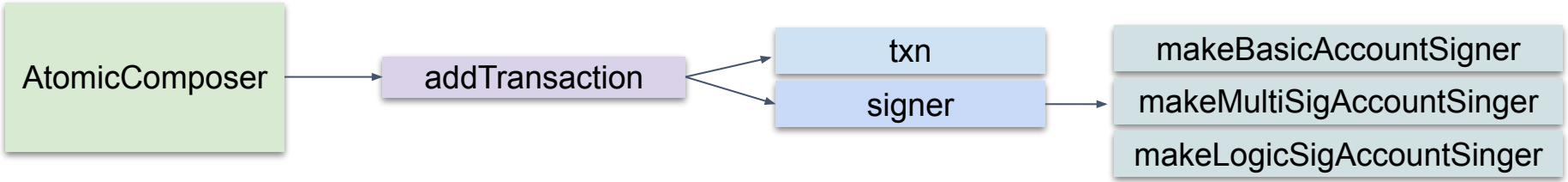


```
let txn = algosdk.makePaymentTxnWithSuggestedParams(....
let transactionWithSigner = {
    txn: txn,
    signer: algosdk.makeBasicAccountTransactionSigner(acct),
};
comp.addTransaction(transactionWithSigner)
```

SDK New Atomic Builder addMethodCall

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```
const sp = await client.getTransactionParams().do()
const commonParams = {
    appId:contract.appId,
    sender:acct.addr,
    suggestedParams:sp,
    signer: algosdk.makeBasicAccountTransactionSigner(acct)
}
const comp = new algosdk.AtomicTransactionComposer()
comp.addMethodCall({
    method: sum, methodArgs: [1,1], ...commonParams
})
```

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Demo

JS SDK ABIComposer: Simple Payment and Method Call

Method Descriptions and Special Types

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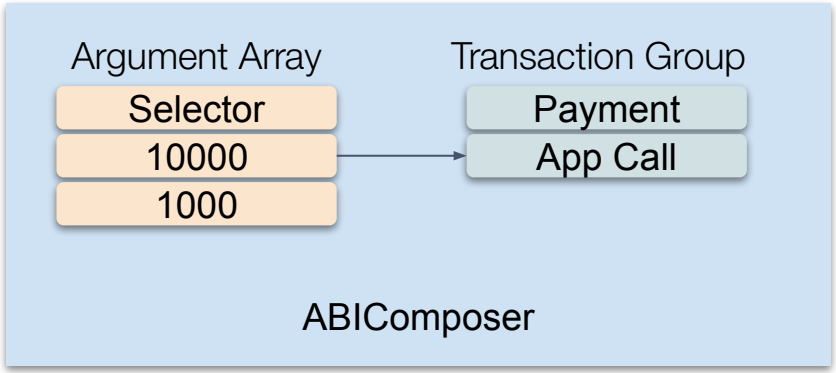
```
myCall(pay,uint64,uint64)uint64
```

```
let txn = algosdk.makePaymentTxnWithSuggestedParams(acct.addr, acct.addr, 10000, undefined, undefined, sp);
comp.addMethodCall({
    method: myCall,
    methodArgs: [
        {
            txn: txn,
            signer: algosdk.makeBasicAccountTransactionSigner(acct)
        },
        10000,
        1000
    ],
    ...commonParams
})
```



Method Descriptions and Foreign Types

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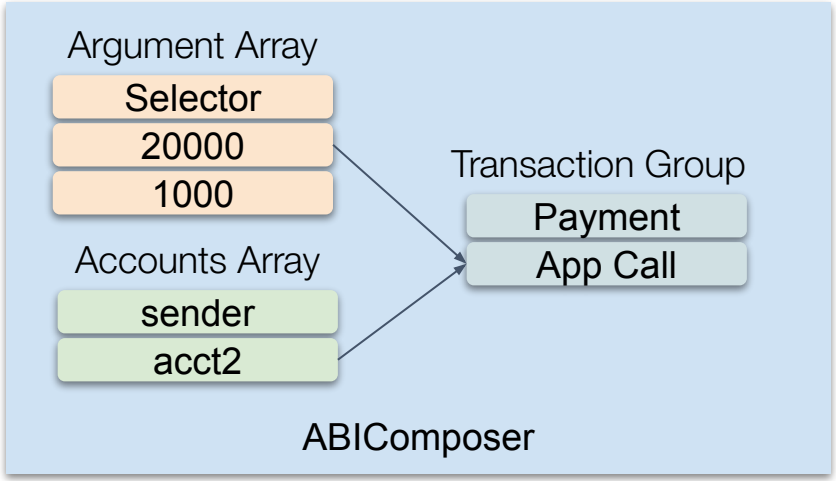
```
myCall(pay,uint64,uint64,account)uint64
```

```
let txn = algosdk.makePaymentTxnWithSuggestedParams(acct.addr, acct.addr, 10000, undefined, undefined,
sp);
comp.addMethodCall({
    method: myCall,
    methodArgs: [
        {
            txn: txn,
            signer: algosdk.makeBasicAccountTransactionSigner(acct)
        },
        20000,
        1000,
        acct2.addr
    ],
    ...commonParams
})
```



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Demo

JS SDK
ABIComposer: multi transaction calls

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Smart Contract Requirements

method, log and extract opcodes

Method Opcode

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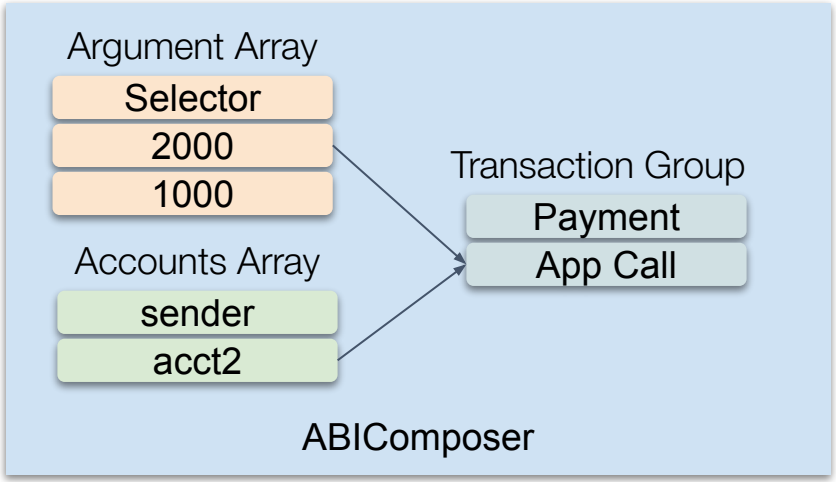
```
myCall(pay,uint64,uint64,account)uint64
```

- method opcode converts signature to selector
- Use method opcode to compare
- Make sure to cover selectors that match no method

```
method "myCall(pay,uint64,uint64,account)uint64"
txna ApplicationArgs 0
==
bnz myCall_Sub
```



Example Return values

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Example PyTeal Return value for an integer

```
Log(
    Concat(
        Bytes("base16", "0x151f7c75"), #Literally hash('return')[:4]
        Itob(b)
    )
)
```

Example Teal Return value for an integer

```
store 0 //store result
byte 0x151f7c75 //return bytes
load 0 //containing return integer
itob
concat
log
```

Example PyTeal Return value for a byte array

```
Log(
    Concat(
        Bytes("base16", "0x151f7c75"), #Literally hash('return')[:4]
        b
    )
)
```

Example Teal Return value for an byte[]

```
store 0 //store result
byte 0x151f7c75 //return bytes
load 0 //containing return byte[]
concat
log
```

- only required on non-void return values
- last log with the 4-byte signature
- PyTeal will change to simplify

Dynamic Types Extract Opcode

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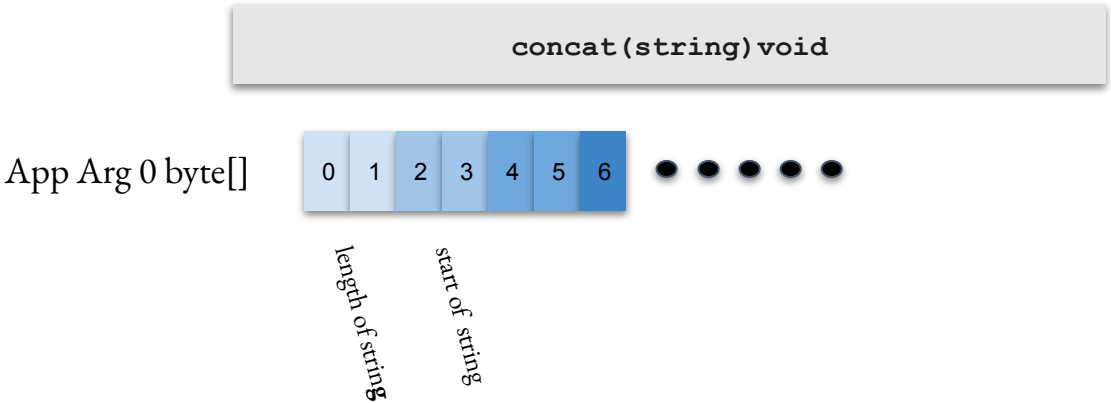


```
txna ApplicationArgs 1
int 0
extract_uint16 //length of first string
```

Dynamic Types Extract Opcode

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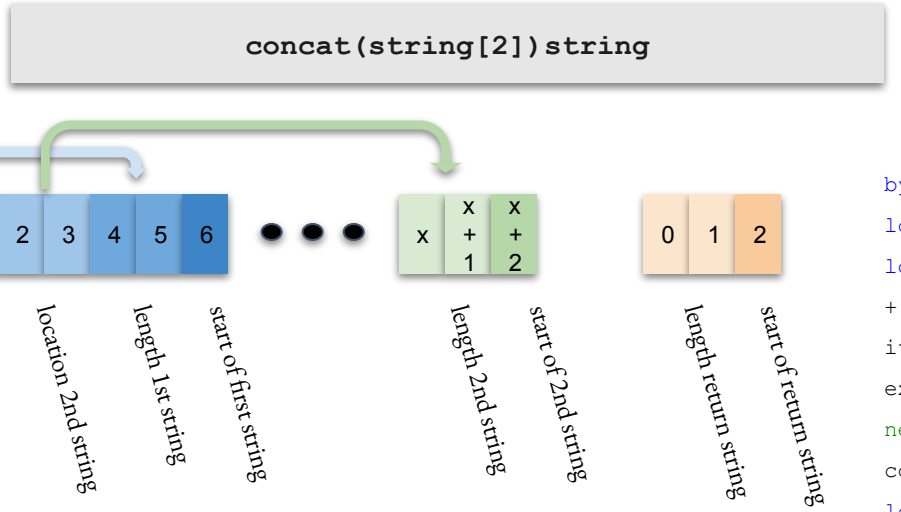


```
txna ApplicationArgs 1
int 0
extract_uint16 //location of first string
```

```
byte 0x151f7c75 //return bytes
load 11 //length of first string
load 13 //length of second string
+
itob
extract 6 2 //itob produces 8 bytes we just need the last two
concat
load 0 //containing return contated strings
concat
log
```

Extract Opcode

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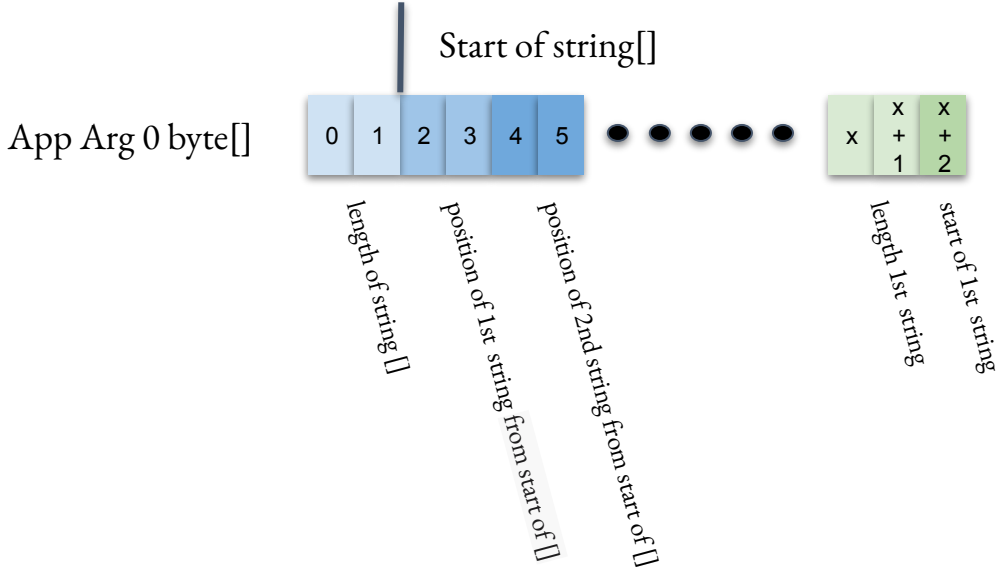
```
concat(string[])void ie [][]
```




```
txna ApplicationArgs 1
int 0 //index into argument byte[]
extract_uint16 //length of array
```

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Demo

TEAL: method opcode and returning values

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More Examples

https://github.com/algorand-devrel/demo-abi

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Questions?